Volume 19 Number 1 June 2014

FOCUS

PAPANICOLAOU SOCIETY OF CYTOPATHOLOGY

Companion Society of the United States and Canadian Academy of Pathology

Dedicated to Clinical Practice, Clinical Education and Clinical Research

From the Editor's Desk

Dear colleagues,

It is time for our coming Focus issue!

We have exciting articles on recent topics potentially affecting our profession in the coming years. On lighter side we have images from Dr. Giorgadze. Please enjoy the music and join the fun!

The details about various benefits of joining PSC membership are highlighted on the last page. Please recommend to your colleague to join PSC membership by sending the membership form downloaded from http://www.papsociety.org/docs/09/pscapp2009.pdf.

Members and other readers are encouraged to send the articles or other contributions (eg. interesting images in cytology, book reviews, case reports, reviews etc) to me or any of the Focus editorial board members. We are accepting contributions for the December 2014 edition. The deadline for submitting the contributions are flexible, but we appreciate if your submissions are received at vshidham@med.wayne.edu prior to November 7, 2014.

Please enjoy the issue!

Sincerely,

Vinod B. Shidham, MD, FRCPath, FIAC

President's Message

Zubair W. Baloch, MD, PhD

"Everyone has been made for some particular work and the desire for that work has been put in every heart".

~Mewlana Jalaludin Rumi

"Society with Big Heart" – these were the words I used in my first President's message in 2013 describing what PSC means to me; not surprising I am still holding this emotion as I write this communication. The close of my two year Presidency is only a small punctuation mark in my career with PSC and I look forward to continuing my work as an active member of my favorite society. I have to thank many of friends of PSC whose support and constructive criticism kept me aligned with the goals of the society and needs of the membership. I cannot begin to describe the immense support from the PSC executive board and various committee members that have enabled me to carry out society tasks for two years. The PSC committee chairs have worked

Con't on page 2

In This Issue

Membership Application

(Please download, print and complete)
http://www.papsociety.org/docs/09/pscapp2009.pdf

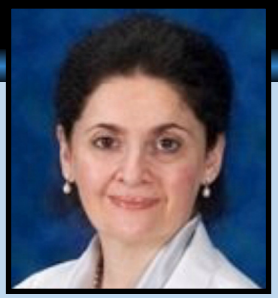
Focus is published by the Papanicolaou Society of Cytopathology

Editor:
Vinod B. Shidham, MD, FRCPath, FIAC
Wayne State University School of Medicine
Karmanos Cancer Center, & DMC
vshidham@med.wayne.edu

Associate editor:
Adebowale Joel Adeniran, M.D.
Yale University School of Medicine
adebowale.adeniran@yale.edu

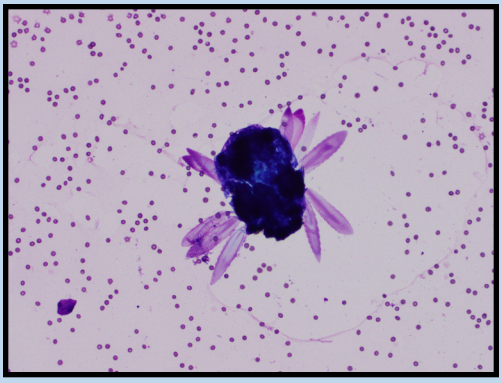
Editorial office:
Vinod B. Shidham, MD, FRCPath, FIAC
Professor & Vice-chair, Dept of Pathology,
Wayne State University School of Medicine,
Karmanos Cancer Center, & DMC
Old Hutzel Hospital (Dept of Cytology-Ground Floor),
4707 St. Antoine Blvd
Detroit, MI 48201
Ph: (313) 745 0831
(Kathy Rost Assistant to Dr. Shidham)
Fx: (313) 745 7158

Images in Cytology



FLIGHT OF THE BUMBLEBEE

We found this bumblebee-like artifact in a thyroid aspirate during our departmental conference. It immediately reminded us of the famous musical piece "Flight of the Bumblebee" by the great Russian composer Rimsky-Korsakov. In our opinion, adding a fragment from this musical piece rendered by the virtuoso American trumpeter Harry James enhances the impression of the "flight" and reflects a "bee-zzzy" atmosphere of our departmental conference. Please click on the link to listen: **www.papsociety.org/newsletters/2014/June-2014-Focus-bmbbeefinal.wav**



From the Papanicolaou Cytology Laboratory
Weill Cornell Medical College/Cornell University

Tamar Giorgadze, MD, PhD
Rana Hoda, MD, FIAC
June Koizumi, MD,
Andrew Schreiner, MD
Rema Rao, MD,
Grace Yang, MD, FIAC
David Molina, MD
Michael Chaump, MD

Con't from page 1

From the President's Desk

tirelessly on an exceptional volume of projects, charges and tasks, either planned or unexpected to maintain the effectiveness of our society. My USA and international colleagues have been very creative in these past two years to keep the name and goals of PSC current at both national and international events. To name the few the Annual Papanicolaou Cytopathology Tutorial is being cosponsored by PSC for the past three-years. PSC is co-sponsoring a slide seminar with American Society of Cytopathology at the annual meeting of American Society of Clinical Pathology at Tampa, Florida. PSC was also a prominent sponsor of educational events at the recent meeting of European Federation of Cytology Societies held in Geneva, Switzerland.

Although cytopathologist don't always acknowledge this, in my view we have always occupied the most leveraged position in diagnostic medicine. We are situated in a space where the "rubber meets the road"; a cytopathologist is the face of pathology department to a patient during fine-needle aspiration (FNA) service and molecular analysis performed on a limited cellularity cytology specimen is now essential in the current era of personalized medicine. PSC from its inception has recognized the importance of our profession, and has devised educational sessions to bring forth and discuss current trends in cytopathology. In keeping with this tradition, the topic for the upcoming 2015 PSC scientific program to be given at the 104th USCAP annual meeting will focus on the diagnostic challenges and exciting new developments in the field of head and neck pathology especially in reference to small biopsy and FNA specimens. The session has been developed by Dr. Mathew Zarka and is titled as ***"Small Biopsy Specimens of Head and Neck with Emphasis on Cell Cytology and the Role of Special Studies."*** Dr. William C. Faquin will address the diagnosis of salivary gland lesions by FNA including diagnostic pitfalls and the incorporation of ancillary studies as an aid to the diagnosis of these challenging lesions. The second presentation by Dr. Raja R. Seethala will focus on small biopsies of intraoral lesions and para-pharyngeal space lesions. Dr. Lester D.R. Thompson will discuss small biopsy specimens of sino-nasal lesions; and the final talk by Dr. Margaret S. Brandwein-Gensler will cover difficult squamo-proliferative lesions and variants of squamous cell carcinoma, and challenging benign and malignant mimics of head and neck squamous lesions.

Finally, the best is yet to come. The next president of PSC, Dr. Tarik Elshiekh, is one of the brightest and most dynamic surgical pathologist and cytopathologist I know, with strong interest in education and fostering relationship among various disciplines in pathology. He has been an active member of PSC and ASC executive board and holds a prominent position in USCAP. I am confident that PSC, under his leadership will continue to maintain its current place and gain prominence at both national and international levels. Yes, it has been a rewarding experience and pleasure serving PSC for the past two years. And yes, I am with PSC for the rest of my professional journey.

Immunocompromized Host Cytology

Dr. Michelle Pramick
Michelle.Pramick@uphs.upenn.edu

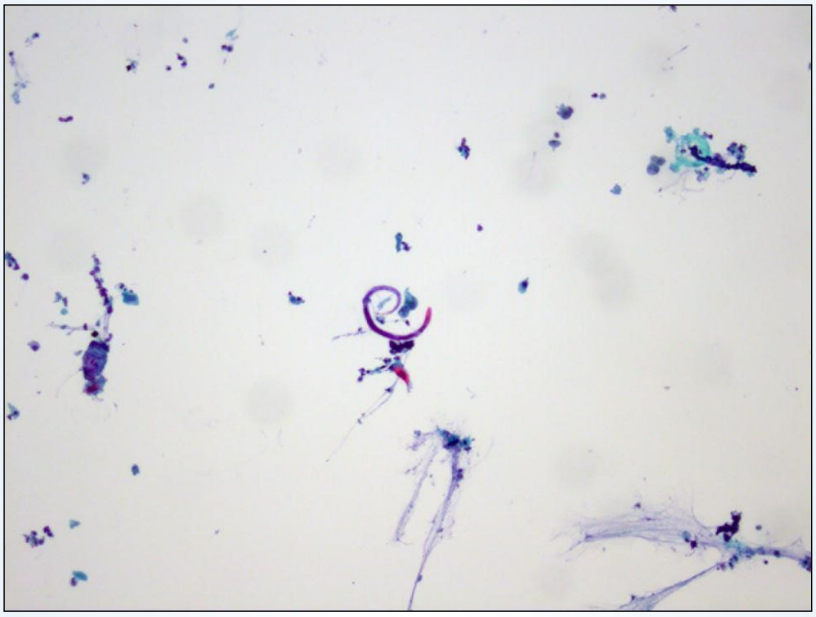
Clinical History

20 year-old male with HTLV-1 associated T-cell lymphoma presented as a left nasal cavity mass with status post hyper-CVAD and intrathecal methotrexate chemotherapy, was admitted for lower back pain. The initial concern was for spinal cord compression. He was found to have persistent lytic lesions in the lumbar spine. The patient was also found to have central diabetes insipidus. He remained an inpatient for his next round of chemotherapy after which he was planned to be discharged. His temperatures however, his temperature spiked to 102.9°F with nausea, vomiting, and diarrhea. At that time he was already on PO Flagyl for C. difficile prophylaxis. His fever continued to spike as he had a change in mental status. A cerebrospinal fluid culture was positive for Enterococcus and he was started on broad spectrum antibiotics.

Two weeks following the lumbar puncture, he developed worsening abdominal distention, pain, and constipation. A CT of the abdomen showed dilation of the proximal and mid small bowel with pneumatosis and portal venous gas. This was concerning for obstruction and possibly ischemic bowel. He was taken to surgery for an exploratory laparotomy; however, there was no evidence of perforation. He was then transferred to the intensive care unit where his course was complicated by hypoglycemia and seizures and he had to be intubated. He was noted to have severe constipation and a partial small bowel obstruction five days following surgery. The patient also had difficulty weaning from the ventilator. A bronchoalveolar lavage specimen was obtained.

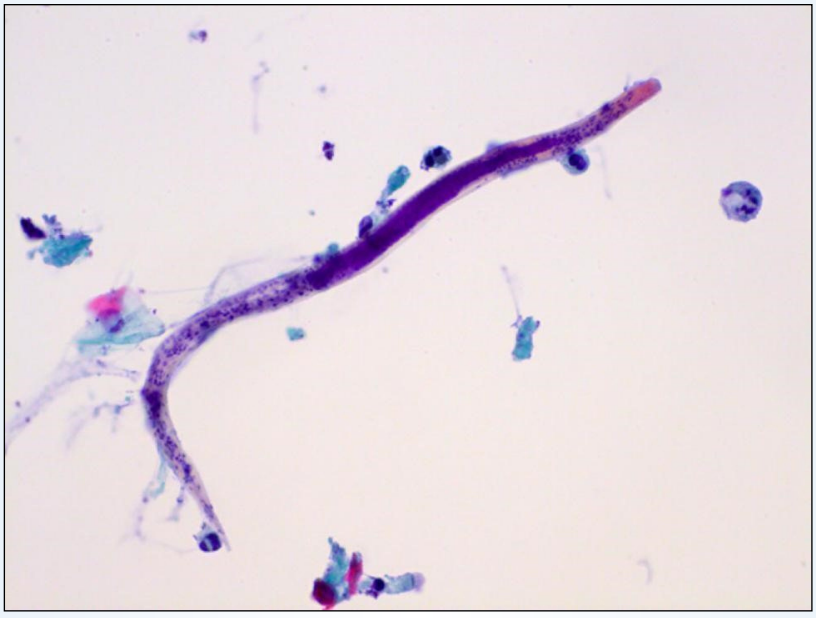
Image Figures
1. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 10x
2. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 20x
3. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 40x
4. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 63x
5. ThinPrep slide, Bronchoalveolar lavage, Grocott's Methenamine Silver stain, 40x
6. ThinPrep slide, Bronchoalveolar lavage, Gram Weigert stain, 40x

Images

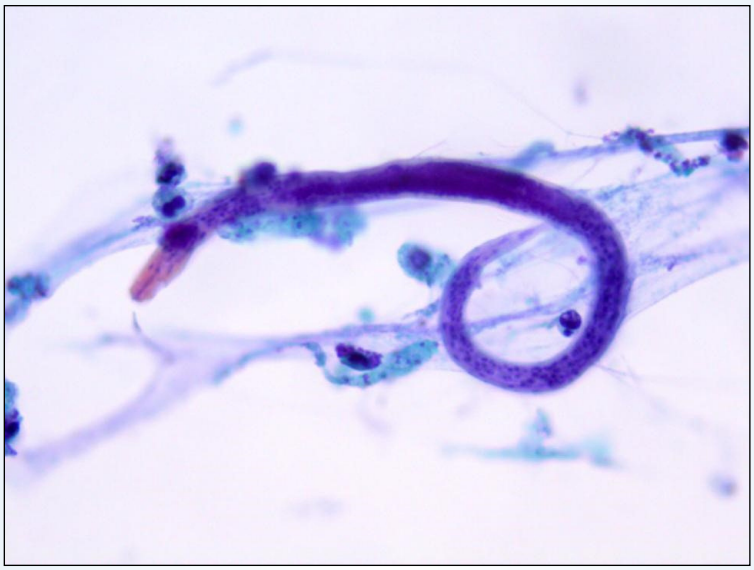


1. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 10x

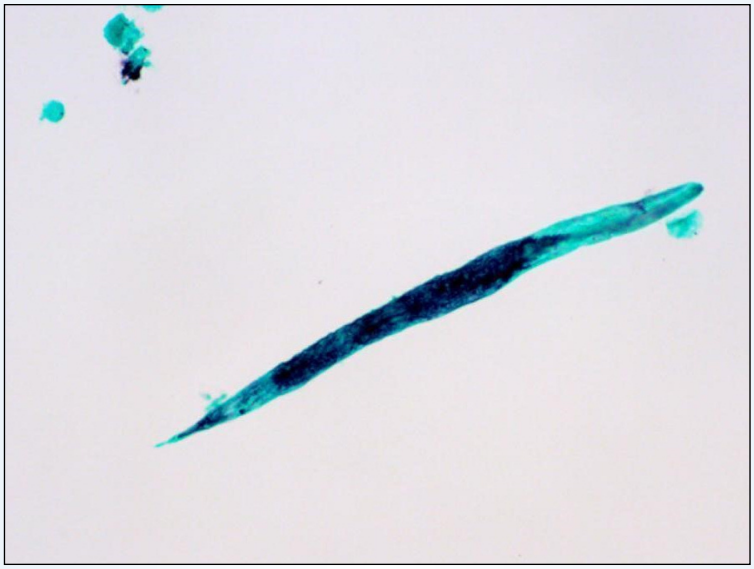
2. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 20x



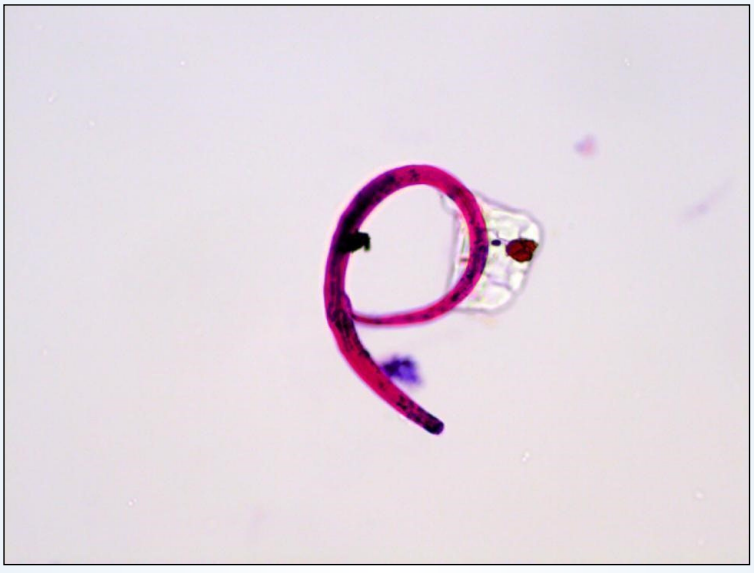
3. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 40x



4. ThinPrep slide, Bronchoalveolar lavage, Papanicolaou stain, 63x



5. ThinPrep slide, Bronchoalveolar lavage, Grocott's Methenamine Silver stain, 40x



6. ThinPrep slide, Bronchoalveolar lavage, Gram Weigert stain, 40x

Questions

1. What is the diagnosis?
a. Trichinella spiralis
b. Trichuris trichiura
c. Strongyloides stercoralis
d. Ascaris lumbricoides

2. What is the most common way of becoming infected with *Strongyloides*?
a. by ingesting infected meat
b. by fecal-oral transmission
c. through mosquito bites
d. contacting contaminated soil

3. There is an association with *Strongyloides* infection with which virus?
a. Hepatitis C virus
b. Human T-Cell Lymphotropic Virus-1
c. Human herpesvirus 8
d. BK polyomavirus

4. What is the gold standard for the diagnosis of *Strongyloides*?
a. serial stool examination
b. enzyme-linked immunosorbent assay
c. indirect immunofluorescence assay
d. luciferase immunoprecipitation assay

Discussion

ThinPrep slides show the curved cylindrical shaped larval form of strongyloides. The slides demonstrate organisms with both blunted and a tapered ends amongst a relatively clean background. (Figures 1 and 2) On higher magnification, detailed internal structure can be appreciated. (Figures 3 and 4) The organism's internal structure stains with Grocott's Methenamine Silver (GMS) stain (Figure 5) and Gram Weigert stain (Figure 6).

A prior case report of Strongyloides in a cervical smear showed a more tightly coiled larva. In that case, the internal structures of the parasite took a deep purple color on a Papanicolaou-stained cervical smear.[1] In comparison, a case of Strongyloides in a bronchoalveolar lavage specimen processed as a ThinPrep slide had a less coiled appearance, which may be due to processing technique.[2] The clean background on ThinPrep, as well as the light stain of the larvae, and detail of the internal structure make the organisms readily apparent.

Strongyloidiasis is caused by an intestinal parasitic nematode (roundworm). The species, *Strongyloides stercoralis*, is the most prevalent and is clinically important. *Strongyloides stercoralis* is most common in tropical regions; however it occurs in a wide variety of climates. In the United States, it is most commonly reported among refugees and immigrants.[3] Studies performed in the 1980s in rural southeastern United States reported prevalence estimates ranging from 1.2%–6.1%.[4,5] Infection is often associated with agricultural activities; the most common way of becoming infected with *Strongyloides* is by contacting soil that is contaminated with *Strongyloides* larvae.[3] Studies have shown an association with *Strongyloides* infection and Human T-Cell Lymphotropic Virus-1 (HTLV-1). People infected with HTLV-1 are more likely to become infected with *Strongyloides*, and are more likely to develop severe cases of strongyloidiasis.[6]

The life cycle of *Strongyloides* is quite complex, with fluctuation between free-living and parasitic cycles, the potential for autoinfection, and multiplication within a host. In an autoinfection, the rhabditiform larvae become infective filariform larvae, which can penetrate either the intestinal mucosa (internal autoinfection) or the skin of the perianal area (external autoinfection) where they enter the circulatory system, and are carried successively to the lungs and penetrate the alveolar spaces. They are carried to the bronchial tree and pharynx where they are swallowed to eventually reach the small intestine where they mature into adults. They may also disseminate widely in the body.[3]

Infection with *Strongyloides* can occur as acute strongyloidiasis, chronic strongyloidiasis, hyperinfection syndrome, or disseminated strongyloidiasis. Symptoms vary widely based on the type on infection. Acute strongyloidiasis can be associated with a localized pruritic rash at the site of skin penetration. The patient may develop a dry cough as the larvae migrate from the lungs through the trachea. After the larvae are swallowed into the gastrointestinal tract, patients may experience gastrointestinal symptoms. Chronic strongyloidiasis is usually asymptomatic, but in patients with clinical disease gastrointestinal and cutaneous manifestations are the most frequent.[3] Eosinophilia is present in 50% to 80% of patients with mild chronic infection.[7]

Hyperinfection syndrome and disseminated strongyloidiasis are most frequently associated with a subclinical infection in immunocompromised patients, including those receiving high-dose corticosteroids.[3,8] There are numerous signs and symptoms associated with hyperinfection syndrome and disseminated strongyloidiasis, and a partial list includes: abdominal pain, nausea, vomiting, diarrhea, ileus, intestinal obstruction, bacterial sepsis, cough, wheezing, dyspnea, hoarseness, pneumonitis, hemoptysis, respiratory failure, diffuse interstitial infiltrates or consolidation on chest radiographs, aseptic or gram-negative meningitis, peripheral edema and ascites secondary to hypoalbuminemia from protein losing enteropathy, recurrent gram negative bacteremia/sepsis from larvae carrying bacteria that penetrate mucosal walls, syndrome of inappropriate secretion of anti-diuretic hormone (SIADH), recurrent maculopapular or urticarial rash. Patients may also develop, larva currens (the pathognomonic serpiginous rash).[3,9]

The gold standard for the diagnosis of *Strongyloides* is serial stool examination. However, up to seven stool exams to reach a sensitivity of 100% may be required. Frequently, larvae can be seen in fluid from bronchoalveolar lavage specimens. In addition, there are serologic tests available that are sensitive, but have the potential to cross-react with other parasites, decreasing their specificity.[3]

Acute and chronic strongyloidiasis are treated with oral Ivermectin for 1-2 days. Hyperinfection syndrome and disseminated strongyloidiasis are treated with oral Ivermectin until stool and/or sputum exams are negative for 2 weeks. If possible, immunosuppressive therapy should be stopped or reduced. In certain instances, Investigational New Drug (IND) exemptions for the veterinary subcutaneous formulation of Ivermectin have been granted by the FDA.[3] Diagnosis of Strongyloides stercoralis hyperinfection requires clinical awareness. The mortality rate is 15% in hyperinfection syndrome[7] and can reach up to 80% in disseminated disease.[10] Considering that hyperinfection is associated with a higher mortality rate, it is important for the pathologist to convey the findings of the diagnosis to the clinical teams as soon as possible.

In the current case, *Strongyloides stercoralis* larvae were confirmed by morphology in an ova and parasite examination. The patient was treated with subcutaneous ivermectin for Strongyloides hyperinfection. He continued to have daily fevers and was also found to have Pseudomonas on sputum culture, for which he was treated with appropriate antibiotics. He was eventually weaned from the ventilator to a trachea collar. His small bowel obstruction resolved with nasogastric suction and he was transitioned back to an oral diet. He was discharged to home with the plan of continuing chemotherapy and starting radiation therapy for HTLV-1 associated T-cell lymphoma. Of note, this patient did not have any significant travel history.

Answer Key

1. C **2. D** **3. B** **4. A**

References

1. Kapila K1, Pathan SK, Al-Boloushi K. Diagnosis of Strongyloides stercoralis in a routine cervical smear. Diagn Cytopathol. 2005 Jul;33(1):31-2.

2. Avant CC1, Hitchcock T, Colello CJ, Hoda RS. Strongyloides stercoralis in a bronchoalveolar lavage processed as ThinPrep. Diagn Cytopathol. 2007 Aug;35(8):503-4.

3. CDC. Parasites—*Strongyloides*: resources for health professionals. Atlanta, GA: US Department of Health and Human Resources, CDC; 2012. Available at http://www.cdc.gov/parasites/strongyloides/health_professionals/index.html.

4. Starr MC, Montgomery SP. Soil-transmitted helminthiasis in the United States: a systematic review–1940–2010. Am J Trop Med Hyg 2011;85:680–4.

5. Berk SL, Verghese A, Alvarez S, Hall K, Smith B. Clinical and epidemiologic features of strongyloidiasis. A prospective study in rural Tennessee. Arch Intern Med 1987;147:1257–61.

6. Porto MA1, Alcântara LM, Leal M, Castro N, Carvalho EM. Atypical clinical presentation of strongyloidiasis in a patient co-infected with human T cell lymphotrophic virus type I. Am J Trop Med Hyg. 2005 Feb;72(2):124-5.

7. Concha R, Harrington WJ, Rogers AI. Intestinal strongylodiasis: recognition, management, and determinants of outcome. J Clin Gastroenterol 2005;39(3):203–11.

8. Apewokin S., Steciuk M, Griffin S and Jhala D Strongyloides hyperinfection diagnosed by bronchoalveolar lavage in an immunocompromised host. Cytopathology 2010; 21(5): 345-347

9. Keiser PB, Nutman TB. Strongyloides stercoralis in the Immunocompromised Population. Clin Microbiol Rev 2004; 17:208

10. Lam CS, Tong MK, Chan KM, Siu YP. Disseminated strongyloidiasis: a retrospective study of clinical course and outcome. Eur J Clin Microbiol Infect Dis. 2006 Jan;25(1):14-8.

Contributed By

Michelle R. Pramick, MD
Cytopathology Fellow
Department of Pathology and Laboratory Medicine
Hospital of the University of Pennsylvania
Philadelphia, PA

Nirag C. Jhala, MD
Professor,
Department of Pathology and Laboratory Medicine
Hospital of the University of Pennsylvania
Philadelphia, PA

Reproduced from Open Access (OA) Publication:
CytoJournal 2014; 11:S1:3

CytoJournal

Executive editor:
Vinod B. Shidham, MD, FIAC, FRCPath
Wayne State University School of Medicine, Detroit, MI, USA

Co-editors-in-chief:
Richard DeMay, MD (University of Chicago, Chicago, USA)
Vinod B. Shidham, MD, FIAC, FRCPath (WSU School of Medicine, Detroit, USA)

For entire Editorial Board visit : http://www.cytojournal.com/eb.pdf
PDFs FREE for Members (visit http://www.cytojournal.com/CFMember.asp)

OPEN ACCESS
HTML format

CMAS‡ - Pancreas - EUS-FNA Cytopathology (PSC guidelines) S1:3 of 5.

Standardized terminology and nomenclature for pancreatobiliary cytology: The Papanicolaou Society of Cytopathology Guidelines

Martha B. Pitman, *MD*[*] Barbara A. Centeno, *MD*[1], Syed Z. Ali, *MD*[2], Muriel Genevay, *MD*[3], Ed Stelow, *MD*[4], Mari Mino-Kenudson, *MD*, Carlos Fernandez-del Castillo, *MD*[5], C. Max Schmidt, *MD*[6], William R. Brugge, *MD*[7], Lester J. Layfield, *MD*[8]

Address: [*]Department of Pathology, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, [1]H. Lee Moffitt Cancer Center and Research Institute, Tampa, Florida, [2]The Johns Hopkins University School of Medicine, Baltimore, Maryland, [3]Hospital de Pathologie Clinique, Geneva, Switzerland, [4]University of Virginia Medical Center, Charlottesville, Virginia, [5]Deparment of Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, [6]Deparment of Surgery, Indiana University Medical Center, Indianapolis, [7]Department of Medicine, Division of Gastroenterology, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, [8]Department of Pathology and Anatomical Sciences, University of Missouri, Columbia, Missouri

E-mail: Martha Bishop Pitman* - mpitman@partners.org; Barbara A. Centeno - barbara.centeno@moffitt.org; Syed Z. Ali - sali@jhmi.edu; Muriel Genevay - Muriel.Genevay@dianapath.ch; Ed Stelow - es7yj@cms.mail.virginia.edu; Mari Mino-Kenudson - mminokenudson@partners.org; Carlos Fernandez-del Castillo - cfernandez@partners.org; C. Max Schmidt - maxschmi@iupui.edu; William Brugge - wbrugge@partners.org; Lester Layfield - layfieldl@health.missouri.edu
*Corresponding author

Published: 2 June 2014
CytoJournal 2014, 11:S1:3
This article is available from: http://www.cytojournal.com/content/11/1/S1:3

Received: 15 January 2014
Accepted: 06 February 2014

This article may be cited as:
Pitman MB, Centeno BA, Ali SZ, Genevay M, Stelow E, Mino-Kenudson M, *et al.* Standardized terminology and nomenclature for pancreatobiliary cytology: The Papanicolaou Society of Cytopathology Guidelines. CytoJournal 2014;11, Suppl S1:3.

These PSC guideline articles published under Open Access charter may be disseminated by multiple journals/platforms.

All parts of these PSC guidelines are also available in print as CMAS (CytoJournal Monographs/Atlas Series) #1. Please check on CytoJournal home (www.cytojournal.com) under 'Monograph and Atlas' http://www.cytojournal.com/monographs.asp

Abstract

The Papanicolaou Society of Cytopathology has developed a set of guidelines for pancreatobiliary cytology including indications for endoscopic ultrasound (EUS) guided fine-needle aspiration (FNA) biopsy, techniques of EUS-FNA, terminology and nomenclature of pancreatobiliary disease, ancillary testing and post-biopsy treatment and management. All documents are based on the expertise of the authors, a review of the literature, discussion of the draft document at several national and international meetings over an 18 month period and synthesis of online comments of the draft document on the Papanicolaou Society of Cytopathology web site [www.papsociety.org]. This document selectively presents the results of these discussions and focuses on a proposed standardized terminology scheme for pancreatobiliary specimens that correlate cytological diagnosis with biological behavior and increasingly conservative patient management of surveillance only. The proposed terminology scheme recommends a six-tiered system: Non-diagnostic, negative, atypical, neoplastic [benign or other], suspicious and positive. Unique to this scheme is the "neoplastic" category separated into "benign" (serous cystadenoma) or "other" (premalignant mucinous cysts, neuroendocrine tumors and solid-pseudopapillary neoplasms (SPNs)). The positive or malignant category is reserved for high-grade, aggressive malignancies including ductal adenocarcinoma, acinar cell carcinoma, poorly differentiated neuroendocrine carcinomas, pancreatoblastoma, lymphoma and metastases. Interpretation categories do not have to be used. Some pathology laboratory information systems require an interpretation category, which places the cytological diagnosis into a general category. This proposed scheme provides terminology that standardizes the category of the various diseases of the pancreas, some of which are difficult to diagnose specifically by cytology. In addition, this terminology scheme attempts to provide maximum flexibility for patient management, which has become increasingly conservative for some neoplasms.

Key words: Guidelines, nomenclature, pancreas, Papanicolaou Society of Cytopathology, terminology

Access this article online	
Quick Response Code:	Website: www.cytojournal.com
	DOI: 10.4103/1742-6413.133343

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

INTRODUCTION

Early detection of cancer whether it is a malignancy of the ductal, acinar, or neuroendocrine system is the key to patient survival. With the increased use of endoscopic ultrasound (EUS) guided fine-needle aspiration (FNA) for the evaluation of pancreatobiliary lesions, coupled with our improved understanding of premalignant lesions and the evolving management algorithm for patients with pancreatic cysts,[1,2] it is clear that cytopathologists play a very important role in the diagnosis and management of patients with pancreatic solid or cystic lesions and pancreatobiliary strictures. Hampering patient management is the lack of standardized nomenclature for pancreatobiliary disease, especially for the premalignant cysts.

A standardized terminology and nomenclature system that provides intra- and inter-departmental guidance for diagnosis and which correlates with biological behavior and management recommendations is imperative for both FNA of pancreatic masses and cysts and brushing cytology of pancreatobiliary strictures. Interpretation categories do not have to be used. Some pathology laboratory information systems, however, require an interpretation category, which has been standard practice in cytology for decades. Such categories do aide in clinical and translational research, which is imperative for progress in the field. Below is a proposed terminology scheme with six categories including a category "neoplastic" that is divided into clearly "benign" neoplasms and "other" neoplasms with less definitive biologic behavior predictable by cytological features.

These proposed guidelines on standardized terminology for pancreatobiliary cytology specimens stems from the expertise of the authors, review of the literature, discussions with pathologists at several national and international meetings over an 18 month period and synthesis of online comments of the draft document on the Papanicolaou Society of Cytopathology web site [www.papsociety.org].

PROPOSED PANCREATOBILIARY TERMINOLOGY CLASSIFICATION SCHEME

I Non-diagnostic
II Negative (for malignancy)
III Atypical
IV Neoplastic: Benign or Other
V Suspicious (for malignancy)
VI Positive/malignant.

CATEGORY I: NON-DIAGNOSTIC

Background

Non-diagnostic specimens may be due to technical or sampling issues that preclude the pathologist from providing any useful information from the FNA biopsy relative to the lesion sampled. The clinical and imaging context should be taken into consideration. The absence of "epithelial cells" in the sample does not necessarily make a specimen non-diagnostic. For example, a pseudocyst by definition lacks an epithelial cyst lining, and mucinous cysts may only have thick colloid-like mucin, or a fluid with elevated carcinoembryonic antigen (CEA), findings sufficient to support an interpretation of a neoplastic mucinous cyst even when an epithelial component is lacking.[3-5]

Definition

A non-diagnostic cytology specimen is one that provides no diagnostic or useful information about the solid or cystic lesion sampled; for example, an acellular aspirate of a cyst without evidence of a mucinous etiology such as thick colloid-like mucus, elevated CEA or *KRAS*/*GNAS* mutation (see Category IV). Any cellular atypia precludes a non-diagnostic report.

Example cytological interpretations

Evaluation limited by preparation artifact
Non-diagnostic
Tissue entrapped in blood clot and fibrin precluding cytological evaluation.

Satisfactory for evaluation
Non-diagnostic
Gastrointestinal contamination only

Satisfactory for evaluation
Non-diagnostic
Normal acinar and ductal epithelium. The biopsy does not explain the well-defined pancreatic mass seen on imaging.

Evaluation limited by scant cellularity
Non-diagnostic
Non-specific cyst contents with insufficient cyst fluid volume for ancillary testing.

CATEGORY II: NEGATIVE (FOR MALIGNANCY)

Background

A negative cytology sample is synonymous with the absence of malignancy and any cellular atypia in the cytology sample. A negative cytology interpretation that is descriptive without a diagnosis of a specific condition such as chronic pancreatitis or pseudocyst is not synonymous with a benign lesion. A descriptive negative interpretation implies that the sample is adequately cellular and that no cytological atypia is identified in the evaluated cytology sample. This includes the presence of normal pancreatic tissue in the appropriate clinical setting such a vague fullness on imaging and no distinct mass lesion. The false negative rate of an FNA of a solid mass lesion averages

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

15% and in the setting of a clinically and radiologically suspicious mass with a presumed diagnosis of ductal adenocarcinoma, such an aspirate is presumed to be a false negative sample.[6,7] The false negative rate for aspirates of cystic lesions is as high as 60% due to acellular or scantily cellular samples, in addition to the lack of defined nomenclature, criteria and experience in interpreting these lesions outside of major academic hospital settings.[8] That being said, the absence of high-grade epithelial atypia in a pancreatic cyst aspirate has a very high negative predictive value for malignancy.[9] Since not all centers provide biochemical or molecular analysis of cyst fluid and/or the results of such testing may not be available at the time of cytological interpretation, it is reasonable to report as "negative" cyst fluids with mucinous debris of uncertain origin (lesional versus gastrointestinal contamination) as such findings likely correlate with the clinical and imaging features of a low-grade branch-duct (BD) intraductal papillary mucinous neoplasm (IPMN). The clinician will find such a "negative" report much more helpful for patient management than a "non-diagnostic" report. See example cytological interpretations.

The false negative rate for the interpretation of pancreatobiliary brushing samples is also high due to the difficulty in obtaining diagnostic tissue that is often subepithelial, entrapped in desmoplastic stroma and/or markedly degenerated, coupled with the high threshold for a malignant interpretation due to the typical clinical setting of underlying inflammatory diseases such as primary sclerosing cholangitis and/or biliary stenting that can inherently cause marked reactive atypia.[10]

Definition

A negative cytology sample is one that contains adequate cellular and/or extracellular tissue to evaluate or define a lesion that is identified on imaging. When using the negative category one should give a specific diagnosis when practical including:

- Benign pancreatobiliary tissue in the setting of vague fullness and no discrete mass
- Acute pancreatitis
- Chronic pancreatitis
- Autoimmune pancreatitis
- Pseudocyst
- Lymphoepithelial cyst
- Splenule/accessory spleen.

Example cytological interpretations

Satisfactory for evaluation
Negative for malignancy
Benign, reactive ductal epithelium and acinar tissue, acute and chronic inflammation and a background of necrotic, calcific debris consistent with chronic pancreatitis.

Evaluation limited by scant cellularity
Negative for malignancy
Cellular stromal fragments with lymphocytes and plasma cells suggestive of autoimmune pancreatitis.

Satisfactory for evaluation
Negative for malignancy
Cyst fluid with inflammation and histiocytes, yellow amorphous pigment and no cyst lining epithelial cells consistent with pseudocyst fluid. (If available, add results of cyst fluid analysis; for example "low cyst fluid CEA [10 ng/ml] and markedly elevated amylase level [50,000 U/L] supports the diagnosis").

Satisfactory for evaluation
Negative for malignancy
Mucinous cyst debris of uncertain etiology. No high-grade epithelial atypia identified. Correlation with imaging and ancillary studies required

Satisfactory for evaluation
Negative for malignancy
Non-mucinous cyst fluid with hemosiderin-laden macrophages and no epithelial cells, suggestive of serous cystadenoma. Correlation with clinical and imaging required. (If available, add results of cyst fluid analysis; for example "low CEA and low amylase support the interpretation").

CATEGORY III: ATYPICAL

Background

The interpretation category "atypical" is heterogeneous and includes cases with reactive changes, low cellularity, premalignant changes (dysplasia) and cases assigned to this category due to observer caution in diagnosis. In one study, the risk of malignancy in this category for pancreatic and bile duct brushings was approximately 44%[10] and in another the risk of malignancy for atypical FNAs of pancreatic solid masses was approximately 82%.[11]

This interpretation is used when a cytological specimen contains cellular or extracellular tissue that displays morphologic features beyond recognizable normal tissue components or reactive changes that can comfortably be interpreted as such and therefore classified as benign or "negative". An atypical interpretation does raise the possibility of a neoplasm and in fact, may be suggestive of a low-grade neoplasm, but the cytological findings are insufficient to be suspicious for a high-grade malignancy and tissue is insufficient for confirmation of a specific diagnosis. Conservative interpretation of diagnostic samples is not uncommon due to the significance of the surgical intervention, often a pancreaticoduodenectomy.

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

The negative and atypical categories have historically been the categories containing premalignant mucinous cysts, with benign appearing low-grade dysplastic cysts (adenomas) being placed in the negative category and the higher grade dysplastic cysts being placed in the suspicious category. The lack of well-established criteria for the various grades of dysplasia in mucinous cysts has hampered a more standardized approach to classification. However, given the management algorithm for mucinous cysts which recommends a conservative approach for cysts at low risk for malignancy,[1,2] it is imperative that the pathologist relate on the cytology report that a neoplastic mucinous cyst has been detected by FNA (e.g., Neoplastic: Other) and to relate the presence or absence of cytologically high-grade appearing epithelium (e.g., high-grade epithelial atypia that represents at least high-grade dysplasia and possibly invasive carcinoma[12,13] (see Category IV).

Abundant cytoplasmic mucin in pancreatic ducts is an abnormal finding and indicates a neoplastic change. The differential diagnosis for glandular epithelium with mucinous cytoplasm includes pancreatic intraepithelial neoplasia (PanIN), biliary intraepithelial neoplasia (BilIN), IPMN, mucinous cystic neoplasm (MCN) and adenocarcinoma. PanIN is not an entity recognized by imaging, but it may be a source of atypia in aspirates of solid masses.[14] Gastric epithelial contaminant is another source of mucin containing epithelium that may be confused with ductal epithelium with mucinous dysplasia.[15] Of note, gastric epithelium may demonstrate some of the changes of pancreatic neoplasia, such as nuclear grooves and inclusions and subtle crowding. Duodenal enterocytes are non-mucinous with a brush border and in addition to this feature, can be recognized by the presence of scattered goblet cells and intraepithelial lymphocytes.

Premalignant lesions of the bile ducts have historically been called biliary dysplasia or atypical biliary epithelium. A new consensus classification of BilIN was published in 2007.[16] Using biliary brushing cytology derived from patient's suffering from primary sclerosing cholangitis, choledochal cyst or hepatolithiasis, this proposal classified BilIN into a three-grade classification scheme, similar to that used in other organs such as the pancreas and prostate. The histopathological criteria are similar to those for intraductal lesions of the pancreas; however, the cytopathological criteria of these lesions have not been defined. It can be assumed that their cytological features will be similar to what has been described as dysplasia in the biliary tract[17] with grades 1 and 2 lesions causing atypia of bile duct epithelium on brushings, previously referred to as low grade dysplasia.

Definition

The category of atypical should only be applied when there are cells present with cytoplasmic, nuclear, or architectural features that are not consistent with normal or reactive cellular changes of the pancreas or bile ducts and are insufficient to classify them as a neoplasm or suspicious for a high-grade malignancy. The findings are insufficient to establish an abnormality explaining the lesion seen on imaging. Follow-up evaluation is warranted.

Examples of cytological interpretations

Evaluation limited by preparation artifact
Atypical
Atypical ductal cells obscured by crush artifact.

Evaluation limited by scant cellularity
Atypical
Scant population of small monomorphic polygonal cells of unclear origin: Normal acinar cells versus endocrine proliferation. Additional tissue is warranted for diagnosis of this 2 cm round mass lesion in the pancreatic tail.

Evaluation limited by scant cellularity
Atypical
Atypical bile duct epithelium with nuclear features suggestive of repair in a background of acute inflammation.

Evaluation limited by scant cellularity
Atypical
Atypical bile duct epithelium with mucinous metaplasia and mild nuclear atypia.

CATEGORY IV: NEOPLASTIC

Category IVA: Neoplastic: Benign

Background

A common benign neoplasm of the pancreas is serous cystadenoma. Histologically, serous neoplasms consist of fine fibrous septae lined by cuboidal, glycogen-rich cells without atypia. Fibrous septa include numerous small capillary structures. This dense vascularization explains the often hemorrhagic aspect of the cyst fluid as well as the presence of numerous hemosiderin-laden macrophages on cytological preparations. Such macrophages can be observed in up to 63% of cases, whereas they are almost always absent in cystic mucinous neoplasms.[18] Macrophages can, however, only be considered as a surrogate marker of serous cystic neoplasms and cannot be used as a definitive cytological criterion. When coupled with cytological analysis and with appropriate clinical and imaging features, biochemical analysis of CEA level, typically less than 5 ng/ml and amylase levels, generally also very low relative to other pancreatic cysts support this diagnosis. Caution must be used because some mucinous cysts have very low CEA levels and conversely, serous neoplasms can, albeit rarely, present with elevated CEA levels, which can reach into the hundreds and rarely low thousands.[3-5] Other benign neoplasms in the pancreas

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

such as cystic teratoma and schwannoma are extremely rare and are also placed in this category.

Definition: Neoplastic: Benign

This interpretation category connotes the presence of a cytological specimen sufficiently cellular and representative, with or without the context of clinical, imaging and ancillary studies, to be diagnostic of a benign neoplasm.

Example cytological interpretation

Evaluation limited by scant cellularity
Neoplastic: Benign
Scant non-mucinous cuboidal epithelium and scant hemosiderin-laden macrophages in a non-mucinous cyst fluid consistent with the clinical impression of a serous cystadenoma (if available add results of cyst fluid analysis; for example "low CEA (0.5 ng/ml) and amylase (150 U/L) levels support the diagnosis").

Category IIIB: Neoplastic: Other

Background

Aside from the clearly malignant neoplasms like conventional pancreatic ductal adenocarcinoma (PDAC) and the definitively benign neoplasms like serous cystadenoma, there are neoplasms (other) that are either pre-invasive, premalignant neoplasms (IPMN and MCN with low, intermediate or high grade dysplasia) or of low-grade malignant behavior (pancreatic neuroendocrine tumor [PanNET] and solid-pseudopapillary neoplasm [SPN]) that warrant distinction from aggressive, high-grade malignancies (most notably pancreatic ductal adenocarcinoma (PDAC)). The rationale for this distinction and classification is explained in more detail below for each neoplasm, but, in general, the rational relates the desire to standardize the cytological nomenclature and terminology which correlates with the 2010 world health organization WHO classification and terminology. In addition, there was the need to remove the "malignant" classification from neoplasms diagnosed cytologically with uncertain or low-grade malignant potential, a move which provides a reasonable classification that correlates with the increasingly conservative approach to these neoplasms. The standard cytological categories of "atypical" and "suspicious for malignancy (SFM)" are categories that connote an indeterminate interpretation that does not provide for a definitive cytological interpretation of a neoplasm, which could lead to inappropriate patient management and possibly an unnecessary repeat diagnostic procedure.

All of these pancreatic tumors are clearly neoplastic and some low-grade malignant.[19-21] As such, the heading "Neoplastic: Other" is a reasonable generic term that accurately reflects the pre-operative, cytological terminology. The terminology "Neoplastic: Other" does not define the neoplasm as benign or malignant, nor does it correlate with a specific management algorithm.

Definition: Neoplastic: Other

This interpretation category defines a neoplasm that is either premalignant such as intraductal papillary neoplasm of the bile ducts (IPN-B), IPMN or MCN with low, intermediate or high-grade dysplasia by cytological criteria, or a low-grade malignant neoplasm such as well-differentiated PanNET or SPN. While mucinous epithelium in biliary brushing specimens may indeed represent a neoplastic change, given the lack of evidence-based literature on the cytological interpretation, histology and management of these lesions, low-grade mucinous change of biliary epithelium will remain in the "atypical" rather than "neoplastic" category.

PanNET

The current preferred nomenclature for this neoplasm is PanNET.[22] Synonyms include pancreatic endocrine tumor and pancreatic endocrine neoplasm. The term "neuroendocrine tumor" is inferred to mean a well-differentiated neoplasm and is a term that should be used whether in the primary site or in a metastatic site (e.g., liver FNA with metastatic well-differentiated neuroendocrine tumor). In the WHO 2010 classification system, the term neuroendocrine carcinoma infers either high-grade large cell neuroendocrine carcinoma or small cell carcinoma. The cytological interpretation of PanNET infers a well-differentiated proliferation of the pancreatic endocrine cells creating a mass lesion greater than 0.5 cm that may or may not be functional by producing inappropriate levels of various hormones and that may or may not demonstrate aggressive features on histological examination.[23] Although, it is now widely accepted that well-differentiated PanNETs all have malignant potential,[23] albeit very slow growing and even curable if caught at an early stage, these neoplasms are placed in this more generic neoplastic category to distinguish them from highly aggressive malignant neoplasms and to offer management flexibility in elderly patients with small tumors where the risk to benefit ratio of surgery is high compared to conservative management.

SPN

SPN is a solid, secondarily cystic low-grade epithelial neoplasm with established clonal mutations in cancer-associated genes and an ability to metastasize. They typically occur in young females and demonstrate a variably solid and cystic appearance on imaging. It is a parenchymal-rich, stromal-poor proliferation of monotonous cells that defy prediction of biological

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

behavior based on cytological features. Although, this neoplasm is one that will almost always be resected due to the typical young age of the patient, like PanNET, it is considered a low-grade malignancy and as such, it is included in this category.[24]

Neoplastic mucinous cysts of the pancreas (IPMN and MCN)

The two primary neoplastic mucinous cysts of the pancreas consist of IPMN and MCN. Understanding the clinical, imaging and cyst fluid analysis characteristics of IPMN and MCN is vital to the interpretation of the cytological specimen. Given that the cytological features of these two mucinous cysts are usually indistinguishable for all practical purposes, the cytological features will be presented together. The pathologist should correlate the clinical, imaging and cyst fluid analysis characteristics to make the most likely specific diagnosis.

Management guidelines have evolved over time and have become much more conservative given the prevalence of incidental, asymptomatic cysts identified in the general population and especially in the elderly. MCN, although mostly low-grade,[25,26] are usually identified in young to middle-aged women in the body or tail of the pancreas that can be relatively easily removed with a distal pancreatectomy alleviating the need for expensive, life-long surveillance. Main-duct and combined-type IPMNs are all removed due to the inherent high risk of malignancy.[27] BD-IPMNs are more often than not low-grade neoplasms identified in the pancreatic head of the elderly with co-morbid conditions making pancreaticoduodenectomy a high-risk procedure greater than the risk of the cyst progressing to malignancy.[27] If a cyst is mucinous and there is no evidence of high-grade dysplasia or carcinoma, then conservative management is reasonable.[1,2] The difficult position for the pathologist then becomes grading the epithelium of the cyst. It is quite difficult in other organ systems even on histology to stratify grades into four tiers: Low, moderate and severe dysplasia and carcinoma. This difficulty is exponential when interpreting just a few cells that have undergone partial degeneration in cyst fluid and that may be associated with gastrointestinal tract (GI) contamination. A high threshold for malignancy is in order. That being said, recognition of atypical epithelial cells and their distinction from low-grade dysplasia is vitally important to the recognition of a cyst with high-grade atypia that likely corresponds to at least moderate dysplasia and in a high proportion of cases, high-grade dysplasia or worse.[28-30] Resection prior to invasion provides the patient with the best prognosis and high-risk imaging features such as a markedly dilated main pancreatic duct or a mural nodule in a cyst that lead to resection are very often signs of an invasive neoplasm. As such, aspiration of cysts without these features provides the best opportunity for early detection of carcinoma.

MCN

MCN of the pancreas is typically a multiloculated, mucin-producing epithelial neoplasm with subepithelial ovarian-type stroma that in almost all cases does not communicate with the pancreatic ductal system and in almost all cases occurs in women. Like IPMN, these neoplasms are stratified by the degree of cytological and architectural atypia into low-grade, intermediate-grade and high-grade dysplastic, pre-malignant (non-invasive neoplasms) and invasive carcinomas (invasive mucinous cystadenocarcinoma). The invasive carcinomas are usually of tubular type, but rare carcinomas such as undifferentiated carcinoma with osteoclast-type giant cells may also be seen.[25,26] A similar neoplasm occurs in the biliary tract. The cytological features will be similar to its pancreatic counterpart.

IPMN

IPMNs are primarily intraductal proliferations of ductal epithelium creating a macroscopic lesion resulting in ductal dilatation, cyst formation and/or a mass lesion. Intraductal tubulopapillary neoplasms are included with IPMN as this neoplasm is not only rare, but would be cytologically indistinguishable from some IPMNs. Invasion of the duct or cyst wall occurs in about one-third of resected IPMN and is most common in IPMN of main-duct type. There are three main types of IPMN:[27,31-34]

- Main-duct IPMN: In general, associated with diffuse dilatation of any portion of the main pancreatic duct or the entire pancreas. The definition of "dilatation" is variable in the literature. The 2006 Sendai guidelines define it as >6 mm, but the new 2012 guidelines define it as 10 mm or greater with >5 mm being "worrisome".[2] Visualization of mucin extruding from the ampulla on EUS or endoscopic retrograde cholangiopancreatography (ERCP) is pathognomonic. The epithelial cell type most often associated with main-duct IPMN is intestinal type epithelium (MUC 5AC, MUC 2 and CDX2+) which, by definition, is at least of intermediate (moderate) grade dysplasia. Invasive carcinomas most often arising from intestinal-type IPMN are colloid carcinomas[33,35]
- BD-IPMN: Cysts adjacent to a non-dilated main pancreatic duct, most often in the uncinate process, but occurring throughout the pancreas in one or more locations. Imaging features generally depict a thin-walled unilocular cyst that may or may not demonstrate a connection to the pancreatic ductal system. Small "raspberry-like" multiloculated cysts are also typical of BD-IPMN. The cyst lining is most often of gastric-foveolar type and although most are low-grade, this epithelial cell type can display intermediate and high-grade dysplasia. Invasive carcinomas arising from these cysts tend to be of the tubular type and have a prognosis similar to conventional pancreatic adenocarcinoma.[36]

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

- Combined-type IPMN: Neoplasia involving both the main ducts and BDs of the pancreas typically represented on imaging by a dilated main pancreatic duct with one or more BD cysts.

Two other epithelial cell types may be seen in IPMN. Pancreatobiliary epithelium is relatively uncommon and by definition, is equivalent to high-grade dysplasia. Oncocytic epithelium is the least common epithelial cell type and is also considered high-grade. Oncocytic type epithelium is distinguished by the moderate amounts of dense, granular, oncocytic cytoplasm. While low-grade gastric-foveolar type epithelium is recognizable, it may not be distinguishable from gastric epithelial contamination in transgastric biopsies. It is generally not possible nor is it important to distinguish the epithelial cell types with intermediate to high-grade dysplasia.

Cyst fluid analysis

Analysis of the cyst fluid from pancreatic cysts is invaluable in accurate classification of the cyst as mucinous or non-mucinous. It is well-established that although each lab should establish their own cut-off value, that, CEA levels of ~200 ng/ml are strongly supportive of a neoplastic mucinous cyst.[3,4] A low CEA level does not exclude a mucinous etiology. In addition, CEA levels do not distinguish between benign and malignant cysts.[3,4] Amylase levels of cyst fluid are helpful in supporting the interpretation of a pseudocyst as such fluids typically have amylase levels in the thousands,[5] but amylase levels do not distinguish between IPMN and MCN.[37,38] Serous cystadenomas tend to have both low CEA and amylase levels as do cystic PanNETs.[39,40]

Molecular analysis

KRAS testing may supplement CEA as the detection of *KRAS* supports a mucinous etiology.[41] Although, the combination of *KRAS*, LOH and quality and quantity of deoxyribonucleic acid correlates with malignancy,[42] a *KRAS* mutation in and of itself is not specific for malignancy. A recent study of pancreatic cyst fluid has shown that detection of *GNAS* supports a specific interpretation of IPMN, but does not distinguish pre-malignant from malignant (invasive) IPMN.[43] See the report of Committee IV for a more detailed discussion of ancillary testing.

Approach to the cytological analysis of pancreatic cysts

The cytopathologist's approach to the interpretation of a pancreatic cyst should be to address two basic questions: (1) Is the cyst mucinous or non-mucinous; and (2) Is the cyst high-grade or not? Malignant is defined as unequivocal features of adenocarcinoma (see section on positive for malignant cells). Atypia less than overtly malignant is included in this category of Neoplastic: Other.

To answer the first question of a mucinous etiology, the first clue may come from the gastroenterologist who describes "thick, viscous or white, sticky" fluid upon aspiration. This type of fluid is generally thick enough to make a direct smear. Thinner fluids are best processed as a cytospin preparation in order to capture all of the cells and to preserve the characteristics of the cyst fluid. Placing the cyst fluid in a preservative attenuates the viscosity of the fluid and may make thin mucin difficult or impossible to appreciate. Contamination of the specimen with mucin from the gastrointestinal tract is also a consideration. Thick, colloid-like mucin is neoplastic (with rare exception such as in a gastrointestinal duplication cyst) and mucin with evidence of cellular cyst debris also supports origin from the cyst and not the GI tract.[44] Conversely, thin mucous with naked grooved nuclei evoke GI contamination. Special stains for mucin may be helpful but should be interpreted with caution. A mucicarmine or Alcian blue positive thin film of a cytospin or thick wavy wisps of mucoid fluid that stains positively without significant GI epithelial contamination are stain outcomes that support a mucinous etiology. Negative mucin stains do not exclude a mucinous cyst. CEA elevation or detection of a *KRAS* mutation may be necessary to support a mucinous etiology, but, a non-elevated CEA or absent *KRAS* mutation does not exclude a mucinous cyst.

To answer the second question of high-grade, an evaluation of the epithelial component is required. Less than overt malignancy is best interpreted as either low-grade or high-grade atypia as the accuracy in distinguishing intermediate (moderate) from high-grade dysplasia is difficult if not impossible and the criteria to do so with any accuracy have not been established.[45] GI contaminating epithelium needs to be recognized as such (see criteria under Category I). Cytological criteria distinguishing high-grade atypia from low-grade atypia has recently been described.[12] Cells smaller than a 12 µ duodenal enterocyte showing an increased nuclear to cytoplasmic ratio, an abnormal chromatin pattern and background necrosis represent high-grade epithelial atypia placing the cyst at high-risk for malignancy.[2,13,46-48]

Both mucin production and epithelial cells are not required for the diagnosis of a mucinous cyst. The aspirates of some mucinous cysts are acellular but are clearly mucinous from the visible thick, colloid-like extracellular mucin, elevated CEA or *KRAS*/*GNAS* mutation. Similarly, a cyst fluid with high-grade mucinous epithelial dysplasia or carcinoma may not demonstrate extracellular mucin or an elevated CEA.[28,49]

Approach to the cytological evaluation of biliary tract cysts

The approach to evaluating cysts arising in the biliary tract has not been as formally studied as those of the pancreas. However, it can be surmised that IPN-B and MCN-B will have similar cytological features on aspiration. The role

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

of ancillary studies in these cysts, such as measurement of CEA, is not established.

IPN-B

IPN-B shares many clinical and pathological features with IPMN of the pancreas. It is a neoplastic proliferation growing within the bile ducts composed of a papillary proliferation of mucin containing neoplastic cells that may occur anywhere in the ductal system. It progresses from low, to high grade and eventually invasive carcinoma, just as IPMN of the pancreas does. Gastric, pancreatobiliary, intestinal and oncocytic subtypes have been described, but show a different distribution than observed in IPMN-P.[50,51] These are more likely to be sampled by brushing cytology than by FNA. When they present as cystic masses, they may be aspirated and the cytological features of aspiration cytology will be similar to those of IPMN of the pancreas. The cytological features of brushing cytology for IPN-B are not described here. While there are no prospective or retrospective reports, these features are extrapolated from the histopathological features and are similar to what is encountered in brushing cytology of IPMN of the pancreas.

Gastrointestinal stromal tumor

GISTs are very rare as a primary pancreatic neoplasm (extra-gastrointestinal stromal tumor (EGIST)), however, they commonly occur in a peripancreatic location such as the omentum, mesentery, duodenum and stomach, thus mimicking a primary pancreatic neoplasm at times. GIST are spindle cell and/or epithelioid mesenchymal neoplasms with differentiation along the lines of the interstitial cell of Cajal that usually expression c-kit protein (CD117), DOG1 and CD34 by immunohistochemistry.[52-54] There is variable expression of alpha-smooth muscle actin and essentially no reactivity for desmin. As with all spindle cell lesions, procuring cellblocks on such specimens will facilitate a definitive diagnosis.

Examples of cytological interpretations

Satisfactory for evaluation
Neoplastic: Other
Mucinous cyst fluid with low-grade dysplasia (see note)
Note: Benign-appearing mucinous epithelium is present from this transduodenal FNA in a background of abundant extracellular mucin. (If available, add CEA is elevated at 357 ng/ml supporting the diagnosis).

Satisfactory for evaluation
Neoplastic: Other
Cyst fluid with thick colloid-like extracellular mucin containing cyst debris consistent with a neoplastic mucinous cyst, favor MCN given the clinical and imaging findings of a 45-year-old female with a multiloculated cyst in the pancreatic tail. Scant benign appearing mucinous epithelium is present of uncertain origin, favor gastric contamination. No high-grade epithelial atypia present.

Evaluation limited by scant cellularity
Neoplastic: Other
Mucinous cyst fluid with high-grade epithelial atypia (see note)
Note: No thick extracellular mucin is present, but cyst fluid CEA is 1267 ng/ml supporting the diagnosis. In addition, molecular analysis demonstrates a *KRAS* point mutation, which supports a mucinous etiology. The epithelial cells are most consistent with high-grade dysplasia, however, invasive carcinoma cannot be excluded. Correlation with imaging findings required.

Satisfactory for evaluation
Neoplastic: Other
Well-differentiated neuroendocrine tumor
Note: Tissue is not available for ancillary studies, however, the morphological features of endocrine differentiated are well-defined, or
Immunohistochemical stains on the corresponding cellblock confirm endocrine differentiation (synaptophysin and chromogranin are positive). Proliferation marker Ki-67 shows less than 2% nuclear staining suggestive of a grade 1 tumor.

Satisfactory for evaluation
Noeplastic: Other
Solid-pseudopapillary neoplasm.

CATEGORY V: SUSPICIOUS (FOR MALIGNANCY)

Background

The cytological interpretation category of "SFM" generally refers to pancreatic adenocarcinoma, but may be used with any malignant neoplasm and this terminology scheme recommends using it for high-grade, aggressive malignancies. "Suspicious for" is NOT "diagnostic of" and clinical and radiological information must be correlated with the suspicious cytological findings to justify surgical intervention. Like the "atypical" interpretation category, the "suspicious" category suffers from significant interobserver variability often stemming from varying experience of the pathologist in interpreting pancreatic cytology. Due to the high threshold of a malignant interpretation and thus the low false positive rate of pancreatic cytology, many samples are conservatively interpreted and may benefit from a second opinion by an experienced pancreatic cytopathologist to save the patient the potential of a repeat diagnostic procedure.

Aspirates insufficient to make a definitive diagnosis of at least a neoplasm such as PanNET or SPN should be placed in the atypical category with specification of the indeterminate interpretation in the diagnosis line.

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

However, for aspirates that produce a "solid-cellular" clearly neoplastic epithelial proliferation which includes PanNET, acinar cell carcinoma, pancreatoblastoma and SPN in the differential diagnosis, but which has insufficient tissue for confirmatory ancillary studies to make a specific diagnosis, the SFM category is an appropriate classification.

SFM is an indeterminate category resulting from three major challenges with interpretation of FNA specimens of the pancreas. The first challenge is the very high level of differentiation of certain pancreatic adenocarcinomas that may harbor very subtle cytologic abnormalities.[55] The second challenge is scant cellularity. Pancreatic adenocarcinoma induces a tumor-associated sclerotic response that may contribute to this sparse cellularity.[56] The third problem that cytologists must address is gastrointestinal contamination that, when substantial, may mask some scattered tumor cells and when injured and reactive, may mimic carcinoma. When these challenges are faced in a single case, a definitive diagnosis of malignancy may be impossible, but malignancy is probable. In these cases, where the degree of suspicion for malignancy is high enough to require therapeutic intervention, one may classify the lesion as "SFM". This category has a very high positive predictive value for malignancy.[56-58] The SFM diagnosis must be correlated with clinical symptoms and imaging characteristics. When a patient has a high clinical suspicion of pancreatic cancer and a pancreatic mass on imaging studies, the diagnosis of suspicious most likely indicates the presence of cancer.[56-58] Autoimmune pancreatitis should be a clinical consideration as it is a well-known pitfall mimicker of PDAC clinically, radiologically and cytologically. The distinction between a positive diagnosis and an SFM diagnosis is based on both quantitative and qualitative criteria. Suspicious cases represent 5-12% of published cases,[59] but most studies focus on pancreatic adenocarcinoma, so the number of cases that are considered as suspicious for PanNETs, acinar cell carcinomas or lymphomas is very difficult to establish.

As a category, the risk of malignancy for brushing specimens designated "SFM" is approximately 80% and 96% for the EUS-FNA specimens identified as SFM.[60]

Definition

A specimen is SFM when some, but an insufficient number of the typical features of a specific malignant neoplasm are present, mainly pancreatic adenocarcinoma. The cytological features raise a strong suspicion for malignancy, but the findings are qualitatively and/or quantitatively insufficient for a conclusive diagnosis, or tissue is not present for ancillary studies to define a specific neoplasm. The morphologic features must be sufficiently atypical that malignancy is considered more probable than not.

Examples of cytological interpretations

Satisfactory for evaluation
Suspicious (for malignancy)
Rare markedly atypical epithelial cells suspicious for adenocarcinoma.

Satisfactory for evaluation
Suspicious (for malignancy)
Mucinous cyst with high-grade epithelial atypia and abundant coagulative necrosis suspicious for invasive carcinoma.

Satisfactory for evaluation
Suspicious (for malignancy)
Solid cellular neoplasm with features suspicious for acinar cell carcinoma. Tissue for confirmatory ancillary studies is not available.

CATEGORY VI: POSITIVE OR MALIGNANT

Background

Since 9 of 10 malignancies in the pancreas are conventional ductal adenocarcinoma, the "positive" or "malignant" category is often related to this category. Low-grade malignancies such as well-differentiated PanNET and SPN are included in the Neoplastic: Other category. Other high-grade malignancies are also included here such as acinar cell carcinoma, pancreatoblastoma, lymphoma and metastases. The specificity of a positive or malignant interpretation for both pancreatic FNA and biliary brushing is very high, >90-95% in most studies.[6,7,10,57,61-65] Relying on strict criteria contributes to this high specificity at the expense of sensitivity. Rapid on site evaluation of solid mass lesion FNAs contributes to diagnostic yield.[66-68]

Definition

A group of neoplasms that unequivocally display malignant cytologic characteristics and include PDAC and its variants, cholangiocarcinoma, acinar cell carcinoma, high-grade neuroendocrine carcinoma (small cell and large cell), pancreatoblastoma, lymphomas, sarcomas and metastases to the pancreas.

PDAC

PDAC is a malignant invasive gland (duct) forming epithelial neoplasm typically composed of classic tubular glands, but, in variants, with other morphologically diverse epithelial morphologies. PDAC, or infiltrating ductal adenocarcinoma, is the most common primary cancer of the pancreas which accounts for 85-90% of all pancreatic malignancies.[27,34] High-grade tumors generally demonstrate overt features of malignancy that makes cytological diagnosis straight forward. Well-differentiated tumors can be extremely

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

challenging due to minimal deviation from normal ductal morphology making a definitive diagnosis of malignancy challenging.

Cholangiocarcinoma
The diagnostic criteria for invasive cholangiocarcinoma are the same as for ductal adenocarcinoma of the pancreas on FNA samples. Published diagnostic criteria for adenocarcinoma in a bile duct brushing specimen[69,70] demonstrate variable predictive values.[71] The presence of indwelling stents and the underlying inflammatory conditions that lead to bile duct stricture and the increased risk for malignancy are factors in and of themselves that contribute to the need for a high threshold for malignancy in these specimens. As such, the sensitivity for detecting malignancy in these specimens is low.[10,61,62,65] An overall assessment for the presence of malignancy may be best in these samples. The addition of ancillary testing using FISH and other molecular methods may also improve sensitivity[72,55] (see report from Committee IV on ancillary testing in pancreatobiliary specimens).

Major diagnostic pitfalls in the evaluation of bile duct brushings include obscuring of malignant epithelium by overlying benign epithelium, insufficient sampling, degeneration due to bile or duodenal contents, primary sclerosing cholangitis[73] and atypical squamous metaplasia due to bile duct stones and stents. Correlation of the cytological findings with the clinical findings may help as a biliary stricture is more likely to be malignant in older male patients who are symptomatic and do not have a history of stones.[10]

Colloid carcinoma (mucinous, non-cystic)
A carcinoma of ductal differentiation showing abundant extracellular mucin production, with at least 80% of the tumor on histology demonstrating large pools of extracellular mucin and cuboidal epithelial cells "floating" in the mucin. This uncommon variant accounts for 1-3% of PDAC and the vast majority arise in association with IPMN of intestinal type. Gender and age distribution is similar to PDAC; however, the prognosis appears to be significantly better.[35]

Medullary carcinoma
A carcinoma characterized by poor histologic differentiation, syncytial growth pattern, pushing borders and an intense lymphoplasmacytic response. Medullary carcinoma is characterized by a special genetic profile with 69% of these tumors displaying wild-type *KRAS* genes and 22% of these tumors have microsatellite instability.

Adenosquamous carcinoma
A rare subtype with relative frequency of 3-4% and relatively poorer prognosis compared to the conventional ductal adenocarcinoma, this variant shows malignant glandular and squamous components ranging from extensive glandular differentiation with focal squamous differentiation to predominantly squamous differentiation.[74]

Undifferentiated carcinoma with osteoclast-like giant cells
Often admixed with ordinary PDAC, this tumor is a distinctive type of sarcomatoid carcinoma with the striking and unique cytohistologic features characterized by a prominent component of reactive osteoclast-like giant cells in a background of spindle cells. Often seen in association with MCN, these tumors may also arise with *in-situ* (PanIN III and invasive ductal carcinoma.[75]

Undifferentiated carcinoma
Also known as anaplastic carcinoma this rare variant of PDAC has a relative frequency of 2-7%. It is a high-grade carcinoma composed of large, undifferentiated, markedly pleomorphic cells.[76] Tumors with this morphology should prompt the pathologist to consider metastatic disease and to evaluate available tissue with ancillary studies to investigate the possibility.

Acinar cell carcinoma
A rare malignant epithelial neoplasm with exocrine acinar differentiation. Lipase hypersecretion syndrome is present in only 16% of the patients but serves as a clinical clue to the diagnosis. A significant proportion of the cases have small neuroendocrine component or scattered neuroendocrine cells within the tumor. Approximately 50% of the patients have metastatic disease at presentation, often restricted to the regional lymph nodes and liver.[77-83]

Poorly-differentiated neuroendocrine carcinoma (small cell carcinoma or large cell neuroendocrine carcinoma)
Both small cell and large cell high-grade neuroendocrine carcinomas exhibit cytoarchitectural and clinicopathological features indistinguishable from their pulmonary (and extra pulmonary) counterparts. These carcinomas account for less than 1% of all primary pancreatic cancers and 2-3% of PanNETs. These carcinomas are extremely rare in the pancreas and the possibility of metastatic lung carcinoma or extension from the more common primary site of the ampulla (for large cell type) should always be excluded first.[22,84]

Pancreatoblastoma
A rare neoplasm, primarily of childhood, characterized by acinar differentiation, endocrine differentiation and distinctive squamoid nests. Furthermore known as infantile pancreatic carcinoma, this is an extremely rare pancreatic tumor in childhood, comprising 0.5% of pancreatic non-endocrine tumors with rare occurrence

CytoJournal 2014, 11:S1-3 http://www.cytojournal.com/content/11/1/S1-3

in adults. Pancreatoblastoma tends to be less aggressive in infants and children compared to adults. The cancer has been associated with alterations in the Wnt signaling pathway and chromosome 11p loss of heterozygosity, Beckwith-Wiedemann syndrome and familial adenomatous polyposis. Alpha-fetoprotein may be elevated in up to 68% of patients with pancreatoblastoma and can be used to follow patients for recurrence post-operatively.[85]

Non-Hodgkin lymphoma

Hematopoietic malignancies in the pancreas are rare and usually involve the pancreas secondarily.[86] Pancreatic lymphomas are most commonly non-Hodgkin lymphoma that can clinically mimic pancreatic adenocarcinoma. One of the advantages to FNA evaluation is that pre-operative diagnosis of lymphoma can preclude unnecessary surgery. Primary pancreatic lymphomas are most commonly large B-cell lymphomas.[86] While the cytomorphological features may suggest lymphoid differentiation, there may be overlapping features with other neoplasms that produce a solid cellular smear pattern. Ancillary tests such as flow cytometry and immunohistochemistry are typically necessary for diagnosis and especially for subclassification.

Metastatic tumors

Secondary neoplasms involving the pancreas are rare and pancreatic involvement as the sole site of metastasis is even more uncommon. The common neoplasms that metastasize to the pancreas include melanoma, renal cell carcinoma and carcinomas from the lung, colorectum and breast.[27] Direct extension from cancer of the stomach, duodenum, gallbladder, liver and retroperitoneum may also occur.

Renal cell carcinoma is notorious for giving rise to a late solitary metastasis, even decades following nephrectomy. Renal cell carcinoma is also the most likely malignancy to metastasize to the pancreas and mimic a primary neoplasm.[87] The cytological findings of metastatic renal cell carcinoma are similar to those seen in the kidney with bland polygonal cells, round slightly eccentric nuclei, prominent nucleoli and vacuolated cytoplasm. Distinction from clear cell or lipid rich neuroendocrine tumor is warranted as the morphology of these two neoplasms may be indistinguishable.

Examples of cytological interpretations

Satisfactory for evaluation
Positive (for malignancy)
Adenocarcinoma.

Satisfactory for evaluation
Positive (for malignancy)
Malignant glandular and squamous cells consistent with adenosquamous carcinoma.

Satisfactory for evaluation
Positive (for malignancy)
Adenocarcinoma with morphological features consistent with renal primary.

COMPETING INTERESTS STATEMENT BY ALL AUTHORS

The authors declare that they have no competing interests.

AUTHORSHIP STATEMENT BY ALL AUTHORS

All authors of this article declare that we qualify for authorship as defined by ICMJE http://www.icmje.org/#author. Each author has participated sufficiently in the work and take public responsibility for appropriate portions of the content of this article. Each author acknowledges that this final version was read and approved.

REFERENCES

1. Tanaka M, Chari S, Adsay V, Fernandez-del Castillo C, Falconi M, Shimizu M, *et al*. International consensus guidelines for management of intraductal papillary mucinous neoplasms and mucinous cystic neoplasms of the pancreas. Pancreatology 2006;6:17-32.
2. Tanaka M, Fernández-del Castillo C, Adsay V, Chari S, Falconi M, Jang JY, *et al*. International consensus guidelines 2012 for the management of IPMN and MCN of the pancreas. Pancreatology 2012;12:183-97.
3. Brugge WR, Lewandrowski K, Lee-Lewandrowski E, Centeno BA, Szydlo T, Regan S, *et al*. Diagnosis of pancreatic cystic neoplasms: A report of the cooperative pancreatic cyst study. Gastroenterology 2004;126:1330-6.
4. Cizginer S, Turner BG, Bilge AR, Karaca C, Pitman MB, Brugge WR. Cyst fluid carcinoembryonic antigen is an accurate diagnostic marker of pancreatic mucinous cysts. Pancreas 2011;40:1024-8.
5. van der Waaij LA, van Dullemen HM, Porte RJ. Cyst fluid analysis in the differential diagnosis of pancreatic cystic lesions: A pooled analysis. Gastrointest Endosc 2005;62:383-9.
6. Turner BG, Cizginer S, Agarwal D, Yang J, Pitman MB, Brugge WR. Diagnosis of pancreatic neoplasia with EUS and FNA: A report of accuracy. Gastrointest Endosc 2010;71:91-8.
7. Ylagan LR, Edmundowicz S, Kasal K, Walsh D, Lu DW. Endoscopic ultrasound guided fine-needle aspiration cytology of pancreatic carcinoma: A 3-year experience and review of the literature. Cancer 2002;96:362-9.
8. Frossard JL, Amouyal P, Amouyal G, Palazzo L, Amaris J, Soldan M, *et al*. Performance of endosonography-guided fine needle aspiration and biopsy in the diagnosis of pancreatic cystic lesions. Am J Gastroenterol 2003;98:1516-24.
9. Wu RI, Yoon WJ, Brugge WR, Mino-Kenudson M, Pitman MB. Endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) contributes to a triple-negative test in preoperative screening of pancreatic cysts. Cancer Cytopathol 2013; Dec. 10, epub ahead of print.
10. Volmar KE, Vollmer RT, Routbort MJ, Creager AJ. Pancreatic and bile duct brushing cytology in 1000 cases: Review of findings and comparison of preparation methods. Cancer 2006;108:231-8.
11. Layfield LJ, Scmidt RL, Hirschowitz SR, Olson M, Syed A, Dodd L. Significance of the diagnostic categories "atypical" and "suspicious for malignancy" in the cytologic diagnosis of solid pancreatic masses. Diagn Cytopathol. Feb 28. [Epub ahead of print].
12. Pitman MB, Centeno BA, Daglilar ES, Brugge WR, Mino-Kenudson M. Cytological criteria of high-grade epithelial atypia in the cyst fluid of pancreatic intraductal papillary mucinous neoplasms. Cancer Cytopathol 2014;122:40-7.

13. Pitman MB, Yaeger KA, Brugge WR, Mino-Kenudson M. Prospective analysis of atypical epithelial cells as a high-risk cytologic feature for malignancy in pancreatic cysts. Cancer Cytopathol 2013;121:29-36.
14. Jarboe EA, Layfield LJ. Cytologic features of pancreatic intraepithelial neoplasia and pancreatitis: Potential pitfalls in the diagnosis of pancreatic ductal carcinoma. Diagn Cytopathol 2011;39:575-81.
15. Nagle JA, Wilbur DC, Pitman MB. Cytomorphology of gastric and duodenal epithelium and reactivity to B72.3: A baseline for comparison to pancreatic lesions aspirated by EUS-FNAB. Diagn Cytopathol 2005;33:381-6.
16. Zen Y, Adsay NV, Bardadin K, Colombari R, Ferrell L, Haga H, *et al.* Biliary intraepithelial neoplasia: An international interobserver agreement study and proposal for diagnostic criteria. Mod Pathol 2007;20:701-9.
17. Lee JG, Leung JW, Baillie J, Layfield LJ, Cotton PB. Benign, dysplastic, or malignant – Making sense of endoscopic bile duct brush cytology: Results in 149 consecutive patients. Am J Gastroenterol 1995;90:722-6.
18. Belsley NA, Pitman MB, Lauwers GY, Brugge WR, Deshpande V. Serous cystadenoma of the pancreas: Limitations and pitfalls of endoscopic ultrasound-guided fine-needle aspiration biopsy. Cancer 2008;114:102-10.
19. Ferrone CR, Tang LH, Tomlinson J, Gonen M, Hochwald SN, Brennan MF, *et al.* Determining prognosis in patients with pancreatic endocrine neoplasms: Can the WHO classification system be simplified? J Clin Oncol 2007;25:5609-15.
20. Kuo EJ, Salem RR. Population-level analysis of pancreatic neuroendocrine tumors 2 cm or less in size. Ann Surg Oncol 2013;20:2815-21.
21. Haynes AB, Deshpande V, Ingkakul T, Vagefi PA, Szymonifka J, Thayer SP, *et al.* Implications of incidentally discovered, nonfunctioning pancreatic endocrine tumors: Short-term and long-term patient outcomes. Arch Surg 2011;146:534-8.
22. Klimstra S, Arnold R, Capella C, Hruban RH, Arnold R, Kloppel G, Komminoth P, *et al.*, ed. Neuroendocrine neoplasms of the pancreas. In: Bosman C, Carneiro F, Hruban RH, Theise ND, editors. WHO Classification of Tumours of the Digestive System. 4th ed. Lyon: Stylus Publishing, LLC; 2010.
23. Klimstra DS. Pathology reporting of neuroendocrine tumors: Essential elements for accurate diagnosis, classification, and staging. Semin Oncol 2013;40:23-36.
24. Kloppel G, Hruban R, Klimstra DS, Maitra A, Morohoshi T, Notohara K, *et al.* In: Carneiro F, Bosman C, Hruban RH, Theise ND, editors. Solid-pseudopapillary neoplasm of the pancreas. Sterling: Stylus Publishing, LLC; 2010. p. 327-30.
25. Crippa S, Fernández-Del Castillo C, Salvia R, Finkelstein D, Bassi C, Domínguez I, *et al.* Mucin-producing neoplasms of the pancreas: An analysis of distinguishing clinical and epidemiologic characteristics. Clin Gastroenterol Hepatol 2010;8:213-9.
26. Crippa S, Salvia R, Warshaw AL, Domínguez I, Bassi C, Falconi M, *et al.* Mucinous cystic neoplasm of the pancreas is not an aggressive entity: Lessons from 163 resected patients. Ann Surg 2008;247:571-9.
27. Hruban RH, Pitman MB, Klimstra DS. Tumors of the Pancreas. Atlas of Tumor Pathology. 4th Series, Fascicle 6. Washington, DC: American Registry of Pathology; Armed Forces Institutes of Pathology; 2007.
28. Pitman MB, Deshpande V. Endoscopic ultrasound-guided fine needle aspiration cytology of the pancreas: A morphological and multimodal approach to the diagnosis of solid and cystic mass lesions. Cytopathology 2007;18:331-47.
29. Pitman MB, Michaels PJ, Deshpande V, Brugge WR, Bounds BC. Cytological and cyst fluid analysis of small (< or=3 cm) branch duct intraductal papillary mucinous neoplasms adds value to patient management decisions. Pancreatology 2008;8:277-84.
30. Pitman MB, Genevay M, Yaeger K, Chebib I, Turner BG, Mino-Kenudson M, *et al.* High-grade atypical epithelial cells in pancreatic mucinous cysts are a more accurate predictor of malignancy than "positive" cytology. Cancer Cytopathol 2010;118:434-40.
31. Adsay NV. Cystic neoplasia of the pancreas: Pathology and biology. J Gastrointest Surg 2008;12:401-4.
32. Adsay NV, Longnecker DS, Klimstra DS. Pancreatic tumors with cystic dilatation of the ducts: Intraductal papillary mucinous neoplasms and intraductal oncocytic papillary neoplasms. Semin Diagn Pathol 2000;17:16-30.
33. Adsay NV, Merati K, Basturk O, Iacobuzio-Donahue C, Levi E, Cheng JD, *et al.* Pathologically and biologically distinct types of epithelium in intraductal papillary mucinous neoplasms: Delineation of an "intestinal" pathway of carcinogenesis in the pancreas. Am J Surg Pathol 2004;28:839-48.
34. Hruban RH, Takaori K, Klimstra DS, Adsay NV, Albores-Saavedra J, Biankin AV, *et al.* An illustrated consensus on the classification of pancreatic intraepithelial neoplasia and intraductal papillary mucinous neoplasms. Am J Surg Pathol 2004;28:977-87.
35. Adsay NV, Pierson C, Sarkar F, Abrams J, Weaver D, Conlon KC, *et al.* Colloid (mucinous noncystic) carcinoma of the pancreas. Am J Surg Pathol 2001;25:26-42.
36. Mino-Kenudson M, Fernández-del Castillo C, Baba Y, Valsangkar NP, Liss AS, Hsu M, *et al.* Prognosis of invasive intraductal papillary mucinous neoplasm depends on histological and precursor epithelial subtypes. Gut 2011;60:1712-20.
37. Moparty B, Pitman MB, Brugge WR. Pancreatic cyst fluid amylase is not a marker to differentiate IPMN from MCN. Gastrointest Endosc 2007;65:AB303.
38. Kucera S, Centeno BA, Springett G, Malafa MP, Chen YA, Weber J, *et al.* Cyst fluid carcinoembryonic antigen level is not predictive of invasive cancer in patients with intraductal papillary mucinous neoplasm of the pancreas. JOP 2012;13:409-13.
39. Ryu JK, Woo SM, Hwang JH, Jeong JB, Yoon YB, Park IA, *et al.* Cyst fluid analysis for the differential diagnosis of pancreatic cysts. Diagn Cytopathol 2004;31:100-5.
40. O'Toole D, Palazzo L, Hammel P, Ben Yaghlene L, Couvelard A, Felce-Dachez M, *et al.* Macrocystic pancreatic cystadenoma: The role of EUS and cyst fluid analysis in distinguishing mucinous and serous lesions. Gastrointest Endosc 2004;59:823-9.
41. Khalid A, Zahid M, Finkelstein SD, LeBlanc JK, Kaushik N, Ahmad N, *et al.* Pancreatic cyst fluid DNA analysis in evaluating pancreatic cysts: A report of the PANDA study. Gastrointest Endosc 2009;69:1095-102.
42. Shen J, Brugge WR, Dimaio CJ, Pitman MB. Molecular analysis of pancreatic cyst fluid: A comparative analysis with current practice of diagnosis. Cancer 2009;117:217-27.
43. Wu J, Matthaei H, Maitra A, Dal Molin M, Wood LD, Eshleman JR, *et al.* Recurrent GNAS mutations define an unexpected pathway for pancreatic cyst development. Sci Transl Med 2011;3:92ra66.
44. Lau SK, Lewnadrowski KB, Brugge WR, Warshaw A, and Centeno BA. Diagnostic significance of mucin in fine needle aspiration samples of pancreatic cysts. Mod Pathol 2000;13:48A.
45. Pitman MB, Centeno BA, Genevay M, Fonseca R, Mino-Kenudson M. Grading epithelial atypia in endoscopic ultrasound-guided fine-needle aspiration of intraductal papillary mucinous neoplasms: An international interobserver concordance study. Cancer Cytopathol 2013;121:729-36.
46. Genevay M, Mino-Kenudson M, Yaeger K, Konstantinidis IT, Ferrone CR, Thayer S, *et al.* Cytology adds value to imaging studies for risk assessment of malignancy in pancreatic mucinous cysts. Ann Surg 2011;254:977-83.
47. Pitman M, Centeno BA, Genevay M, Fonseca R, Mino-Kenudson M. Grading epithelial atypia in EUS-FNA of pancreatic mucinous cysts: An international interobsever concordance study. Cancer Cytopathology 2013 Dec;121:729-36.
48. Pitman MB. Pancreatic cyst fluid triage: A critical component of the preoperative evaluation of pancreatic cysts. Cancer Cytopathol 2013;121:57-60.
49. Layfield LJ, Cramer H. Fine-needle aspiration cytology of intraductal papillary-mucinous tumors: A retrospective analysis. Diagn Cytopathol 2005;32:16-20.
50. Kloek JJ, van der Gaag NA, Erdogan D, Rauws EA, Busch OR, Gouma DJ, *et al.* A comparative study of intraductal papillary neoplasia of the biliary tract and pancreas. Hum Pathol 2011;42:824-32.
51. Barton JG, Barrett DA, Maricevich MA, Schnelldorfer T, Wood CM, Smyrk TC, *et al.* Intraductal papillary mucinous neoplasm of the biliary tract: A real disease? HPB (Oxford) 2009;11:684-91.
52. Ando N, Goto H, Niwa Y, Hirooka Y, Ohmiya N, Nagasaka T, *et al.* The diagnosis of GI stromal tumors with EUS-guided fine needle aspiration with immunohistochemical analysis. Gastrointest Endosc 2002;55:37-43.
53. Reith JD, Goldblum JR, Lyles RH, Weiss SW. Extragastrointestinal (soft tissue) stromal tumors: An analysis of 48 cases with emphasis on histologic predictors of outcome. Mod Pathol 2000;13:577-85.
54. Willmore-Payne C, Layfield LJ, Holden JA. c-KIT mutation analysis for diagnosis of gastrointestinal stromal tumors in fine needle aspiration specimens. Cancer 2005;105:165-70.
55. Barr Fritcher EG, Caudill JL, Blue JE, Djuric K, Feipel L, Maritim BK, *et al.* Identification of malignant cytologic criteria in pancreatobiliary brushings with corresponding positive fluorescence *in situ* hybridization results. Am J Clin Pathol 2011;136:442-9.
56. Eloubeidi MA, Jhala D, Chhieng DC, Chen VK, Eltoum I, Vickers S, *et al.* Yield of endoscopic ultrasound-guided fine-needle aspiration biopsy in patients with suspected pancreatic carcinoma. Cancer 2003;99:285-92.
57. Bhutani MS, Hawes RH, Baron PL, Sanders-Cliette A, van Velse A, Osborne JF,

et al. Endoscopic ultrasound guided fine needle aspiration of malignant pancreatic lesions. Endoscopy 1997;29:854-8.
58. Faigel DO, Ginsberg GG, Bentz JS, Gupta PK, Smith DB, Kochman ML. Endoscopic ultrasound-guided real-time fine-needle aspiration biopsy of the pancreas in cancer patients with pancreatic lesions. J Clin Oncol 1997;15:1439-43.
59. Lin F, Staerkel G. Cytologic criteria for well differentiated adenocarcinoma of the pancreas in fine-needle aspiration biopsy specimens. Cancer 2003;99:44-50.
60. Layfield LJ, Dodd L, Factor R, Schmidt RL. Malignancy risk associated with diagnostic categories defined by the Papanicolaou Society of Cytopathology pancreatico biliary guidelines. Diagn Cytopathol. 2013 Dec 11. [Epub ahead of print].
61. Layfield LJ, Wax TD, Lee JG, Cotton PB. Accuracy and morphologic aspects of pancreatic and biliary duct brushings. Acta Cytol 1995;39:11-8.
62. Ylagan LR, Liu LH, Maluf HM. Endoscopic bile duct brushing of malignant pancreatic biliary strictures: Retrospective study with comparison of conventional smear and Thin Prep techniques. Diagn Cytopathol 2003;28:196-204.
63. Eloubeidi MA, Chen VK, Eltoum IA, Jhala D, Chhieng DC, Jhala N, *et al*. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: Diagnostic accuracy and acute and 30-day complications. Am J Gastroenterol 2003;98:2663-8.
64. Eloubeidi MA, Tamhane A. EUS-guided FNA of solid pancreatic masses: A learning curve with 300 consecutive procedures. Gastrointest Endosc 2005;61:700-8.
65. Adamsen S, Olsen M, Jendresen MB, Holck S, Glenthøj A. Endobiliary brush biopsy: Intra- and interobserver variation in cytological evaluation of brushings from bile duct strictures. Scand J Gastroenterol 2006;41:597-603.
66. Hébert-Magee S, Bae S, Varadarajulu S, Ramesh J, Frost AR, Eloubeidi MA, *et al*. The presence of a cytopathologist increases the diagnostic accuracy of endoscopic ultrasound-guided fine needle aspiration cytology for pancreatic adenocarcinoma: A meta-analysis. Cytopathology 2013;24:159-71.
67. Klapman JB, Logrono R, Dye CE, Waxman I. Clinical impact of on-site cytopathology interpretation on endoscopic ultrasound-guided fine needle aspiration. Am J Gastroenterol 2003;98:1289-94.
68. da Cunha Santos G, Ko HM, Saieg MA, Geddie WR. "The petals and thorns" of ROSE (rapid on-site evaluation). Cancer Cytopathol 2013;121:4-8.
69. Cohen MB, Wittchow RJ, Johlin FC, Bottles K, Raab SS. Brush cytology of the extrahepatic biliary tract: Comparison of cytologic features of adenocarcinoma and benign biliary strictures. Mod Pathol 1995;8:498-502.
70. Nakajima T, Tajima Y, Sugano I, Nagao K, Sakuma A, Koyama Y, *et al*. Multivariate statistical analysis of bile cytology. Acta Cytol 1994;38:51-5.
71. Renshaw AA, Madge R, Jiroutek M, Granter SR. Bile duct brushing cytology: Statistical analysis of proposed diagnostic criteria. Am J Clin Pathol 1998;110:635-40.
72. Kipp BR, Stadheim LM, Halling SA, Pochron NL, Harmsen S, Nagorney DM, *et al*. A comparison of routine cytology and fluorescence *in situ* hybridization for the detection of malignant bile duct strictures. Am J Gastroenterol 2004;99:1675-81.
73. Layfield LJ, Cramer H. Primary sclerosing cholangitis as a cause of false positive bile duct brushing cytology: Report of two cases. Diagn Cytopathol 2005;32:119-24.
74. Rahemtullah A, Misdraji J, Pitman MB. Adenosquamous carcinoma of the pancreas: Cytologic features in 14 cases. Cancer 2003;99:372-8.
75. Chopra S, Wu ML, Imagawa DK, Lee J, Gu M. Endoscopic ultrasound-guided fine-needle aspiration of undifferentiated carcinoma with osteoclast-like giant cells of the pancreas: A report of 2 cases with literature review. Diagn Cytopathol 2007;35:601-6.
76. Paal E, Thompson LD, Frommelt RA, Przygodzki RM, Heffess CS. A clinicopathologic and immunohistochemical study of 35 anaplastic carcinomas of the pancreas with a review of the literature. Ann Diagn Pathol 2001;5:129-40.
77. Kitagami H, Kondo S, Hirano S, Kawakami H, Egawa S, Tanaka M. Acinar cell carcinoma of the pancreas: Clinical analysis of 115 patients from Pancreatic Cancer Registry of Japan Pancreas Society. Pancreas 2007;35:42-6.
78. Hartwig W, Denneberg M, Bergmann F, Hackert T, Hinz U, Strobel O, *et al*. Acinar cell carcinoma of the pancreas: Is resection justified even in limited metastatic disease? Am J Surg 2011;202:23-7.
79. Suzuki A, Sakaguchi T, Morita Y, Oishi K, Fukumoto K, Inaba K, *et al*. Long-term survival after a repetitive surgical approach in a patient with acinar cell carcinoma of the pancreas and recurrent liver metastases: Report of a case. Surg Today 2010;40:679-83.
80. Matos JM, Schmidt CM, Turrini O, Agaram NP, Niedergethmann M, Saeger HD, *et al*. Pancreatic acinar cell carcinoma: A multi-institutional study. J Gastrointest Surg 2009;13:1495-502.
81. Schmidt CM, Matos JM, Bentrem DJ, Talamonti MS, Lillemoe KD, Bilimoria KY. Acinar cell carcinoma of the pancreas in the United States: Prognostic factors and comparison to ductal adenocarcinoma. J Gastrointest Surg 2008;12:2078-86.
82. Seth AK, Argani P, Campbell KA, Cameron JL, Pawlik TM, Schulick RD, *et al*. Acinar cell carcinoma of the pancreas: An institutional series of resected patients and review of the current literature. J Gastrointest Surg 2008;12:1061-7.
83. Basturk O, Zamboni G, Klimstra DS, Capelli P, Andea A, Kamel NS, *et al*. Intraductal and papillary variants of acinar cell carcinomas: A new addition to the challenging differential diagnosis of intraductal neoplasms. Am J Surg Pathol 2007;31:363-70.
84. Yachida S, Vakiani E, White CM, Zhong Y, Saunders T, Morgan R, *et al*. Small cell and large cell neuroendocrine carcinomas of the pancreas are genetically similar and distinct from well-differentiated pancreatic neuroendocrine tumors. Am J Surg Pathol 2012;36:173-84.
85. Morohoshi T, Hruban R, Klimstra DS, Ohike N, Terris B. Pancreatoblastoma. In:, Bosman C, Carneiro F, Hruban RH, Theise ND, editors. WHO Classification of Tumours of the Digestive System. Lyon: International Agency for Research on Cancer; 2010. p. 319-21.
86. Volmar KE, Routbort MJ, Jones CK, Xie HB. Primary pancreatic lymphoma evaluated by fine-needle aspiration: Findings in 14 cases. Am J Clin Pathol 2004;121:898-903.
87. Thompson LD, Heffess CS. Renal cell carcinoma to the pancreas in surgical pathology material. Cancer 2000;89:1076-88.

EDITORIAL STATEMENT

To ensure the integrity and highest quality of CytoJournal publications, general manuscripts undergo a **double blind peer review** process (authors are blinded for reviewers and vice versa) through automatic online system. However, the current article is part of guidelines by Papanicolaou Society of Cytopathology (PSC) submitted by the committee members as authors and is being published after due copy-editing without peer review. Because it is agreed to be published as Open Access article under Creative Commons Legal Code (http://creativecommons.org/licenses/by/2.0/), this intellectual property (IP) would be retained in public domain.

Reproduced from Open Access (OA) Publication:
CytoJournal 2013; 11:10

CytoJournal

Executive editor:
Vinod B. Shidham, MD, FIAC, FRCPath
Wayne State University School of Medicine, Detroit, MI, USA

Co-editors-in-chief:
Richard DeMay, MD (University of Chicago, Chicago, USA)
Vinod B. Shidham, MD, FIAC, FRCPath (WSU School of Medicine, Detroit, USA)

For entire Editorial Board visit : http://www.cytojournal.com/eb.pdf
PDFs FREE for Members (visit http://www.cytojournal.com/CFMember.asp)

OPEN ACCESS
HTML format

Research Article

Authors attain comparable or slightly higher rates of citation publishing in an open access journal (CytoJournal) compared to traditional cytopathology journals - A five year (2007-2011) experience

Nora K. Frisch, *MD, FCAP**, Romil Nathan, *BS(Student)*, Yasin K. Ahmed, *MD*, Vinod B. Shidham, *MD, FRCPath, FIAC*

Address: Department of Pathology, Wayne State University School of Medicine, Karmanos Cancer Center and Detroit Medical Center, Old Hutzel Hospital, Detroit, MI 48201, USA

E-mail: Nora K. Frisch* - nfrisch@med.wayne.edu; Romil Nathan - romilnathan@gmail.com; Yasin K. Ahmed - yahme@med.wayne.edu; Vinod B. Shidham - vshidham@med.wayne.edu
*Corresponding author

Published: 29 April 2014
CytoJournal 2013, 11:10
This article is available from: http://www.cytojournal.com/content/11/1/10

Received: 26 September 2013
Accepted: 31 March 2013

This article may be cited as:
Frisch NK, Nathan R, Ahmed YK, Shidham VB. Authors attain comparable or slightly higher rates of citation publishing in an open access journal (CytoJournal) compared to traditional cytopathology journals - A five year (2007-2011) experience. CytoJournal 2014;11:10.

Abstract:

Background: The era of Open Access (OA) publication, a platform which serves to better disseminate scientific knowledge, is upon us, as more OA journals are in existence than ever before. The idea that peer-reviewed OA publication leads to higher rates of citation has been put forth and shown to be true in several publications. This is a significant benefit to authors and is in addition to another relatively less obvious but highly critical component of the OA charter, i.e. retention of the copyright by the authors in the public domain. In this study, we analyzed the citation rates of OA and traditional non-OA publications specifically for authors in the field of cytopathology. **Design:** We compared the citation patterns for authors who had published in both OA and traditional non-OA peer-reviewed, scientific, cytopathology journals. Citations in an OA publication (*CytoJournal*) were analyzed comparatively with traditional non-OA cytopathology journals (*Acta Cytologica*, *Cancer Cytopathology*, *Cytopathology*, and *Diagnostic Cytopathology*) using the data from web of science citation analysis site (based on which the impact factors (IF) are calculated). After comparing citations per publication, as well as a time adjusted citation quotient (which takes into account the time since publication), we also analyzed the statistics after excluding the data for meeting abstracts. **Results:** Total 28 authors published 314 publications as articles and meeting abstracts (25 authors after excluding the abstracts). The rate of citation and time adjusted citation quotient were higher for OA in the group where abstracts were included ($P < 0.05$ for both). The rates were also slightly higher for OA than non-OA when the meeting abstracts were excluded, but the difference was statistically insignificant ($P = 0.57$ and $P = 0.45$). **Conclusion:** We observed that for the same author, the publications in the OA journal attained a higher rate of citation than the publications in the traditional non-OA journals in the field of cytopathology over a 5 year period (2007-2011). However, this increase was statistically insignificant if the meeting abstracts were excluded from the analysis. Overall, the rates of citation for OA and non-OA were slightly higher to comparable.

Key words: Citations, impact, open access, publication

Access this article online	
Quick Response Code:	Website: www.cytojournal.com
	DOI: 10.4103/1742-6413.131739

CytoJournal 2014, 11:10 http://www.cytojournal.com/content/11/1/10

INTRODUCTION

It has been more than a decade since the publication of The Budapest Declaration, a landmark article, which was the result of a meeting of key players including many Nobel-laureates from the Open Access (OA) movement [1]. This declaration stated in part, "An old tradition and a new technology have converged to make possible an unprecedented public good." They were speaking of using the internet and OA principles to disseminate scientific knowledge obtained through research to more people than ever before.[1-4]

In the time since this declaration, the scientific world has seen a steady increase in the acceptance of the OA publication charter as a robust and viable method of publication, thereby increasing the impact of OA on the scientific literature. This has increased the number of OA publications on the internet, which are available freely to anyone with internet access. Major societies, government agencies, top publishers, and consortiums in the scientific community have followed by publishing many additional declarations supporting the use of OA.[5]

One reason for the growth of OA in the medical community is the known advantage this platform has for both the readers and the authors. In 2001, Steve Lawrence reported in Nature a sentinel publication after analyzing 119,924 articles and concluded that free online availability of scientific publications increased citation rates.[6] Kurtz *et al*.,[7] Harnad *et al*.,[8] and others published similar results.[5,9,10]

Other than increasing the citation rates[11], an additional relatively less appreciated beneficial aspect of the OA charter is the retention of copyright by the intellectual property (IP) owner of the individual publication, that is its author/researcher[2,12]. The efforts, time, skills, talent, and many more assets, including variety of public resources, contributed by the ethical owner, the author (s) of the individual publications, are very important and deserve further consideration. Not to lose this IP to any group with restricted benefits to general academia and the public is a major benefit of the OA charter, which is achieved by applying the Creative Commons Attribution License[13], allowing retention of published material in the public domain. Authors are increasingly experiencing the benefits of this feature, which leads to more freedom in sharing and utilizing previously published unique materials such as images, figures, tables, etc., *The benefit is applied to numerous academic activities including but not limited to writing reviews, chapters, books, and other teaching material, simply by citing the source of the original information*.[14]

Authors have a better chance of becoming a renowned expert on their given subject, by seamless global distribution of their effort to anyone in the world with internet access. An additional advantage gained by authors, readers and the medical community as a whole, and perhaps the most important benefit of OA, is the advances in discovery and treatment as purported by the translational research model, which are made possible by barrier free dissemination of scientific knowledge.

No studies to date have looked at the impact of Open Access publishing on the citation rate in a small subspecialty field like cytopathology, where the majority of journals have been traditional-type publications. Our hypothesis, based on the findings reported previously concerning open access publishing,[5-10] is that for the same author publishing in both types of cytopathology journals, the publications in OA Cytopathology Journal such as *CytoJournal* under the Open Access charter will have a similar or higher citation rate (CR) as compared to the publications in the traditional non-OA cytopathology journals.

MATERIAL AND METHODS

The data in this study was collected solely from the Web of Science based on which impact factors (IF) are calculated.[15] The traditional non-OA journals analyzed are *Acta Cytologica*, *Cancer Cytopathology*, *Cytopathology*, and *Diagnostic Cytopathology*. This was compared with similar data for the publications in *CytoJournal* as OA cytopathology journal. The five years, 2007-2011, chosen arbitrarily are closer to the current year of 2013 with reasonable time needed for generation of citations for most of the journals and publications.

The authors selected for this study were those who fit the following criteria:

- Those who published in *CytoJournal at least two times* within the time period of 2007- 2011
- Those who published in non-open access traditional cytopathology journals (*Acta Cytologica*, *Cancer Cytopathology*, *Cytopathology*, and/or *Diagnostic Cytopathology) at least* twice within the time period of 2007-2011
- Those who were not past or current editors/co-editors of the journals under study.

Each publication by these authors from the journals selected and the number of citations garnered by each publication as of August 22, 2013 was recorded using the Web of Science citation analysis site [Figure 1].[15] Web of Science was chosen as the database for our study for several reasons. It is a very large database with over 37 million records, and it includes all of the relevant and credible journals in the field of cytopathology. The database is also

CytoJournal 2014, 11:10 http://www.cytojournal.com/content/11/1/10

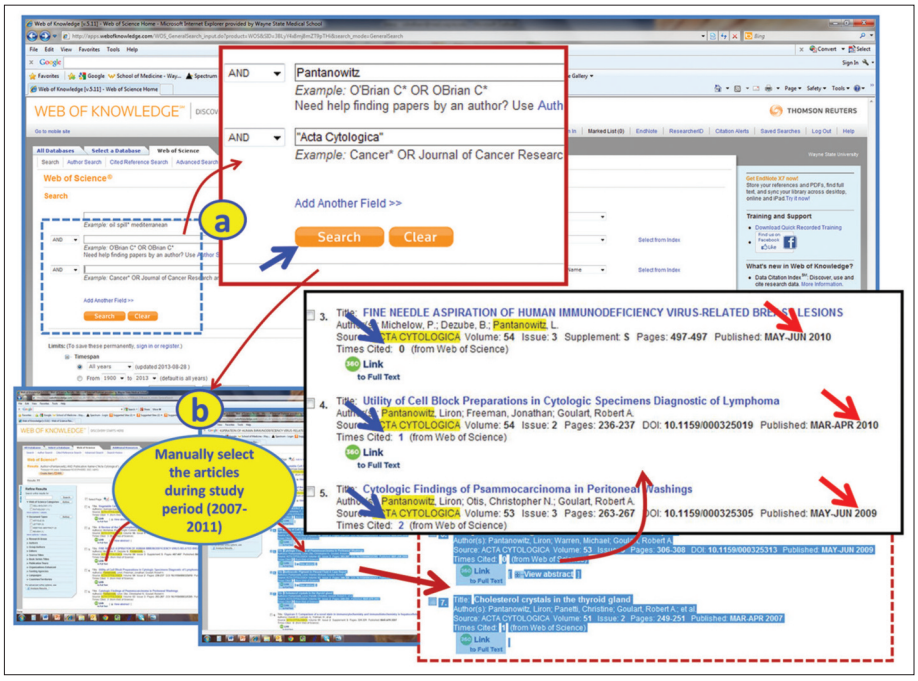


Figure 1: Use of the 'Web of Sciences Database' to harvest the raw data on number of citations for various publications for different authors publishing in cytopathology journals under study [Table 2]. (a) Add the name of the author and the journal. Click 'Search'; (b) Manually select the publications during 2007 through 2011. Note the citation numbers and reference details [Table 2]

publisher neutral" giving equal treatment to commercial, OA, societal and university publications.[15] Citations of each publication for each author in both Open Access and traditional non-OA journals were noted and categorized by the publication year. The citations per publication (CPP) for the two journal types were compared.

We designed another value to take into account the influence of the time factor after the publication (i.e. giving more power to publications which have had less time since publication). This metric, the 'time adjusted citation quotient' (Q value) was defined and calculated as follows:

$$\text{Q Value} \triangleq \sum_{i=2007}^{5} [\text{N(Yr)}/\text{C(Yr)}]/\text{X}$$

i Starting year 2007.

N (Yr): Total number of citations for all publications under consideration in a specific year (Yr).

C (Yr): Average number of CPP in a specific year (Yr) by all cytopathology journals under study.

X: Total number of publications under consideration for that author from 2007 to 2011 for that journal category (OA or non-OA).

The Web of Science's citation analysis [Figure 2][15] was the source of the average number of CPP for that year in that journal i.e. C (2007), C (2008), C (2009), C (2010), and C (2011). Upon completion of the search for each of the cytopathology journal, C (Yr), the mean value for each year was calculated [Table 1]. The Q value for each publication in CytoJournal as OA cytopathology journal as well as the traditional non-OA cytopathology journals was then calculated by above formula. Minitab software[16] was used for statistical analysis.

To compare CRs for CytoJournal as an OA cytopathology journal *versus* non-OA cytopathology journals, by using freely available data on the web, a few of these authors were also analyzed arbitrarily by 'Publish or Perish' software which uses 'Google scholar' data.[17,18]

RESULTS

A total of 28 authors were identified as per the criteria who published papers or meeting abstracts in both OA and non-OA journals. When meeting abstracts were excluded 25 authors were considered. Overall, a total of 314 publications in cytopathology journals during 2007-2011 were evaluated based on the data from web of science citation analysis site (Impact factor is calculated based on this data) [Table 2].[19-325] Some publications were attributed to more than one author included in the study. The data shown in red in Table 2 indicate publications as meeting abstracts. Because OA cytopathology journal and some non-OA cytopathology journals did not publish meeting abstracts on regular basis and this feature may

CytoJournal 2014, 11:10 http://www.cytojournal.com/content/11/1/10

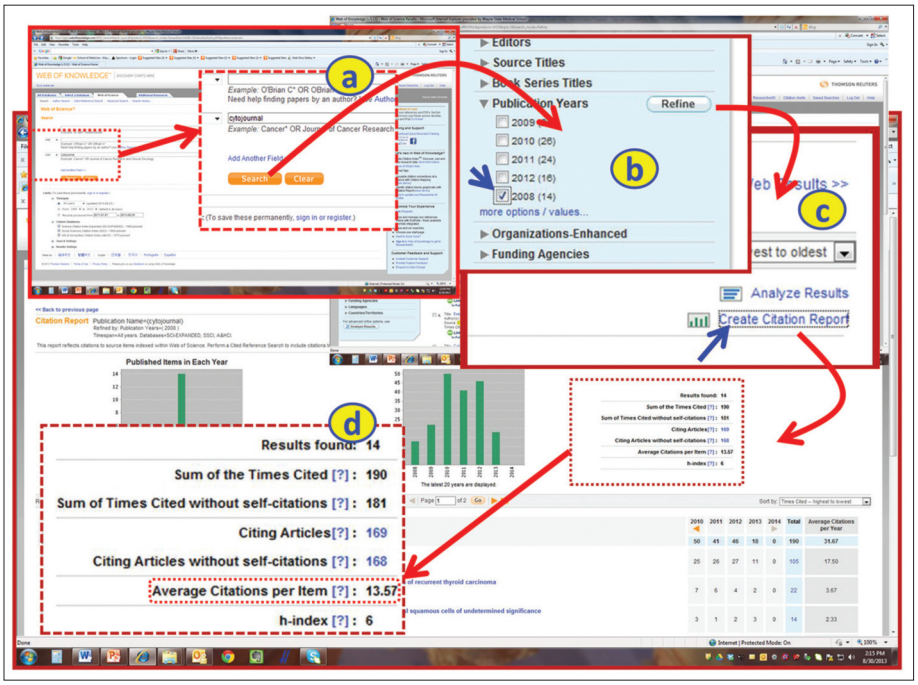


Figure 2: Use of 'Web of Sciences citation analysis tool' for finding the average number of citations per publication [C (Yr)] in a specific year for all the cytopathology journals under study. (a) Add the name of the journal; (b) Click 'publication years', choose the specific year of interest (2008); (c) Click 'Create Citation Report' link on the next screen; (d) Note the 'Average Citations per Item' C (Yr) for that journal for that year (2008) [Table 1]

Table 1. Average number of citations per publication in a specific year [C (Yr)] for various cytopathology journals

Year	*Annual averages for various Cytopathology journals*					*C (Yr)*
	CytoJournal	*Acta cytologica*	*Cancer cytopathology*	*Cytopathology*	*Diagnostic cytopathology*	
2007	NA*	1.02	4.87	5.44	5.99	4.330
2008	13.50	2.69	2.94	4.34	6.01	5.896
2009	3.35	1.90	2.82	3.62	3.63	3.064
2010	3.08	0.27	2.31	2.65	2.52	2.166
2011	2	2.15	3.94	1.85	1.65	2.318

* CytoJournal publications were indexed by ISI from 2008, so they were not indexed in 2007. C (Yr), Mean of annual averages of citations per publication for that year

potentially impact the final comparison, we analyzed the data in two ways: First on all the data including the meeting abstracts, and then repeating the analysis after excluding the meeting abstracts.

In the group in which meeting abstracts were included, the combined number of publications per author ranged from 4 to 41 with an average of 15.6 and a median of 15. The number of publications per author in CytoJournal ranged from 2 to 9 with an average of 3.1 and a median of 2. The number of publications per author in traditional non-OA journals ranged from 2 to 32 with an average of 12.5 and a median of 15.

In the group in which meeting abstracts were excluded, the combined number of publications per author ranged from 3 to 27 with an average of 11.6 and a median of 10. The number of publications per author in CytoJournal ranged from 2 to 9 with an average of 3.1 and a median of 2. The number of publications per author in traditional non-OA journals ranged from 1 to 25 with an average of 8.4 and a median of 7.

The citations per publication (CPP) and the time adjusted quotions (Q values) were calculated for CytoJournal as an OA journal *versus* the traditional non-OA cytopathology Journals with the meetings abstracts included [Table 3]. Overall, the averages of both CPP and Q values were higher for OA Cytopathology Journal (cytojournal) than the traditional non-OA journals. To confirm our hypothesis, paired t-tests were run on both data sets (CPP and Q values) using Minitab software.[16]

Table 2. Authors and citations (raw data)

Author name	Author# (See Table 3)	Open access journal number of citations reference number (T=Number of articles)						Non-open access journals number of citations reference number (T=Number of articles)					
		2007*	2008	2009	2010	2011	Average citations per article 2007-2011	2007	2008	2009	2010	2011	Average citations per article 2007-2011
Shipra Agarwal	1	N/A	- (T=0)	- (T=0)	- (T=0)	4[19], 2[20] (T=2)	6/2=3	2[21] (T=1)	- (T=0)	- (T=0)	0[22], 0[23], 0[24], 0[25] (T=4)	0[26], 0[27] (T=2)	2/7=0.286
Manon Auger	2	N/A	- (T=0)	9[28], 3[29] (T=2)	- (T=0)	- (T=0)	12/2=6	25[30], 0[31], 0[32], 0[33] (T=4)	0[34], 21[35], 6[36] (T=3)	0[37], 13[38], 0[39] (T=3)	1[40], 2[41], 2[42], 0[43], 0[44] (T=5)	0[45] (T=1)	70/16=4.38
R. M. Austin	3	N/A	- (T=0)	3[46], 4[47] (T=2)	7[48] (T=1)	-	14/3=4.67	0[49], 0[50], 8[51], 0[52], 24[53], 0[54] (T=6)	0[55], 0[56], 0[57], 0[58], 0[59], 0[60], 15[61] (T=7)	9[62], 0[63] (T=2)	1[64], 1[65], 1[66] (T=3)	1[67], 11[68], 5[69] (T=3)	76/21=3.62
Zubair W. Baloch	4	N/A	24[70], 110[71] (T=2)	- (T=0)	- (T=0)	21[72] (T=1)	155/3 51.67	12[73] (T=1)	211[74], 0[75] (T=2)	11[76], 53[77], 0[78] (T=3)	45[79], 14[80] (T=2)	- (T=0)	346/8=43.25
Oralia Barboza-Quintana	5	N/A	10[81] (T=1)	3[82] (T=1)	- (T=0)	- (T=0)	13/2=6.5	3[83] (T=1)	- (T=0)	- (T=0)	0[84] (T=1)	- (T=0)	3/2=1.5
Joel S. Bentz	6	N/A	- (T=0)	3[46] (T=1)	5[85] (T=1)	- (T=0)	8/2=4	0[86] (T=1)	1[87], 0[88], 0[89], 10[90] (T=4)	0[91], 0[92], 0[93], 0[94], 4[95] (T=5)	0[96], 8[97], 0[98] (T=3)	3[99] (T=1)	26/14=1.86
Fadi Brimo	7	N/A	- (T=0)	9[28], 3[29] (T=2)	- (T=0)	- (T=0)	12/2=6	25[30] (T=1)	4[100] (T=1)	13[38], 0[37] (T=2)	1[40], 2[41] (T=2)	- (T=0)	45/6=7.5
Krista L. D'Amore	8	N/A	- (T=0)	- (T=0)	6[101] (T=1)	3[102] (T=1)	9/2=4.5	- (T=0)	- (T=0)	0[103], 0[104] (T=2)	- (T=0)	- (T=0)	0/2=0
Gregory G. Freund	9	N/A	- (T=0)	3[46], 1[105] (T=2)	- (T=0)	- (T=0)	4/2=2	0[106] (T=1)	- (T=0)	0[107] (T=1)	0[108] (T=1)	- (T=0)	0/3=0
Raquel Garza-Guajardo	10	N/A	10[81] (T=1)	3[82] (T=1)	- (T=0)	- (T=0)	13/2=6.5	3[83] (T=1)	- (T=1)	- (T=0)	0[84] (T=1)	- (T=0)	3/2=1.5
Robert A. Goulart	11	N/A	6[109] (T=1)	17[110] (T=1)	4[111], 0[112] (T=2)	- (T=0)	27/4=6.75	5[113], 40[114], 0[115], 1[116], 0[117], 0[118], 0[119], 0[120], 0[121], 0[122], 0[123], 0[124] (T=12)	0[125], 0[126], 0[127] (T=3)	2[128], 0[129], 0[130], 1[131], 0[132], 0[133] T=6)	1[134], 0[135], 0[136] (T=3)	0[137] (T=1)	50/25=2
Prabodh K. Gupta	12	N/A	24[70], 2[138] (T=2)	- (T=0)	9[139] (T=1)	4[140] (T=1)	39/4=9.75	12[73], 3[141] (T=2)	3[142] (T=1)	6[143], 53[77], 0[78] T=3)	1[144] (T=1)	- (T=0)	78/7=11.14

Cont....

Table 2. Contd...

Author name	Author#	Open access journal number of citations reference number (T=Number of articles)						Non-open access journals number of citations reference number (T=Number of articles)					
		2007*	2008	2009	2010	2011	Average citations per article 2007-2011	2007	2008	2009	2010	2011	Average citations per article 2007-2011
Rana S. Hoda	14	N/A	14[171]	-	1[172]	-	15/2=7.5	2[173], 2[174], 29[175], 0[176]	0[177], 0[178]	1[179], 0[180], 0[181], 2[182]	1[183], 0[185], 0[186]	2[187], 0[188]	39/15=2.6
			(T=1)	(T=0)	(T=1)	(T=0)		(T=4)	(T=2)	(T=4)	(T=3)	(T=2)	
Maryanne Hornish	15	N/A	6[109]	17[110]	-	-	23/2=11.5	0[115], 0[117], 0[119]	0[125], 0[126], 0[127]	0[130]	0[136]	-	0/8=0
			(T=1)	(T=1)	(T=0)	(T=0)		(T=3)	T=3)	(T=1)	(T=1)	(T=0)	
Venkateswaran K. Iyer	16	N/A	-	2[145]	3[146]	4[19], 2[20]	11/4=2.75	3[188]	0[189]	-	0[22], 5[190], 1[191], 1[192], 0[24], 0[25], 0[193], 0[194], 1[195], 0[196]	0[26], 0[169], 0[197], 1[198], 0[167]	12/18=0.67
			(T=0)	(T=1)	(T=1)	(T=2)		(T=1)	(T=1)	(T=0)	(T=11)	(T=5)	
Dharshana N. Jhala	17	N/A	-	-	5[199]	0[200]	5/2=2.5	19[201], 0[202]	3[203], 17[204], 0[205], 0[206]	0[207], 0[208]	3[209]	0[210], 1[211], 0[212]	43/12=3.58
			(T=0)	(T=0)	(T=1)	(T=1)		(T=2)	(T=4)	(T=2)	(T=1)	(T=3)	
Nirag C. Jhala	18	N/A	-	-	5[199]	0[200]	5/2=2.5	19[201], 0[202]	3[203], 17[204], 0[205], 0[206]	0[207], 0[208]	-	0[211], 1[212], 0[213]	40/11=3.64
			(T=0)	(T=0)	(T=1)	(T=1)		(T=2)	(T=4)	(T=2)	(T=0)	(T=3)	
Walid Khalbuss	19	N/A	-	-	5[213], 2[214], 15[215]	1[216], 0[217], 1[218], 1[219], 1[220], 0[221]	26/9=2.89	1[222], 2[223], 3[224]	0[225], 0[226]	0[227], 0[228], 0[229]	4[230], 0[231], 0[232], 0[233], 0[234]	1[235], 1[236]	12/15=0.8
			(T=0)	(T=0)	(T=3)	(T=6)		(T=3)	(T=2)	(T=3)	(T=5)	(T=2)	
Kamal K. Khurana	20	N/A	7[237]	3[238]	-	-	10/2=5	0[239]	0[240]	0[241], 0[242]	0[243], 0[244]	-	0/6=0
			(T=1)	(T=1)	(T=0)	(T=0)		(T=1)	(T=1)	(T=2)	(T=2)	(T=0)	
Sandeep R. Mathur	21	N/A	-	2[145]	3[146]	-	5/2=2.5	3[188]	5[152], 8[151], 0[189]. 2[150]	4[158], 0[245]	5[190], 1[162], 0[246], 0[196], 0[194], 1[195], 0[25], 0[23]	0[197], 0[167], 0[27], 0[169]	29/19=1.53
			(T=0)	(T=1)	(T=1)	(T=0)		(T=1)	(T=4)	(T=2)	(T=8)	(T=4)	
Pam Michelow	22	N/A	-	4[247]	2[248]	-	6/2=3	0[249]	10[250]	0[251], 1[252], 2[253], 11[254], 1[255], 0[256]	0[257], 3[258], 0[259], 0[260], 0[261], 0[262]	3[263]	31/15=2.07
			(T=0)	(T=1)	(T=1)	(T=0)		(T=1)	(T=1)	(T=6)	(T=6)	(T=1)	

Cont....

Table 2. Contd...

Author name	Author#	Open access journal number of citations[reference number] (T=Number of articles)						Non-open access journals number of citations[reference number] (T=Number of articles)					
		2007*	2008	2009	2010	2011	Average citations per article 2007-2011	2007	2008	2009	2010	2011	Average citations per article 2007-2011
Sara E. Monaco	23	N/A	-	-	5[213], 2[214], 15[215]	1[216], 0[217], 1[218], 1[219], 1[220], 0[221]	26/9=2.89	-	3[264]	6[265], 0[227], 0[229], 1[266]	4[230], 0[231], 0[232], 0[233], 1[267]	1[235]	16/11=1.45
			(T=0)	(T=0)	(T=3)	(T=6)		(T=0)	(T=1)	(T=4)	(T=5)	(T=1)	
Liron Pantanowitz	24	N/A	6[109]	17[110]	4[111], 3[250]	1[217], 1[219], 1[220], 1[221], 0[222]	34/9=3.78	5[113], 40[114], 17[269], 0[115], 1[116], 0[270], 0[119], 0[120], 0[121], 0[271], 0[123], 1[272], 0[124]	4[273], 0[125], 0[126], 0[127]	2[128], 0[129], 0[130], 1[131], 0[256], 0[132], 0[133], 0[274]	3[258], 0[260], 1[134], 0[136]	1[237], 3[264], 0[137]	79/32=2.47
			(T=1)	(T=1)	(T=2)	(T=5)		(T=13)	(T=4)	(T=8)	(T=4)	(T=3)	
Bharat Rekhi	25	N/A	-	-	1[275]	1[276]	2/2=1	0[277], 2[278]	0[279], 5[280], 3[281], 1[282]	0[283]	0[284], 3[285], 4[286], 3[287], 1[288]	0[289], 0[290]	21/14=1.5
			(T=0)	(T=0)	(T=1)	(T=1)		(T=2)	(T=4)	(T=1)	(T=5)	(T=2)	
Husain A. Saleh	26	N/A	5[313], 6[314]	12[293]	-	-	23/3=7.67	2[294], 5[295]	0[296], 0[297], 0[298], 0[299]	0[300], 0[301], 0[302], 3[303], 2[304], 0[305], 8[306], 2[307], 7[308], 11[309]	2[310], 0[311], 0[312]	-	42/19=2.21
			(T=2)	(T=1)	(T=0)	(T=0)		(T=2)	(T=4)	(T=10)	(T=3)	(T=0)	
Torill Sauer	27	N/A	-	-	3[313], 6[314], 2[315]	-	11/3=3.67	4[316], 0[317], 0[318]	5[319], 2[320]	-	4[321], 0[322], 0[323], 13[324]	-	28/9=3.11
			(T=0)	(T=0)	(T=3)	(T=0)		(T=3)	(T=2)	(T=0)	(T=4)	(T=0)	
Michael J. Thrall	28	N/A	14[171]	1[325]	-	-	15/2=7.5	4[326], 0[327], 0[328]	5[329], 0[330], 0[178]	-	7[331], 0[332]	-	16/8=2
			(T=1)	(T=1)	(T=0)	(T=0)		(T=3)	(T=3)	(T=0)	(T=2)	(T=0)	

*CytoJournal indexing with ISI started from 2008 onwards, so the data for 2007 was not applicable- N/A

**Traditional non-OA cytopathology journals (Acta Cytologica, Cancer Cytopathology, Cytopathology, and Diagnostic Cytopathology), N/A: Not applicable

The data in red indicate publications as meeting abstracts.

CytoJournal 2014, 11:10 http://www.cytojournal.com/content/11/1/10

Table 3. Comparison of 'Citations per publication' and 'time adjusted citation quotients' (Q values) for CytoJournal as OA cytopathology journal *versus* non-OA cytopathology journals with meeting abstracts included [Figure 3]

Data with meeting abstracts								
Author#	*Author*		*Citation per article*			*Time adjusted citation quotient (Q)*		
	Last name	*First name, MI*	*OA*	*Non-OA*	*Difference*	*OA*	*Non-OA*	*Difference*
1	Agarwal	Shipra	4	0.286	3.71	1.726	0.066	1.66
2	Auger	Manon	6	4.38	1.62	1.958	1.085	0.873
3	Austin	R. M.	4.67	3.62	1.05	1.839	1.028	0.811
4	Baloch	Zubair W.	51.67	43.25	8.42	10.596	10.836	−0.240
5	Barboza-Quintana	Oralia	6.5	1.5	5	1.338	0.346	0.991
6	Bentz	Joel S.	4	1.86	2.14	1.644	0.583	1.061
7	Brimo	Fadi	6	7.5	−1.5	1.958	2.013	−0.055
8	D'Amore	Krista L.	4.5	0	4.5	2.032	0	2.032
9	Freund	Gregory G.	2	0	2	0.653	0	0.653
10	Garza-Guajardo	Raquel	6.5	1.5	5	1.338	0.346	0.991
11	Goulart	Robert A.	6.75	2	4.75	2.103	0.483	1.621
12	Gupta	Prabodh K.	9.75	11.14	−1.39	2.573	3.384	−0.812
13	Gupta	Ruchika	2.5	3.6	−1.1	1.019	1.318	−0.299
14	Hoda	Rana S.	7.5	2.6	4.9	1.418	0.662	0.756
15	Hornish	Maryanne	11.5	0	11.5	3.283	0	3.283
16	Iyer	Venkateswaran K.	2.75	0.67	2.08	1.157	0.268	0.889
17	Jhala	Dharshana N.	2.5	3.58	−1.08	1.154	0.8	0.354
18	Jhala	Nirag C.	2.5	3.64	−1.14	1.154	0.747	0.408
19	Khalbuss	Walid	2.89	0.8	2.09	1.320	0.273	1.047
20	Khurana	Kamal K.	5	0	5	1.083	0	1.083
21	Mathur	Sandeep R.	2.5	1.53	0.97	1.019	0.777	0.241
22	Michelow	Pam	3	2.07	0.93	1.114	0.618	0.496
23	Monaco	Sara E.	2.89	1.45	1.44	1.320	0.503	0.817
24	Pantanowitz	Liron	3.78	2.47	1.31	1.28	0.625	0.655
25	Rekhi	Bharat	1	1.5	−0.5	0.447	0.505	−0.058
26	Saleh	Husain A.	7.67	2.21	5.46	1.927	0.701	1.227
27	Sauer	Torill	3.67	3.11	0.56	1.693	1.107	0.586
28	Thrall	Michael J.	7.5	2	5.5	1.350	0.625	0.725

OA: Open access

For CPP, the following methodology was used. To make sure valid paired t-tests could be used, an Anderson-Darling normality test was run on the differences between CPP for CytoJournal as OA cytopathology journal and for the traditional non-OA journals. The normality test was passed and the paired *t*-test was run. A 95% confidence interval for the mean difference between [CytoJournal citations per publication] – [traditional non-OA citations per publication] was generated with the interval being (1.406, 3.824) with a *P* value of 0.001.

The same methodology was used to analyze the Q values. The 95% confidence interval for the mean difference between [CytoJournal Q value] – [traditional non-OA Q value] was (0.473, 1.084) with a *P* value of approximately 0.0001. The findings confirmed the hypothesis that the publications in OA cytopathology journal generated improved citation rate (CR) with higher CPP and Q values with statistically significant difference as compared to the publications in the traditional non-OA cytopathology journals [Figure 3a and b].

With the second set of data, without the inclusion of meeting abstracts [Table 4], the same paired *t*-tests were run, with the null and alternative hypothesis similar to that for the first set of data. CPP with Open Access *versus* Non-Open Access showed a 95% confidence interval

CytoJournal 2014, 11:10 http://www.cytojournal.com/content/11/1/10

Table 4. Comparison of 'Citations per publication' and 'time adjusted citation quotients' (Q values) for CytoJournal as OA cytopathology journal *versus* non-OA cytopathology journals without meeting abstracts [Figure 3c and d]

Data without meeting abstracts								
Author#	*Author*		*Citation per article*			*Time adjusted citation quotient (Q)*		
	Last name	*First name, MI*	*OA*	*Non-OA*	*Difference*	*OA*	*Non-OA*	*Difference*
1	Agarwal	Shipra	4	0.4	3.71	1.726	0.092	1.633
2	Auger	Manon	6	7	1.62	1.958	1.690	0.268
3	Austin	R. M.	4.67	7.5	1.05	1.839	2.113	−0.274
4	Baloch	Zubair W.	51.67	57.67	8.42	10.596	14.448	−3.852
5	Barboza-Quintana	Oralia	6.5	3	5	1.338	0.693	0.645
6	Bentz	Joel S.	4	4.33	2.14	1.644	1.36	0.284
7	Brimo	Fadi	6	7.5	−1.5	1.958	2.013	−0.055
8	D'Amore	Krista L.	4.5	-	4.5	2.032	-	-
9	Freund	Gregory G.	2	-	2	0.653	-	-
10	Garza-Guajardo	Raquel	6.5	3	5	1.338	0.693	0.645
11	Goulart	Robert A.	6.75	4.9	4.75	2.103	1.174	0.929
12	Gupta	Prabodh K.	9.75	13	−1.39	2.573	3.948	−1.376
13	Gupta	Ruchika	2.5	3.6	−1.1	1.019	1.318	−0.299
14	Hoda	Rana S.	7.5	4.33	4.9	1.418	1.103	0.315
15	Hornish	Maryanne	11.5	0	11.5	3.283	0	3.283
16	Iyer	Venkateswaran K.	2.75	0.86	2.08	1.157	0.344	0.812
17	Jhala	Dharshana N.	2.5	5.38	−1.08	1.154	1.2	−0.045
18	Jhala	Nirag C.	2.5	5.71	−1.14	1.154	1.173	−0.019
19	Khalbuss	Walid	2.89	2	2.09	1.320	0.455	0.865
20	Khurana	Kamal K.	5	-	5	1.083	-	-
21	Mathur	Sandeep R.	2.5	1.7	0.97	1.019	0.457	0.562
22	Michelow	Pam	3	3.88	0.93	1.114	1.159	−0.044
23	Monaco	Sara E.	2.89	3	1.44	1.320	1.107	0.214
24	Pantanowitz	Liron	3.78	5.2	1.31	1.28	1.312	−0.032
25	Rekhi	Bharat	1	1.75	−0.5	0.447	0.589	−0.142
26	Saleh	Husain A.	7.67	3.23	5.46	1.927	1.024	0.904
27	Sauer	Torill	3.67	5.6	0.56	1.693	1.992	−0.299
28	Thrall	Michael J.	7.5	5.33	5.5	1.350	1.669	−0.317

OA: Open access

of (-1.038, 1.848) with a *P* value of 0.568. For the *Q* value, a 95% CI interval of (-0.309, 0.677) with a *P* value of 0.448. This analysis showed that CPP and *Q* values were also higher when meeting abstracts were taken out of the data set, but the difference was statistically insignificant [Figure 3c and d].

The results with 'Publish or Perish' software using 'Google scholar' data[17,18] also showed comparable pattern with higher citation rates for the publications in OA cytopathology journal than the traditional non-OA cytopathology journals. This data was unfiltered and included citations by all sorts of publication types.

DISCUSSION

A citation is defined as "a quoting of an authoritative source for substantiation".[11] As almost all authors would like to be seen as "authoritative source" and their work as "substantial," citations are a crucial metric in determining the success of both authors and journals. They are used in calculating such relied upon publication metrics in journology as impact factor and H-factor, which are used critically by many in evaluating the worthiness of a journal or an author[12]. Citations are indexed in several large databases on the World Wide Web, the largest of which is Thomson Scientific's Web of Science® which currently

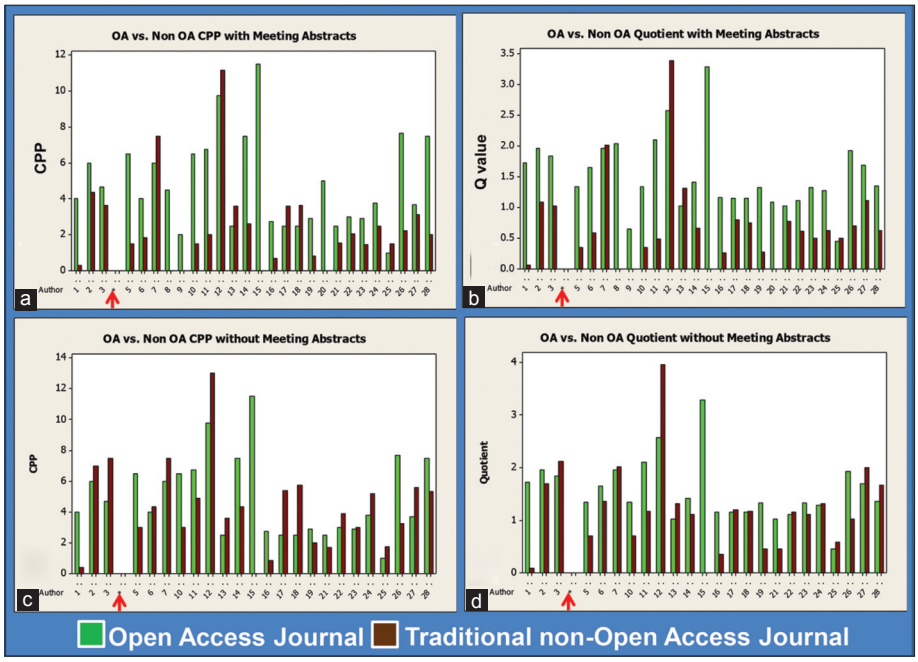


Figure 3: Comparison of citations per publication (CPP) and time adjusted citation quotient (Q value) for OA cytopathology journal (a and c) *versus* non-OA cytopathology journals (b and d) with (a and b) and without (c and d) inclusion of meeting abstracts in the analysis. (a and b) The publications in OA cytopathology journal generated relatively improved citation rate with higher CPP and Q values as compared to the publications in the traditional non-OA cytopathology journals if all publications were included in the analysis. c and d. Although the CPP and Q values continued to be higher for OA cytopathology journal when the meeting abstracts were taken out of the analysis, the difference was statistically insignificant
[Red Arrows : Author ↑#4 is not included in these graphs. This author (also with higher CPP and Q value for OA journal (CytoJournal) as compared to non-OA cytopathology journals with meeting abstracts included) would have decreased the size of other bars and skewed the graph. For the data details on this author, please see Tables 2 and3]

contains more than 40 million bibliographic records and 550 million citations from the past 100 years. We conducted the current study using the same data which is also used to calculate impact factor (IF)[15].

Since the Budapest declaration, several studies have examined the impact of the Open Access model of publication on the rates of citation for publications/authors. In 2001 in *Nature*, Steve Lawrence was the first to publish that free online availability of a publication greatly increased its impact on the scientific community. He analyzed CRs for 119,924 conference articles in computer science and related disciplines and excluded self-citations. He demonstrated the relationship of online availability as a function of the number of citations per article and the year of publication. The results were quite dramatic, showing a direct relationship between the factors, specifically a 157% increase in citations for articles that were free online compared to those which were not available free online.[6]

Our study showed that, in the field of cytopathology, authors who published in both OA cytopathology journal and traditional non-OA journals, accrued a relatively higher rate of citation per publication and time adjusted citation quotient for their publications in the OA journal with statistical difference ($P < 0.01$) [Table 3 and Figure 3a, b]. However, if meeting abstracts were excluded from the analysis, increase in CPP and Q values was statistically insignificant [Table 4 and Figure 3c, d] This data supports the prior published conclusions that the OA model is a legitimate platform for publication with comparable or even higher citation rates to traditional journals.

Kurtz *et al*. studied the increased CRs in OA publications but noted a possibility of selection bias. The suggested bias was that the most prominent authors are more likely to make their publications available in an OA model, artificially increasing the rate of citations.[7] As previously mentioned, cytopathology is a uniquely concise field, in which there are very limited numbers of Open Access journals, *CytoJournal* being one, but several traditional non-OA cytopathology journals. Because of this there are some authors who have publications in both OA and traditional journals, making comparison of the CRs possible while eliminating the above mentioned selection bias suggested by Kurtz *et al*. as a confounding factor.[7]

Another type of variable is the 'early view bias,' wherein a publication that is posted on an OA platform before final

publication will have more time to accrue citations and thus skew the data towards citations in OA.[10] The OA journal used in our project (*CytoJournal*) does not post in pre-publication form, and thus our study was controlled against this type of bias.

Kurtz *et al*. also discussed another type of bias for which we were not able to control and that might influence the CRs of OA publications. This is a different type of selection bias, wherein the individual author selects their most important (and thus citable) publications for OA.[7] This type of bias is extremely subjective and difficult to prove or refute in a controlled study. However, it is important to highlight that the quality of the published material is generally the primary factor responsible for its overall impact and CR. Traditionally, the quality of published material is predominantly facilitated by the peer-review component of the editorial activity of the peer-reviewed journals. Thus, it is critical to understand and consider the quality of the peer-review process of any scientific journal irrespective of its OA status.

Some concerns have been raised in recent years regarding sprawling, low-quality journals (including some OA journals) which may have high turnover of many publications that have little relevance or contribution to today's scientific discoveries. This is an issue not applicable only to OA, but also to any journal irrespective of its status as an OA journal or traditional non-OA journal. The very core of any reputable scientific journal, with a quality-minded editorial board, is the high standard of the publications received and accepted after a vigorous peer review process with proactive participation by peer-reviewers.

We also evaluated, using a small cohort, the citation pattern of OA *versus* non-OA cytopathology publications with 'Publish or Perish,' software which uses 'Google Scholar' data on open, freely available platform.[17,18] As compared to the Web of Science, the inclusion of citations by Goggle Scholar is wider and includes many journals and other platforms which may cite the original work with a relatively liberal approach. The initial analysis with 'Publish or Perish' based on 'Google Scholar' data showed comparable results with relatively higher rates of citation for *CytoJournal* practicing OA publication model as compared to traditional non-OA cytopathology journals (without statistical significance).

In summary, this study demonstrated that in the small subspecialty field of cytopathology, authors who published in both an Open Access journal (*CytoJournal)* and at least one traditional journal (*Acta Cytologica*, *Cancer Cytopathology*, *Cytopathology*, and/or *Diagnostic Cytopathology)* accrued a comparable or slightly higher CR for OA publications as compared to the traditional non-OA cytopathology journals over a five year period from 2007-2011 [Figure 3].

ACKNOWLEDGMENTS

We thank Anushree Shidham for the copy-editing support. We thank Sandra Martin, Director of the Shiffman Medical Library and Learning Resources Centers, Wayne State University School of Medicine; Distinguished Member of the Academy of Health Information Professionals for her guidance to harvest the raw data on citations for all the authors in this study using 'Web of Sciences Database'.

Abbreviations (in alphabetical order) used:

C, average number of CPP for a particular journal; C(Yr), C for a specific year; CPP, Citations Per Publication; CR, Citation Rate; IF, Impact Factor; IP, Intellectual Property; N/A, not applicable; OA, Open Access; Q value, time adjusted citation quotient; Yr, year.

COMPETING INTEREST STATEMENT BY ALL AUTHORS

No competing interest to declare by any of the authors.

AUTHORSHIP STATEMENT BY ALL AUTHORS

All authors declare that we qualify for authorship as defined by ICMJE http://www.icmje.org/#author.

ETHICS STATEMENT BY ALL AUTHORS

This study did not require approval from Institutional Review Board (IRB) (or its equivalent) as it is based on analysis of published data on web.

REFERENCES

1. Timeline of the open access movement. Available from: http://legacy.earlham.edu/~peters/fos/timeline.htm. [Last accessed on 2014 Feb 24].
2. Open access explained!-PHD animation. Available from: http://www.youtube.com/watch?v=L5rVH1KGBCY. [Last accessed on 2014 Feb 24].
3. Science in the Open, The online home of Cameron Neylon, 14 February 2012. On the 10th Anniversary of the Budapest Declaration. Available from: http://www.cameronneylon.net/blog/on-the-10th-anniversary-of-the-budapest-declaration/. (Archived by WebCite® at http://www.webcitation.org/6ISSTKfrP). [Last accessed on 2013 Aug 25].
4. Berlin declaration on open access to knowledge in the sciences and humanities. Available from: http://www.freeknowledge.eu/documents/reference/berlin. [Last accessed on 2014 Feb 24].
5. Testa J, McVeigh ME. The impact of open access journals: A citation study from Thomson ISI. Available from: http://www.lib.uiowa.edu/scholarly/documents/ISI_impact-oa-journals.pdf [Last accessed on 2013 Aug 25].
6. Lawrence S. Free online availability substantially increases a paper's impact. Nature 2001;411:521.
7. Kurtz MJ, Eichhorn G, Accomazzi A, Grant C, Demleitner M, Henneken E,

et al. The effect of use and access on citations. Inf Process Manage 2005;41. Available from: https://www.cfa.harvard.edu/~kurtz/IPM-abstract.html.
8. Harnad S, Brody T. Comparing the impact of open access (OA) vs. Non-OA articles in the same journals. D-Lib Mag 2004;10. Available from: http://www.dlib.org/dlib/june04/harnad/06harnad.html.
9. Gargouri Y, Hajjem C, Larivière V, Gingras Y, Carr L, Brody T, *et al*. Self-selected or mandated, open access increases citation impact for higher quality research. PLoS One 2010;5:e13636.
10. Craig ID, Plume AM, McVeigh ME, Pringle J, Amin M. Do open access articles have greater citation impact? A critical review of the literature. J Informetr 2007;1:239-48.
11. The free dictionary. Available from: http://www.thefreedictionary.com. [Last accessed on 2013 Aug 28].
12. Shidham VB, Sandweiss L, Atkinson BF. First CytoJournal peer-reviewer's retreat in 2006-Open access, peer-review, and impact factor. Cytojournal 2006;3:5.
13. The creative commons attribution license. Available from: http://www.creativecommons.org/licenses/by/2.0/. [Last accessed on 2014 Feb 24].
14. Shidham VB, Pitman MB, Demay RM. How to write an article: Preparing a publishable manuscript! Cytojournal 2012;9:1.
15. Web of Science: The world's most trusted citation index covering the leading scholarly literature. Available from: http://www.thomsonreuters.com/web-of-science/. [Last accessed on 2013 Aug 28].
16. Minitab (Version 16) [Software], 2013. Available from: http://www.minitab.com/en-US/products/minitab/default.aspx. [Last accessed on 2013 Aug 28].
17. Harzing AW. Publish or perish, 2007. Available from: http://www.harzing.com/pop.htm. [Last accessed on 2013 Aug 29].
18. Google Scholar. Available from: http://www.scholar.google.com/. [Last accessed on 2013 Aug 29].
19. Arora R, Agarwal S, Mathur SR, Verma K, Iyer VK, Aron M. Utility of a limited panel of calretinin and Ber-EP4 immunocytochemistry on cytospin preparation of serous effusions: A cost-effective measure in resource-limited settings. Cytojournal 2011;8:14.
20. Chitragar S, Agarwal S, Iyer VK, Mathur SR, Karak AK, Chharchhodawala T, *et al*. Cyto-morphological features of extramedullary acute megakaryoblastic leukemia on fine needle aspiration and cerebrospinal fluid cytology: A case report. Cytojournal 2011;8:17.
21. Sharma M, Agarwal S, Wadhwa N, Mishra K, Gadre DJ. Spectrum of cytomorphology of tuberculous lymphadenitis and changes during anti-tubercular treatment. Cytopathology 2007;18:180-3.
22. Nayak A, Iyer VK, Agarwal S, Agarwala S. Fine needle aspiration cytology of fetal rhabdomyomatous and teratoid Wilms tumor. Acta Cytol 2010;54:563-8.
23. Agarwal S, Mathur SR, Ray R, Sharma SC, Sinha P. Cytopathological diagnosis of hyalinizing trabecular tumour, a rare thyroid neoplasm. Cytopathology 2010;21:133-4.
24. Iyer V, Nayak A, Agarwal S, Agarwala S. Cytomorphologic spectrum of pediatric renal tumors on aspiration cytology: A study of 120 cases. Acta Cytol 2010;54:416.
25. Mathur SR, Arora R, Agarwal S, Verrna K, Iyer VK, Aron M. diagnostic utility of a limited panel of markers in distinguishing reactive mesothelial proliferations from adenocarcinomas. Acta Cytol 2010;54:471.
26. Agarwal S, Gupta R, Iyer VK, Mathur SR, Ray R. Cytopathological diagnosis of alveolar soft part sarcoma, a rare soft tissue neoplasm. Cytopathology 2011;22:318-22.
27. Agarwal S, Mathur SR, Ray R, Sharma SC, Sinha P. Cytopathological diagnosis of hyalinising trabecular tumour, a rare thyroid neoplasm. Cytopathology 2011;22:65-6.
28. Brimo F, Popradi G, Michel RP, Auger M. Primary effusion lymphoma involving three body cavities. Cytojournal 2009;6:21.
29. Renshaw AA, Brimo F, Auger M. Surrogate indicators of sensitivity in gynecologic cytology: Can they be used to improve the measurement of sensitivity in the laboratory? Cytojournal 2009;6:19.
30. Brimo F, Michel RP, Khetani K, Auger M. Primary effusion lymphoma: A series of 4 cases and review of the literature with emphasis on cytomorphologic and immunocytochemical differential diagnosis. Cancer 2007;111:224-33.
31. Auger M. A duo of diagnostic challenges in fine needle aspirations of the thyroid: The suspicious for follicular neoplasm" and "suspicious for papillary carcinoma categories. Acta Cytol 2007;51:274.
32. Alkuwari E, Khetan K, Dendukuri N, Wang L, Auger M. Quantitative assessment of nuclear grooves in neoplastic and nonneoplastic lesions in fine needle aspiration samples of the thyroid: A retrospective cytohistologic study of 94 cases. Acta Cytol 2007;51:284.
33. Auger M, Aikuwari E. Accuracy of fine needle aspiration cytology of axillary lymph nodes-A study of 132 cases with cyto-histological correlation. Cancer Cytopathol 2007;111:414.
34. Alkuwari E, Auger M. Accuracy of fine-needle aspiration cytology of axillary lymph nodes in breast cancer patients: A study of 115 cases with cytologic-histologic correlation. Cancer 2008;114:89-93.
35. Deschenes M, Renshaw AA, Auger M. Measuring the significance of workload on performance of cytotechnologists in gynecologic cytology: A study using rapid prescreening. Cancer 2008;114:149-54.
36. Deschênes M, Michel RP, Tabah R, Auger M. Fine-needle aspiration cytology of Castleman disease: Case report with review of the literature. Diagn Cytopathol 2008;36:904-8.
37. Brimo F, Ouad L, Brodeur J, Charbonneau M, Auger M. Unusual microbial organisms seen in two cervical smears. Diagn Cytopathol 2009;37:836-8.
38. Brimo F, Renshaw AA, Deschenes M, Charbonneau M, Auger M. Improvement in the routine screening performance of cytotechnologists over time: A study using rapid prescreening. Cancer 2009;117:311-7.
39. Moriarty AT, Laucirica R, Auger M, Souers RJ, Chmara BA, Wilbur DC. Granulomatous inflammation: An underestimated cause of false positive diagnoses in lung fine needle aspirates observations from the college of American pathologists non gynecologic cytopathology (NGC) interlaboratory comparison program. Cancer Cytopathol 2009;117:350.
40. Kushner YB, Brimo F, Schwartzman K, Auger M. A rare case of pulmonary cryptococcal inflammatory myofibroblastic tumor diagnosed by fine needle aspiration cytology. Diagn Cytopathol 2010;38:447-51.
41. Orellana ME, Brimo F, Auger M, Galic J, Deschenes J, Burnier MN. Cytopathological diagnosis of adult retinoblastoma in a vitrectomy specimen. Diagn Cytopathol 2010;38:59-64.
42. Renshaw AA, Auger M, Birdsong G, Cibas ES, Henry M, Hughes JH, *et al*. ASC/SIL ratio for cytotechnologists: A survey of its utility in clinical practice. Diagn Cytopathol 2010;38:180-3.
43. Auger M, Vielh P. FNAC of the breast: The (cyto) pathologist input. Acta Cytol 2010;54:371-2.
44. Schwartz M, Laucirica R, Booth C, Auger M, Thomas R, Thomas N, *et al*. Cytology of spontaneous nipple discharge: Is it worth it? Performance of nipple discharge preparations in the college of American pathologists inter-laboratory comparison program in non-gynecologic cytology. Cancer Cytopathol 2010;118:317-8.
45. Auger M. Rapid prescreening in gynecologic cytology: A more efficient quality assurance method. Cancer Cytopathol 2011;119:357-60.
46. Austin RM, Benstein B, Bentz J, Bigner S, Freund GG, Rocco GL, *et al*. Market survey predictions on the future of US Pap testing. Cytojournal 2009;6:17.
47. Austin RM, Zhao C. Test group biases and ethical concerns mar New England Journal of Medicine articles promoting HPV screening for cervical cancer in rural India. Cytojournal 2009;6:12.
48. Al-Abbadi MA, Bloom LI, Fatheree LA, Haack LA, Minkowitz G, Wilbur DC, *et al*. Adequate reimbursement is crucial to support cost-effective rapid on-site cytopathology evaluations. Cytojournal 2010;7:22.
49. Bandyopadhyay S, Austin M, Zhao C. Hybrid capture 2 hrHPV DNA detection in ThinPrep Pap test vials is a very useful ancillary test in women with atypical squamous cells, cannot exclude HSIL (ASC-H). Cancer Cytopathol 2007;111:379-80.
50. Flanangan MB, Dabbs DJ, Mauser N, White S, Austin RM, Chivukula M. Replacement of conventional Pap smears (CPS) with liquid based cytology (LBC) and imaged-LBC increases detection of abnormals. Cancer Cytopathol 2007;111:387-8.
51. Kapali M, Agaram NP, Dabbs D, Kanbour A, White S, Austin RM. Routine endometrial sampling of asymptomatic premenopausal women shedding normal endometrial cells in Papanicolaou tests is not cost effective. Cancer 2007;111:26-33.
52. O'Connor SM, Austin RM, Carter G, White S, Dabbs DJ, Chivukula M. HPV triage of ASC-H with follow-up cervical Intraepithelial neoplasia 3 (CIN 3) lesions is more efficient than routine colposcopic referral. Cancer Cytopathology. 2007;111:375.
53. Zhao C, Elishaev E, Yuan KH, Yu J, Austin RM. Very low human Papillomavirus

DNA prevalence in mature women with negative computer-imaged liquid-based Pap tests. Cancer 2007;111:292-7.
54. Austin RM, McCoy DR. The confused pathology expert: The ongoing challenge of monitoring physician expert witness testimony. Diagn Cytopathol 2007;35:749-55.
55. Austin RM, Felix JC, Alonzo TA. Improved diagnostic reproducibility with the MonoPrep (R) Pap test. Cancer Cytopathol 2008;114:387.
56. Austin RM, Felix JC, Alonzo TA. Improvement in specimen adequacy using the MonoPrep Pap test system. Cancer Cytopathol 2008;114:386-7.
57. Austin RM, Onisko A, Druzdzel MJ. The Pittsburgh Cervical Cancer Screening Model (PCCSM). Cancer Cytopathol 2008;114:345.
58. Kanbour-Shakir A, Onisko A, Austin M. High Risk Hpv test results preceding over 500 cases of biopsy proven high grade cervical squamous dysplasia (Cin 2/3). Cancer Cytopathol 2008;114:345-6.
59. Zhao C, Austin RM. Adjunctive high-risk human papillomavirus DNA testing is a useful option for disease risk assessment in patients with negative Papanicolaou tests without an endocervical/transformation zone sample. Cancer 2008;114:242-8.
60. Zhao CQ, Austin RM. Detection rates for high risk HPV DNA in women 50 and older with negative and abnormal pap test results. Cancer Cytopathol 2008;114:366-7.
61. Zhao CQ, Austin RM. High risk HPV DNA detection rates in over 26,000 cytology negative imaged liquid-based pap test samples. Cancer Cytopathol 2008;114:369-70.
62. Zhao C, Austin RM, Pan J, Barr N, Martin SE, Raza A, *et al*. Clinical significance of atypical glandular cells in conventional pap smears in a large, high-risk U.S. west coast minority population. Acta Cytol 2009;53:153-9.
63. Zhao CQ, Kalposi-Novak P, Austin RM. histological follow-up findings in adolescents with HSIL cytology results. Cancer Cytopathol 2009;117:383-4.
64. Austin RM. Computer-assisted Papanicolaou imaging: Another valuable tool in the challenge of Papanicolaou test screening for glandular neoplasia. Cancer Cytopathol 2010;118:65-7.
65. Chivukula M, Austin M, Matsko J, Duwe A, Freidman T, Mauser N, *et al*. Use of dual-stain for P16 and Ki-67 in the interpretation of abnormal pap cytology results: A prospective study. Cancer Cytopathol 2010;118:333-4.
66. Austin RM. Exhortations to abandon the Pap test as a routine initial cervical screening test are still premature and carry significant risks. Diagn Cytopathol 2010;38:783-7.
67. Heider A, Austin RM, Zhao C. HPV test results stratify risk for histopathologic follow-up findings of high-grade cervical intra-epithelial neoplasia in women with low-grade squamous intra-epithelial lesion Pap results. Acta Cytol 2011;55:48-53.
68. Gao FF, Austin RM, Zhao C. Histopathologic follow-up and human papillomavirus DNA test results in 290 patients with high-grade squamous intraepithelial lesion Papanicolaou test results. Cancer Cytopathol 2011;119:377-86.
69. Gao FF, Khalbuss WE, Austin RM, Monaco SE. Cytomorphology of crystal storing histiocytosis in the breast associated with lymphoma: A case report. Acta Cytol 2011;55:302-6.
70. Baloch ZW, Barroeta JE, Walsh J, Gupta PK, Livolsi VA, Langer JE, *et al*. Utility of thyroglobulin measurement in fine-needle aspiration biopsy specimens of lymph nodes in the diagnosis of recurrent thyroid carcinoma. Cytojournal 2008;5:1.
71. Baloch ZW, Cibas ES, Clark DP, Layfield LJ, Ljung BM, Pitman MB, *et al*. The National Cancer Institute Thyroid fine needle aspiration state of the science conference: A summation. Cytojournal 2008;5.
72. Griffin AC, Schwartz LE, Baloch ZW. Utility of on-site evaluation of endobronchial ultrasound-guided transbronchial needle aspiration specimens. Cytojournal 2011;8:20.
73. Deveci MS, Deveci G, LiVolsi VA, Gupta PK, Baloch ZW. Concordance between thyroid nodule sizes measured by ultrasound and gross pathology examination: Effect on patient management. Diagn Cytopathol 2007;35:579-83.
74. Baloch ZW, LiVolsi VA, Asa SL, Rosai J, Merino MJ, Randolph G, *et al*. Diagnostic terminology and morphologic criteria for cytologic diagnosis of thyroid lesions: A synopsis of the National Cancer Institute Thyroid Fine-Needle Aspiration State of the Science Conference. Diagn Cytopathol 2008;36:425-37.
75. Khayyata S, Barroeta JE, Livolsi VA, Baloch ZW. Papillary hyperplastic nodule: Pitfall in the cytopathologic diagnosis of papillary thyroid carcinoma. Cancer Cytopathol 2008;114:441.
76. Bongiovanni M, Bloom L, Krane JF, Baloch ZW, Powers CN, Hintermann S, *et al*. Cytomorphologic features of poorly differentiated thyroid carcinoma: A multi-institutional analysis of 40 cases. Cancer 2009;117:185-94.
77. Khayyata S, Yun S, Pasha T, Jian B, McGrath C, Yu G, *et al*. Value of P63 and CK5/6 in distinguishing squamous cell carcinoma from adenocarcinoma in lung fine-needle aspiration specimens. Diagn Cytopathol 2009;37:178-83.
78. Baloch ZW, Pasha T, Wong L, Shiina N, Zhang P, Tomaszewski J, *et al.* ProEx C expression in urothelial carcinoma: A tissue microarray and cytology study. Cancer Cytopathol 2009;117:370.
79. Faquin WC, Baloch ZW. Fine-needle aspiration of follicular patterned lesions of the thyroid: Diagnosis, management, and follow-up according to National Cancer Institute (NCI) recommendations. Diagn Cytopathol 2010;38:731-9.
80. Layfield LJ, Cibas ES, Baloch Z. Thyroid fine needle aspiration cytology: A review of the National Cancer Institute state of the science symposium. Cytopathology 2010;21:75-85.
81. Ponce-Camacho MA, Diaz de Leon-Medina R, Miranda-Maldonado I, Garza-Guajardo R, Hernandez-Salazar J, Barboza-Quintana O. A 5-year-old girl with a congenital ganglioneuroma diagnosed by fine needle aspiration biopsy: A case report. Cytojournal 2008;5:5.
82. Gomez-Macías GS, Garza-Guajardo R, Segura-Luna J, Barboza-Quintana O. Inadequate fine needle aspiration biopsy samples: Pathologists *versus* other specialists. Cytojournal 2009;6:9.
83. Barboza-Quintana O, Garza-Guajardo R, Assad-Morel C, Méndez-Olvera N. Pseudomycetoma for microsporum canis: Report of a case diagnosed by fine needle aspiration biopsy. Acta Cytol 2007;51:424-8.
84. Barboza-Quintana O, Alvarado-Bernal YL, Flores-Gutiérrez JP, Ancer-Rodríguez J, Garza-Guajardo R. Diagnosis of carcinosarcoma metastatic to the umbilicus by fine needle aspiration biopsy: A case report. Acta Cytol 2010;54:819-22.
85. Smith GD, Riding M, Oswald K, Bentz JS. Integrating a FISH imaging system into the cytology laboratory. Cytojournal 2010;7:3.
86. Smith GD, Willmore-Payne C, Chadwick BE, Bentz JS. Real time PCR and high resolution melting analysis platforms to detect EGFR mutations and predict response to tyrosine kinase inhibitor (TKI) therapy in NSCLC. Cancer Cytopathol 2007;111:409.
87. Layfield LJ, Skripenova S, Bentz J, Smock C. Cytologic fine needle aspiration findings by vegetant intravascular hemangioendothelioma. Acta Cytol 2008;52:273-5.
88. Collins BT, Layfield LJ, Gopez EV, Bentz JS. utilization of the indeterminate/atypia of undetermined significance category in thyroid aspiration cytology. How often is it used. Cancer Cytopathol 2008;114:440.
89. Smith GD, Bentz JS. Fishing to detect urinary and other cancers: Do imaging systems help? Cancer Cytopathol 2008;114:361.
90. Layfield LJ, Bentz J. Giant-cell containing neoplasms of the pancreas: An aspiration cytology study. Diagn Cytopathol 2008;36:238-44.
91. Ducatman BS, Bentz JS, Moriarty AT, Souers RJ, Fatheree LA, Booth CN, *et al*. Performance in gynecologic cytology proficiency testing: What have we learned? Cancer Cytopathol 2009;117:352-3.
92. Laucirica R, Bentz JS, Clayton AC, Souers RS, Chmara BA, Moriarty AT. Performance characteristics of mucinous (Colloid) carcinoma of the breast in fine needles aspirates: Observations from the college of American pathologists interlaboratory comparison program in nongynecologic cytopathology (CAP NGC). Cancer Cytopathol 2009;117:359.
93. Smith GD, Collins BT, Bentz JS. Bioview duet-Assisted fluorescence *in situ* hybridization for gastrointestinal malignancy. Cancer Cytopathol 2009;117:367-8.
94. Teman CJ, Wilson AR, Collins BT, Bentz JS. Cytologic detection of endometrial adenocarcinoma: Correlation with adenocarcinoma grade and papanicolaou preparation type. Cancer Cytopathol 2009;117:379-80.
95. Agarwal AM, Bentz JS, Hungerford R, Abraham D. Parathyroid fine-needle aspiration cytology in the evaluation of parathyroid adenoma: Cytologic findings from 53 patients. Diagn Cytopathol 2009;37:407-10.
96. Fischer A, Clayton A, Bentz J, Wasserman P, Henry M, Souers R, *et al*. Performance of direct smears compared to liquid-based preparations of thyroid FNA samples: Analysis of 47,076 responses in the college of American pathologists interlaboratory comparison program in non-gynecologic cytopathology. Cancer Cytopathol 2010;118:307-8.
97. Smith GD, Bentz JS. "FISHing" to detect urinary and other cancers: Validation of an imaging system to aid in interpretation. Cancer Cytopathol 2010;118:56-64.

98. Smith GD, Chadwick BE, Adler DG, Bentz JS. Comparison of ThinPrep UroCyte and cytospin slide preparations for gastrointestinal specimens: Evaluation and retrospective performance review. Diagn Cytopathol 2010;38:902-12.
99. Smith GD, Zhou L, Rowe LR, Jarboe EA, Collins BT, Bentz JS, *et al*. Allele-specific PCR with competitive probe blocking for sensitive and specific detection of BRAF V600E in thyroid fine-needle aspiration specimens. Acta Cytol 2011;55:576-83.
100. Brimo F, Nahal A. Malignant epithelioid hemangioendothelioma with spindle phenotype: Report of an unusual case diagnosed by fine needle aspiration cytology. Acta Cytol 2008;52:721-4.
101. Shidham VB, Varsegi G, D'Amore K. Two-color immunocytochemistry for evaluation of effusion fluids for metastatic adenocarcinoma. Cytojournal 2010;7:1.
102. Shidham VB, Mehrotra R, Varsegi G, D'Amore KL, Hunt B, Narayan R. p16 immunocytochemistry on cell blocks as an adjunct to cervical cytology: Potential reflex testing on specially prepared cell blocks from residual liquid-based cytology specimens. Cytojournal 2011;8:1.
103. D'Amore KL, Basir Z. Anal screening cytology and histomorphologic correlation: A Single center experience. Cancer Cytopathol 2009;117:385-6.
104. Shidham VB, D'Amore K, Varsegi G. Objective and definitive subcategorization of LSIL with p16(INK4a) immunocytochemistry on cell 104. Block sections of cervical cytology specimens. Cancer Cytopathol 2009;117:390-1.
105. Davis-Devine S, Day SJ, Anderson A, French A, Madison-Henness D, Mohar N, *et al*. Collection of the BD SurePath Pap Test with a broom device plus endocervical brush improves disease detection when compared to the broom device alone or the spatula plus endocervical brush combination. Cytojournal 2008;6:4.
106. Freund GG, Saccomanno G, Boreson N, Davis-Devine S, Day SJ. High-risk HPV is found within the no further review tier using the focal point slide profilier. Cancer Cytopathol 2007;111:370.
107. Blunier TE, Patel A, Shears R, Day SJ, Davis-Devine S, Risley N, *et al*. The relationship between digene high-risk HPV HC2 DNA test relative light unit (RLU)/Cutoff (CO) value and cervical biopsy proven dysplasia using the BD surepath (TM) liquid-based pap test for specimen collection. Cancer Cytopathol 2009;117:380-1.
108. Van Dyke J, Davis-Devine S, Mentock E, Blunier T, Gaudier F, Freund G. Clinical utility of FNA-derived cell block when compared to simultaneously collected core biopsy. Cancer Cytopathol 2010;118:391.
109. Pantanowitz L, Hornish M, Goulart RA. Informatics applied to cytology. Cytojournal 2008;5:16.
110. Pantanowitz L, Hornish M, Goulart RA. The impact of digital imaging in the field of cytopathology. Cytojournal 2009;6:6.
111. Pantanowitz L, Kuperman M, Goulart RA. Clinical history of HIV infection may be misleading in cytopathology. Cytojournal 2010;7.
112. Setia N, Goulart RA, Leiman G, Otis CN, Modem R, Pantanowtiz L. Cytomorphology of cervicovaginal melanoma: ThinPrep *versus* conventional Papanicolaou tests. Cytojournal 2010;7:25.
113. Hollowell ML, Goulart RA, Gang DL, Otis CN, Prior J, Sachs BF, *et al*. Cytologic features of müllerian papilloma of the cervix: Mimic of malignancy. Diagn Cytopathol 2007;35:607-11.
114. Kandil D, Leiman G, Allegretta M, Trotman W, Pantanowitz L, Goulart R, *et al*. Glypican-3 immunocytochemistry in liver fine-needle aspirates: A novel stain to assist in the differentiation of benign and malignant liver lesions. Cancer 2007;111:316-22.
115. Kandil D, Leiman G, Trotman W, Allegretta M, Pantanowitz L, Goulart R, *et al*. Glypican-3: Comparison of a novel stain in immunocytochemistry and immunohistochemistry in hepatocellular carcinoma. Acta Cytol 2007;51:331.
116. Pantanowitz L, Panetti C, Goulart RA, Cooper R. Cholesterol crystals in the thyroid gland. Acta Cytol 2007;51:249-51.
117. Assaad M, Hornish A, Florence R, Goulart R. Companson of conventional smears *versus* ThinPrep (R) in thyroid fine needle aspiration biopsy: Diagnostic categories and surgical correlation. Cancer Cytopathol 2007;111:397-8.
118. Goulart RA, Bugbee AC, Lemon L, Metzler RL. Community performance characteristics of validated slides in proficiency testing: The American society for clinical pathology GYN PT (TM) program. Cancer Cytopathol 2007;111:364-5.
119. Pantanowitz L, Hornish M, Florence R, Goulart R. Vaginal Pap tests status-post hysterectomy. Diagn Cytopathol 2007;35:539-40.
120. Modem R, Goulart R, Pantanowitz L. Utility of fine needle aspiration biopsy in the diagnosis of thyroid lymphoma. Cancer Cytopathol 2007;111:399.
121. Pantanowitz L, Hornish M, Goulart R. Outcome of clinically based large-scale screening for Chlamydia trachomatis infection using the ThinPrep (R) Pap test collection vial. Cancer Cytopathol 2007;111:383-4.
122. Pantanowitz L, Otis CN, Goulart RA. Cytologic findings of psammocarcinoma in peritoneal washings. Cancer Cytopathol 2007;111:405.
123. Pantanowitz L, Otis CN, Goulart RA. Immunocytochemical evaluation of p16(INK4A) in ThinPrep (R) Pap tests diagnosed as atypical squamous cells, cannot exclude high-grade squamous intraepithelial lesion. Cancer Cytopathol 2007;111:362.
124. Pinco J, Goulart R, Otis C, Garb J, Pantanowitz L. Impact of digital image manipulation in cytopathology. Cancer Cytopathol 2007;111:430.
125. Goulart RA, Hornish M, Panetti C, Pantanowitz L. HPV DNA test results for cytotechnologist ASC-US downgraded to NILM following cytopathologist review: A potential laboratory quality indicator. Cancer Cytopathol 2008;114:428.
126. Henninger B, Hornish M, Pantanowitz L, Goulart RA. A novel computer program for assessment of graduated diagnostic competency of cytopathology fellows. Cancer Cytopathol 2008;114:402-3.
127. Panetti C, Hornish M, Goulart RA, Pantanowitz L. The effect of uterine cervical polyps on cervical cytology. Cancer Cytopathol 2008;114:397.
128. Pantanowitz L, Otis CN, Goulart RA. Cytologic findings of psammocarcinoma in peritoneal washings. Acta Cytol 2009;53:263-7.
129. Pantanowitz L, Warren M, Goulart RA. Anthracotic pigment in pleural fluid: A case report. Acta Cytol 2009;53:306-8.
130. Henninger B, Hornish M, Cao QJ, Pantanowitz L, Goulart R. Morphologic pap test findings in HPV negative women age 30 years and older: What information will be lost with HPV only primary screening? Cancer Cytopathol 2009;117:357-8.
131. Henninger B, Goulart RA, Otis CN, Pantanowitz L. Melamed-wolinska intracytoplasmic urothelial cell bodies: Evaluation with red blood cell markers glycophorin-C and GLUT-1. Cancer Cytopathol 2009;117:373-4.
132. Pantanowitz L, Goulart RA. Added value of cytomorphology in pulmonary specimens submitted for the detection of pneumocystis. Cancer Cytopathol 2009;117:402-3.
133. Setia N, Modem R, Goulart RA, Leiman G, Otis CN, Pantanowitz L. Cytomorphology of cervicovaginal melanoma: ThinPrep *versus* conventional papanicolaou tests. Cancer Cytopathol 2009;117:391-2.
134. Pantanowitz L, Freeman J, Goulart RA. Utility of cell block preparations in cytologic specimens diagnostic of lymphoma. Acta Cytol 2010;54:236-7.
135. Filomena C, Covell J, Metzler R, Goulart R. Morphologic features which affect validation and proficiency test performance of biopsy-proven HSIL pap tests. Cancer Cytopathol 2010;118:306.
136. Pantanowitz L, Hornish M, Cao QJ, Goulart RA. HPV data can be used as a cytopathology laboratory quality indicator. Diagn Cytopathol 2010;38:159-60.
137. Wang Y, Goulart RA, Pantanowitz L. Oil red O staining in cytopathology. Diagn Cytopathol 2011;39:272-3.
138. Jian B, Kolansky AS, Baloach ZW, Gupta PK. Entamoeba gingivalis pulmonary abscess-diagnosed by fine needle aspiration. Cytojournal 2008;5:12.
139. Gupta PK. Progression from on-site to point-of-care fine needle aspiration service: Opportunities and challenges. Cytojournal 2010;7:6.
140. Shi Y, Griffin AC, Zhang PJ, Palmer JN, Gupta P. Sinus histiocytosis with massive lymphadenopathy (Rosai-Dorfman Disease): A case report and review of 49 cases with fine needle aspiration cytology. Cytojournal 2011;8:3.
141. Park JY, Malik A, Dumoff KL, Gupta PK. Case report and review of lupus erythematosus cells in cytology fluids. Diagn Cytopathol 2007;35:806-9.
142. Young NA, Greening SE, Gupta P, Bibbo M, Ehya H. The declining Pap test: An omen of extinction or an opportunity for reform? Acta Cytol 2008;52:277-8.
143. Neumann T, Meyer M, Patten FW, Johnson FL, Erozan YS, Frable WJ, *et al*. Premalignant and malignant cells in sputum from lung cancer patients. Cancer 2009;117:473-81.
144. Gupta PK. University of Pennsylvania aspiration cart (Penn-A-Cart): An innovative journey in fine needle aspiration service. Acta Cytol 2010;54:165-8.
145. Gupta R, Mathur SR, Gupta SD, Durgapal P, Iyer VK, Das CJ, *et al*. Hepatic epithelioid hemangioendothelioma: A diagnostic pitfall in aspiration cytology. Cytojournal 2010;6:25.
146. Gupta R, Mathur SR, Iyer VK, Kumar A S, Seth A. Cytomorphologic

consideration in malignant ascites with renal cell carcinoma: A report of two cases. Cytojournal 2010;7:4.
147. Gupta R, Dhingra K, Singh S, Nigam S, Jain S. Multicystic nephroma: A case report. Acta Cytol 2007;51:651-3.
148. Singh S, Gupta R, Mandal AK. Pilomatrixoma: A potential diagnostic pitfall in aspiration cytology. Cytopathology 2007;18:260-2.
149. Gupta R, Singh S. Cytologic diagnosis of fibrous hamartoma of infancy: A case report of a rare soft tissue lesion. Acta Cytol 2008;52:201-3.
150. Mathur SR, Aron M, Gupta R, Sharma MC, Arora VK. Malignant mesothelioma of tunica vaginalis: A report of 2 cases with preoperative cytologic diagnosis. Acta Cytol 2008;52:740-3.
151. Gupta R, Mathur SR, Arora VK, Sharma SG. Cytologic features of extragonadal germ cell tumors: A study of 88 cases with aspiration cytology. Cancer 2008;114:504-11.
152. Gupta R, Mathur SR, Agarwala S, Kaushal S, Srivastav A. Primary soft tissue hydatidosis: Aspiration cytological diagnosis in two cases. Diagn Cytopathol 2008;36:884-6.
153. Srinivasan R, Gautam U, Gupta R, Rajwanshi A, Vasistha RK. Synovial sarcoma: Diagnosis on fine-needle aspiration by morphology and molecular analysis. Cancer 2009;117:128-36.
154. Gupta R, Jain R, Singh S, Gupta K, Kudesia M. Sclerosing polycystic adenosis of parotid gland: A cytological diagnostic dilemma. Cytopathology 2009;20:130-2.
155. Gupta N, Gupta R, Bakshi J, Rajwanshi A. Fine needle aspiration cytology in a case of fibrous dysplasia of jaw. Diagn Cytopathol 2009;37:920-2.
156. Gupta N, Gupta R, Rajwanshi A, Bakshi J. Multinucleated giant cells in HIV-associated benign lymphoepithelial cyst-like lesions of the parotid gland on FNAC. Diagn Cytopathol 2009;37:203-4.
157. Gupta R, Dey P, Jain V, Gupta N. Cervical tuberculosis detection in Papanicolaou-stained smear: Case report with review of literature. Diagn Cytopathol 2009;37:592-5.
158. Gupta R, Mathur SR, Singh P, Agarwala S, Gupta SD. Cellular mesoblastic nephroma in an infant: Report of the cytologic diagnosis of a rare paediatric renal tumor. Diagn Cytopathol 2009;37:377-80.
159. Gupta R, Singh S, Gupta K, Kudesia M. Clear-cell hidradenoma in a child: A diagnostic dilemma for the cytopathologist. Diagn Cytopathol 2009;37:531-3.
160. Gopal K, Singh S, Gupta R. Fine needle aspiration cytology in bilateral adrenal masses in a 58-year-old man. Acta Cytol 2010;54:234-6.
161. Kalra S, Gupta R, Singh S, Gupta K, Kudesia M. Primary cutaneous Ewing's sarcoma/primitive neuroectodermal tumor: Report of the first case diagnosed on aspiration cytology. Acta Cytol 2010;54:193-6.
162. Mathur SR, Gupta R, Seith A, Agarwala S, Subramanian S, Gupta SD. Aspiration cytology of mesenchymal hamartoma of the chest wall in an infant: A case report. Acta Cytol 2010;54:63-5.
163. Sharma S, Kotru M, Gupta R. Isolated amyloidosis of cervical lymph nodes. Acta Cytol 2010;54:1078-80.
164. Gupta S, Gupta R, Bansal B, Singh S, Gupta K, Kudesia M. Significance of incidental detection of filariasis on aspiration smears: A case series. Diagn Cytopathol 2010;38:517-20.
165. Gupta S, Gupta R, Singh S, Gupta K, Kudesia M. Nuclear morphometry and texture analysis of B-cell non-Hodgkin lymphoma: Utility in subclassification on cytosmears. Diagn Cytopathol 2010;38:94-103.
166. Marchevsky AM, Walts AE, Bose S, Gupta R, Fan X, Frishberg D, *et al*. Evidence-based evaluation of the risks of malignancy predicted by thyroid fine-needle aspiration biopsies. Diagn Cytopathol 2010;38:252-9.
167. Ahuja A, Iyer VK, Gupta R, Suri V, Mathur SR, Arora R. Fine needle aspiration cytology of anaplastic meningioma. Cytopathology 2011;22:276-7.
168. Gupta R, Dey P, Vasishtha RK. Fine needle aspiration cytology in malignant mesothelioma of the tunica vaginalis testis. Cytopathology 2011;22:66-8.
169. Singh G, Gupta R, Kakkar A, Iyer VK, Kashyap S, Bakhshi S, *et al*. Fine needle aspiration cytology of metastatic ocular medulloepithelioma. Cytopathology 2011;22:343-5.
170. Gupta S, Gupta R, Singh S, Pant L. Solitary intrascrotal neurofibroma: A case diagnosed on aspiration cytology. Diagn Cytopathol 2011;39:843-6.
171. Thrall MJ, Russell DK, Bonfiglio TA, Hoda RS. Use of the ThinPrep Imaging System does not alter the frequency of interpreting Papanicolaou tests as atypical squamous cells of undetermined significance. Cytojournal 2008;5:10.
172. Yakoushina TV, Lavi E, Hoda RS. Pituitary carcinoma diagnosed on fine needle aspiration: Report of a case and review of pathogenesis. Cytojournal 2010;7:14.
173. Avant CC, Hitchcock T, Colello CJ, Hoda RS. Strongyloides stercoralis in a bronchoalveolar lavage processed as ThinPrep. Diagn Cytopathol 2007;35:503-4.
174. Hitchcock T, Avant C, Colello C, Hoda RS. Chaetomium fungal elements in a conventional vaginal smear. Diagn Cytopathol 2007;35:376-8.
175. Hoda RS. Non-gynecologic cytology on liquid-based preparations: A morphologic review of facts and artifacts. Diagn Cytopathol 2007;35:621-34.
176. Kaplan JS, Hoda RS. Clear cell variant of fibrolamellar hepatocellular carcinoma: Diagnosis of recurrence by fine-needle aspiration. Diagn Cytopathol 2007;35:459-62.
177. Russell DK, Warner JN, Giampoli EJ, Bonfiglio TA, Hoda RS. Prevalence of anal intraepithelial neoplasia with respect to high risk human papillomavirus and human immunodeficiency virus (HIV) infection. Cancer Cytopathol 2008;114:398.
178. Warner JN, Russell DK, Plavnicky JS, Thrall M, Giampoli EJ, Bonfiglio TA, *et al*. The value of anal cytology as a screening tool in a high risk patient population. Cancer Cytopathol 2008;114:398-9.
179. Wagner DG, Russell DK, Benson JM, Hoda RS, Bonfiglio TA. Cellient (TM) automated cell block *versus* traditional cell block preparation: A comparison of morphologic features and immunohistochemical staining. Cancer Cytopathol 2009;117:396.
180. Yakoushina TV, Wagner D, Benson J, Russell D, Gu E, Bonfiglio TA, *et al*. Incidence of significant cervical lesions in low-risk women after supracervical hysterectomy for benign uterine disease is low. Cancer Cytopathol 2009;117:392-3.
181. Yakoushina TV, Medina IM, Hoda RS. "String of pearls" appearance of blue blobs in postmenopausal atrophy on ThinPrep Pap test. Diagn Cytopathol 2009;37:738-9.
182. Hoda RS, Hoda SA. Fine needle aspiration cytology of breast: Correlation with needle core biopsy. Acta Cytol 2010;54:369.
183. Hoda R, Vakil B, Ma GY, Romain-Delva E, Tolentino C, Erroll M. Pap tests that are negative on computer-imaged ThinPrep (R) cytology but positive for HPV on hybrid-capture test: Study of 344 cases. Cancer Cytopathol 2010;118:337-8.
184. Loukeris K, Salvatore SP, Hoda RS. Pulmonary zygomycoses in an immunosuppressed patient. Diagn Cytopathol 2011;39:37.
185. Johnykutty S, Miller CH, Hoda RS, Giampoli EJ. Fine-needle aspiration of dedifferentiated acinic cell carcinoma: Report of a case with cyto-histological correlation. Diagn Cytopathol 2009;37:763-8.
186. Wagner DG, Weisensel J, Mentrikoski MJ, Leo SD, Bonfiglio TA, Hoda RS. ThinPrep Pap test of endocervical adenocarcinoma with lymph node metastasis: Report of a case in a 17-year-old woman. Diagn Cytopathol 2010;38:633-8.
187. Wagner DG, Russell DK, Benson JM, Schneider AE, Hoda RS, Bonfiglio TA. Cellient™ automated cell block *versus* traditional cell block preparation: A comparison of morphologic features and immunohistochemical staining. Diagn Cytopathol 2011;39:730-6.
188. Arora R, Mathur SR, Aron M, Verma K, Iyer VK, Arora VK, *et al*. Oncocytic carcinoid tumor of the lung: A case report of diagnostic pitfall in filter membrane preparation of bronchial washings. Acta Cytol 2007;51:907-10.
189. Sharma SG, Mathur SR, Aron M, Iyer VK, Arora VK, Verma K. Chromophobe renal cell carcinoma with calcification: Report of a case with rare finding on aspiration smears. Diagn Cytopathol 2008;36:647-50.
190. Das P, Iyer VK, Mathur SR, Ray R. Anaplastic large cell lymphoma: A critical evaluation of cytomorphological features in seven cases. Cytopathology 2010;21:251-8.
191. Gupta R, Iyer VK, Mirdha BR, Guleria R, Kumar L, Agarwal SK. Role of cytology and polymerase chain reaction based detection of Pneumocystis jirovecii infection in bronchoalveolar lavage fluid. Acta Cytol 2010;54:296-302.
192. Sigamani E, Iyer VK, Agarwala S. Fine needle aspiration cytology of infantile haemangioendothelioma of the liver: A report of two cases. Cytopathology 2010;21:398-402.
193. Iyer V, Chopra A, Agarwala S. Diagnosis of pediatric liver tumors on fine needle aspiration cytology and ancillary techniques: A study of 72 cases. Acta Cytol 2010;54:415.
194. Iyer V, Das P, Mathur S, Ray R. Retrospective and prospective analysis of ALK-1

immunocytochemistry in cytodiagnosis of anaplastic large cell lymphoma: A study of 12 cases. Acta Cytol 2010;54:410-1.
195. Arava S, Sharma A, Iyer VK, Mathur SR. Iodamoeba butschlii in a routine cervical smear. Cytopathology 2010;21:342-3.
196. Gupta C, Iyer VK, Kaushal S, Agarwala S, Mathur SR. Fine needle aspiration cytology of undifferentiated embryonal sarcoma of the liver. Cytopathology 2010;21:414-6.
197. Kaushal S, Iyer VK, Mathur SR, Ray R. Fine needle aspiration cytology of medullary carcinoma of the thyroid with a focus on rare variants: A review of 78 cases. Cytopathology 2011;22:95-105.
198. Nayak A, Iyer VK, Agarwala S. The cytomorphologic spectrum of Wilms tumour on fine needle aspiration: A single institutional experience of 110 cases. Cytopathology 2011;22:50-9.
199. Li S, Yan Z, Jhala N, Jhala D. Fine needle aspiration diagnosis of Rosai-Dorfman disease in an osteolytic lesion of bone. Cytojournal 2010;7:12.
200. Crowe A, Knight CS, Jhala D, Bynon SJ, Jhala NC. Diagnosis of metastatic fibrolamellar hepatocellular carcinoma by endoscopic ultrasound-guided fine needle aspiration. Cytojournal 2011;8:2.
201. Eltoum IA, Chhieng DC, Jhala D, Jhala NC, Crowe DR, Varadarajulu S, *et al*. Cumulative sum procedure in evaluation of EUS-guided FNA cytology: The learning curve and diagnostic performance beyond sensitivity and specificity. Cytopathology 2007;18:143-50.
202. Jhala D, Grizzle WE, Jhala N. Clear cells with cytoplasmic vacuolization mimicking macrophages in pancreatic adenocarcinoma in fine needle aspirates obtained by EUS-FNA: A diagnostic caveat. Cancer Cytopathology. 2007;111 (5):416-.
203. Bakdounes K, Jhala N, Jhala D. Diagnostic usefulness and challenges in the diagnosis of mesothelioma by endoscopic ultrasound guided fine needle aspiration. Diagn Cytopathol 2008;36:503-7.
204. Jhala N, Siegal GP, Jhala D. Large, clear cytoplasmic vacuolation: An under-recognized cytologic clue to distinguish solid pseudopapillary neoplasms of the pancreas from pancreatic endocrine neoplasms on fine-needle aspiration. Cancer 2008;114:249-54.
205. Meara RS, Jhala N, Eltoum I, Arnoletti JP, Jhala D. Fine needle aspiration of an axillary lymph node in a patient suspected of having metastatic cancer of unknown primary. Cytopathology 2008;19:192-6.
206. Knight CS, Eloubeidi MA, Crowe R, Jhala NC, Jhala DN, Chhieng DC, *et al*. Utility of endoscopic ultrasound-guided fine needle aspiration in diagnosis of perirectal lesions and in staging of colorectal carcinoma. Cancer Cytopathol 2008;114:359.
207. Snowden C, Eloubeidi M, Crowe R, Jhala N, Jhala D, Kulesza P, *et al*. Endoscopic ultrasound-guided fine needle aspirations of pancreatic and peri-pancreatic spindle cell lesions. Cancer Cytopathol 2009;117:409-10.
208. Taniyama K, Jhala DN, Oshita S, Saito A, Kuraoka K, Kawakami Y, *et al*. Atypical squamous cells and HPV of the uterine cervix in Japan and Asia. Cancer Cytopathol 2009;117:388-9.
209. Apewokin S, Steciuk M, Griffin S, Jhala D. Strongyloides hyperinfection diagnosed by bronchoalveolar lavage in an immunocompromized host. Cytopathology 2010;21:345-7.
210. Bean SM, Baker A, Eloubeidi M, Eltoum I, Jhala N, Crowe R, *et al*. Endoscopic ultrasound-guided fine-needle aspiration of intrathoracic and intra-abdominal spindle cell and mesenchymal lesions. Cancer Cytopathol 2011;119:37-48.
211. Steciuk M, Jhala D, Haber M, Jhala N. Endoscopic ultrasound-guided fine needle aspiration: A powerful modality in the diagnosis of aggressive systemic mastocytosis. Cytopathology 2011;22:130-2.
212. Taniyama K, Jhala DN, Katayama H, Kuraoka K, Naito Z, Rangdaeng S, *et al*. Multinational comparison of diagnostic clues for uterine cervical lesions among cytotechnologists in Asian countries. Diagn Cytopathol 2011;39:489-94.
213. Al-Maghraby HQ, Khalbuss WE, Rao UN, Cieply K, Dacic S, Monaco SE. Fine needle aspiration biopsy diagnosis of dedifferentiated liposarcoma: Cytomorphology and MDM2 amplification by FISH. Cytojournal 2010;7:5.
214. Kastenbaum HA, Khalbuss WE, Felgar RE, Stoller R, Monaco SE. The spectrum of coincident entities with small lymphocytic lymphoma/chronic lymphocytic leukemia (SLL/CLL) diagnosed by cytology. Cytojournal 2010;7:20.
215. Monaco SE, Schuchert MJ, Khalbuss WE. Diagnostic difficulties and pitfalls in rapid on-site evaluation of endobronchial ultrasound guided fine needle aspiration. Cytojournal 2010;7:9.
216. Arya P, Khalbuss WE, Monaco SE, Pantanowitz L. Salivary duct carcinoma with striking neutrophil-tumor cell cannibalism. Cytojournal 2011;8:15.
217. Gilbert CM, Monaco SE, Cooper ST, Khalbuss WE. Endoscopic ultrasound-guided fine-needle aspiration of metastases to the pancreas: A study of 25 cases. Cytojournal 2011;8:7.
218. Khalbuss WE, Yang H, Lian Q, Elhosseiny A, Pantanowitz L, Monaco SE. The cytomorphologic spectrum of small-cell carcinoma and large-cell neuroendocrine carcinoma in body cavity effusions: A study of 68 cases. Cytojournal 2011;8:18.
219. Lang TU, Khalbuss WE, Monaco SE, Pantanowitz L. Solitary Tracheobronchial Papilloma: Cytomorphology and ancillary studies with histologic correlation. Cytojournal 2011;8:6.
220. Purgina B, Jaffe R, Monaco SE, Khalbuss WE, Beasley HS, Dunn JA, *et al*. Cytomorphology of Erdheim-Chester disease presenting as a retroperitoneal soft tissue lesion. Cytojournal 2011;8:22.
221. Yildiz-Aktas IZ, Monaco SE, Khalbuss WE, Parwani AV, Jaffe TM, Pantanowitz L. Testicular touch preparation cytology in the evaluation of male infertility. Cytojournal 2011;8:24.
222. Khalbuss WE, Bajestani S, D'Agostino HJ. Cytomorphology of a solitary left chest wall mass: An unusual presentation from unknown primary hepatocellular carcinoma. Diagn Cytopathol 2007;35:586-9.
223. Khalbuss WE, Fischer G, Bazooband A. Imprint cytology of epithelioid hepatic angiomyolipoma: Mimicry of hepatocellular carcinoma. Acta Cytol 2007;51:670-2.
224. Khalbuss WE, Fischer G, Tutuncuoglu SO. Cytomorphology of basaloid (basal cell) carcinoma of the lung. Acta Cytol 2007;51:834-6.
225. Henry CA, Parwani AV, Khalbuss WE. Bone and soft tissue lymphomas and leukemias diagnosed by fine needle aspiration biopsies. Our experience with 123 cases. Cancer Cytopathol 2008;114:430-1.
226. Khalbuss WE, Parwani AV. Diagnostic utility and accuracy of fine needle aspiration cytology in soft tissue and bone lesions: A retrospective review of 862 cases. Cancer Cytopathol 2008;114:431-2.
227. Domfeh AB, Teot LA, Khalbuss W, Cai GP, Monaco SE. Fine needle aspiration biopsy of the omentum is a sensitive method for detecting malignancy: A review of 42 cases and correlation with peritoneal fluid cytology. Cancer Cytopathol 2009;117:364-5.
228. Gilbert CM, Parwani AV, Khalbuss WE. Digital imaging and its applications for cytopathology. Cancer Cytopathol 2009;117:398.
229. Kastenbaum HA, Khalbuss WE, Monaco SE. Coincident entities with chronic lymphocytic leukemia/small lymphocytic lymphoma (CLL/SLL) diagnosed by fine needle aspiration biopsy. Cancer Cytopathol 2009;117:403-4.
230. Khalbuss WE, Teot LA, Monaco SE. Diagnostic accuracy and limitations of fine-needle aspiration cytology of bone and soft tissue lesions: A review of 1114 cases with cytological-histological correlation. Cancer Cytopathol 2010;118:24-32.
231. Hanson J, Dvorakova M, Bihlmeyer S, Quintana L, Khalbuss W, Naud S, *et al*. Secondary liver tumors diagnosed by fine needle aspiration: Updating old data in the proper patient cohort. Cancer Cytopathol 2010;118:377-80.
232. Kamat S, Felgar R, Khalbuss W, Monaco S. Fine needle aspiration diagnosis of Hodgkin lymphoma: The utility of ancillary studies and core biopsy. Cancer Cytopathol 2010;118:372.
233. Khalbuss W, Monaco S. Cytomorphological spectrum and ancillary studies in liver fine needle aspiration biopsies of non-epithelial neoplasms: A study of 57 cases. Cancer Cytopathol 2010;118:380.
234. Yang HT, Monaco S, Lian QA, Khalbuss W. The cytomorphological spectrum of small cell carcinomas and large cell neuroendocrine carcinomas in serous effusion. Our experience with 68 cases. Cancer Cytopathol 2010;118:321.
235. Gao FF, Khalbuss WE, Austin RM, Monaco SE. Cytomorphology of crystal storing histiocytosis in the breast associated with lymphoma: A case report. Acta Cytol 2011;55:302-6.
236. Pantanowitz L, Parwani AV, Khalbuss WE. Digital imaging for cytopathology: Are we there yet? Cytopathology 2011;22:73-4.
237. Naqvi AH, Abraham JL, Kellman RM, Khurana KK. Calcium pyrophosphate dihydrate deposition disease (CPPD)/Pseudogout of the temporomandibular joint-FNA findings and microanalysis. Cytojournal 2008;5:8.
238. Shah SS, Faquin WC, Izquierdo R, Khurana KK. FNA of misclassified primary malignant neoplasms of the thyroid: Impact on clinical management. Cytojournal 2009;6:1.
239. Steele LA, Johnson J, Khurana KK. Can we eliminate cytologic screening and

use positive HPV digene test alone as a basis for cervical biopsy. Cancer Cytopathol 2007;111:358-9.
240. Walsh B, Zhou Y, Khurana K. Comparative analysis of abnormal cells found in 22 random fields *versus* 22 targeted fields in slides with prior HGSIL diagnosis using the ThinPrep imaging system. Cancer Cytopathol 2008;114:381.
241. Deng FM, Hsu J, Khurana KK. Transmucosal fine needle aspiration of oral and pharyngeal lesions. Cancer Cytopathol 2009;117:435-6.
242. Leung AH, Roy A, Khurana KK. Utility of repeat endoscopic ultrasound-guided fine needle aspiration in evaluation of suspicious pancreatic lesions. Cancer Cytopathol 2009;117:408.
243. Mead K, Izquierdo R, Steele C, Khurana K. Assessing the utility of fine-needle aspiration in male patients with thyroid nodules. Cancer Cytopathol 2010;118:351-2.
244. Rong R, Pavlovitz B, Roy A, Khurana K. Utility of telecytopathology for rapid preliminary diagnosis of endoscopic ultrasound-guided pancreatic fine needle aspiration biopsies. Cancer Cytopathol 2010;118:381.
245. Arora VK, Aggarwal S, Mathur S, Rath GK, Julka PK. Pleural mesothelioma: An unusual case diagnosed on pleural fluid cytology and immunocytochemistry. Diagn Cytopathol 2009;37:509-12.
246. Das P, Kulkarni K, Mathur SR, Kaushal S, Ahuja A, Sarkar C, *et al*. Cytomorphology of posttraumatic testicular mesothelial hyperplasia in a child. Acta Cytol 2010;54:1089-93.
247. Okonda S, Wright C, Michelow P. The status of cervical cytology in Swaziland, Southern Africa: A descriptive study. Cytojournal 2009;6:14.
248. Michelow P, Hartman I, Schulze D, Lamla-Hillie S, Williams S, Levin S, *et al*. Atypical squamous cells, cannot exclude high grade squamous intraepithelial (ASC-H) in HIV-positive women. Cytojournal 2010;7:8.
249. Michelow P, Meyers T, Dubb M, Wright C. The utility of fine needle aspiration in human immunodeficiency virus-positive children. Acta Cytol 2007;51:330.
250. Michelow P, Meyers T, Dubb M, Wright C. The utility of fine needle aspiration in HIV positive children. Cytopathology 2008;19:86-93.
251. Dubb M, Michelow P. Cytologic features of hidradenoma in fine needle aspiration biopsies. Acta Cytol 2009;53:179-82.
252. Dubb M, Michelow P. Fine needle aspiration cytology of pilomatrixoma and differential diagnoses. Acta Cytol 2009;53:683-8.
253. Dubb M, Michelow P, Grayson W. Cytologic features of trichoblastoma in fine needle aspiration biopsies. Acta Cytol 2009;53:679-82.
254. Firnhaber C, Zungu K, Levin S, Michelow P, Montaner LJ, McPhail P, *et al*. Diverse and high prevalence of human papillomavirus associated with a significant high rate of cervical dysplasia in human immunodeficiency virus-infected women in Johannesburg, South Africa. Acta Cytol 2009;53:10-7.
255. Schroeter L, Louw M, Michelow P, Wright C. Application of cytomorphologic features and immunocytochemistry to cervicovaginal smears. A scoring system to distinguish between endometrial and endocervical adenocarcinoma. Acta Cytol 2009;53:630-6.
256. Michelow P, Dezube BJ, Pantanowitz L. Results from a series of fine needle aspirations in South African HIV plus patients. Cancer Cytopathol 2009;117:395.
257. Dubb M, Michelow P. Cytologic features of chondroid syringoma in fine needle aspiration biopsies: A report of 3 cases. Acta Cytol 2010;54:183-6.
258. Michelow P, Dezube BJ, Pantanowitz L. Fine needle aspiration of breast masses in HIV-infected patients: Results from a large series. Cancer Cytopathol 2010;118:218-24.
259. Leiman G, Chhieng D, de Boer B, Klijanienko J, Michelow P, Schalper J. Concluding congress slide seminar: The international cytologic all-stars finale. Acta Cytol 2010;54:386.
260. Michelow P, Dezube B, Pantanowitz L. Fine needle aspiration of human immunodeficiency virus-related breast lesions. Acta Cytol 2010;54:497.
261. Neethling G, Louw M, Schubert P, Michelow P, Wright CA. Autofluorescence on papanicolaou stained smears: A rapid ancillary diagnostic technique. Acta Cytol 2010;54:398.
262. Razack R, Michelow P, Wessels G, Poole J, Stefan C, Wright CA. An inter-institutional study of the value of fine needle aspiration biopsy in pediatric oncology in resource limited countries. Acta Cytol 2010;54:407.
263. Pantanowitz L, Michelow P. Review of human immunodeficiency virus (HIV) and squamous lesions of the uterine cervix. Diagn Cytopathol 2011;39:65-72.
264. Monaco SE, Dabbs DJ, Kanbour-Shakir A. Pleomorphic lobular carcinoma in pleural fluid: Diagnostic pitfall for atypical mesothelial cells. Diagn Cytopathol 2008;36:657-61.
265. Monaco SE, Teot LA, Felgar RE, Surti U, Cai G. Fluorescence *in situ* hybridization studies on direct smears: An approach to enhance the fine-needle aspiration biopsy diagnosis of B-cell non-Hodgkin lymphomas. Cancer 2009;117:338-48.
266. Monaco SE, Navolotskaia O, Cai G. Fine-needle aspiration biopsy diagnosis of prostate carcinoma metastatic to the breast. Diagn Cytopathol 2009;37:388-90.
267. Kanbour-Shakir A, Colaizzi A, Anisa K, Ibrahim A, Monaco S. The role of axillary lymph node FNA in breast cancer staging prior to chemotherapy with histologic correlation. Cancer Cytopathol 2010;118:315.
268. Setia N, Ghobrial P, Liron P. Eosinophilic ascites due to severe eosinophilic ileitis. Cytojournal 2010;7:19.
269. Assaad MW, Pantanowitz L, Otis CN. Diagnostic accuracy of image-guided percutaneous fine needle aspiration biopsy of the mediastinum. Diagn Cytopathol 2007;35:705-9.
270. Modem RR, Otis CN, Florence RR, Pantanowitz L. Intestinal type adenocarcinoma *in situ* of the cervix. Diagn Cytopathol 2007;35:584-5.
271. Pantanowitz L. Black thyroid. Diagn Cytopathol 2007;35:135-6.
272. Pantanowitz L, Otis CN. Myxoid liposarcoma. Diagn Cytopathol 2007;35:283-4.
273. Pantanowitz L, Otis CN. Cystitis glandularis. Diagn Cytopathol 2008;36:181-2.
274. Kuperman MB, Florence RR, Visintainer PF, Pantanowitz L, Otis CN. Diagnostic utility of adding GLUT-1 to an immunocytochemical panel for malignant mesothelioma. Cancer Cytopathol 2009;117:361-2.
275. Rekhi B, Ajit D, Joseph SK, Gawas S, Deodhar KK. Evaluation of atypical squamous cells on conventional cytology smears: An experience from a screening program practiced in limited resource settings. Cytojournal 2010;7:15.
276. Rekhi B, Kane SV. Microfilariae coexisting with a follicular lesion in thyroid aspirate smears in an uncommon case of a retrosternal thyroid mass, clinically presenting as malignancy. Cytojournal 2011;8:4.
277. Rekhi B, Gorad BD, Chinoy R. Scope of FNAC in soft tissue tumors: Five years of experience from a tertiary cancer referral center in India. Acta Cytol 2007;51:343.
278. Khurana A, Rekhi B, Kane SV, Shukla P, Ramadwar M. Pancreatic tuberculosis masquerading as pancreatic carcinoma in two cases: Role of fine needle aspiration cytology in diagnosis. Cytopathology 2007;18:380-3.
279. Ajit D, Gawas S, Rekhi B. ASC and SIL on pap smears-A tmh experience in an opportunistic screening programme. Cancer Cytopathol 2008;114:446.
280. Kumar R, Rekhi B, Shirazi N, Pais A, Amare P, Gawde D, *et al*. Spectrum of cytomorphological features, including literature review, of an extraskeletal myxoid chondrosarcoma with t (9;22)(q22;q12) (TEC/EWS) results in one case. Diagn Cytopathol 2008;36:868-75.
281. Rekhi B, Kane SV, D'Cruz A. Cytomorphology of anaplastic giant cell type of medullary thyroid carcinoma-A diagnostic dilemma in an elderly female: A case report. Diagn Cytopathol 2008;36:136-8.
282. Roy P, Rekhi B, Chinoy RF. Panorama of cytomorphological findings of filariasis in the contralateral breast, clinically mimicking a carcinoma in a known case: A case report. Diagn Cytopathol 2008;36:794-6.
283. Rekhi B, Kane SV, Chaturvedi P. Cytomorphology of a metastatic basaloid squamous carcinoma from an intranasal tumor: A diagnostic mimic for a neuroendocrine tumor – A rare case report. Diagn Cytopathol 2009;37:546-8.
284. Rekhi B, Desai S, Jambhekar NA. Epithelioid variant of a pleomorphic liposarcoma displaying arborizing vascular arrangements on cytology smears: A case report of an interesting cytomorphologic pattern in an uncommon tumor. Acta Cytol 2010;54:963-7.
285. Rekhi B, Sridhar E, Viswanathan S, Shet TM, Jambhekar NA. ALK+anaplastic large cell lymphoma with cohesive, perivascular arrangements on cytology, mimicking a soft tissue sarcoma: A report of 2 cases. Acta Cytol 2010;54:75-8.
286. Uke M, Rekhi B, Ajit D, Jambhekar NA. The use of p63 as an effective immunomarker in the diagnosis of pulmonary squamous cell carcinomas on de-stained bronchial lavage cytological smears. Cytopathology 2010;21:56-63.
287. Rekhi B, Pathuthara S, Ajit D, Kane SV. "Signet-ring" cells – A caveat in the diagnosis of a diffuse peritoneal mesothelioma occurring in a lady presenting with recurrent ascites: An unusual case report. Diagn Cytopathol 2010;38:435-9.
288. Ruben I, Dighe S, Ajit D, Gujral S, Jambhekar NA, Rekhi B. Pulmonary non-Hodgkin's lymphoma (NHL) of diffuse large B-cell type with simultaneous humeral involvement in a young lady: An uncommon presentation with cytologic implications. Diagn Cytopathol 2010;38:217-20.

289. Rekhi B, Ingle A, Patil B, Jambhekar NA. Cytomorphological spectrum of a nodular hidradenoma in a young girl presenting with an inguinal soft tissue mass. Cytopathology 2011;22:135-7.
290. Rekhi B, Ramadwar M, Shukla P. Cytomorphological spectrum of amoebic liver abscess in an uncommon case, clinically masquerading as malignancy. Diagn Cytopathol 2011;39:827-9.
291. Saleh HA, Clayman L, Masri H. Fine needle aspiration biopsy of intraoral and oropharyngeal mass lesions. Cytojournal 2008;5:4.
292. Saleh HA, Hammoud J, Zakaria R, Khan AZ. Comparison of Thin-Prep and cell block preparation for the evaluation of Thyroid epithelial lesions on fine needle aspiration biopsy. Cytojournal 2008;5:3.
293. Saleh HA, Feng J, Tabassum F, Al-Zohaili O, Husain M, Giorgadze T. Differential expression of galectin-3, CK19, HBME1, and Ret oncoprotein in the diagnosis of thyroid neoplasms by fine needle aspiration biopsy. Cytojournal 2009;6:18.
294. Al-Abbadi MA, Abuhammour W, Harahsheh A, Abdel-Haq NM, Hasan RA, Saleh HA. Conjunctival changes in children with Kawasaki disease: Cytopathologic characterization. Acta Cytol 2007;51:370-4.
295. Halloush RA, Khasawneh FA, Saleh HA, Soubani AO, Piskorowski TJ, Al-Abbadi MA. Fine needle aspiration cytology of lung lesions: A clinicopathological and cytopathological review of 150 cases with emphasis on the relation between the number of passes and the incidence of pneumothorax. Cytopathology 2007;18:44-51.
296. Palmieri B, Sblendorio V, Saleh F, Al-Sebeih K. Securebox: A multibiopsy sample container for specimen identification and transport. Acta Cytol 2008;52:691-6.
297. Saleh H, Kapadia R. Aspiration biopsy cytology of extraabdominal desmoid tumor concurrently occurring in a patient with tumoral calcinosis. Diagn Cytopathol 2008;36:624-7.
298. Saleh HA, Hammoud J, Bassily N. The utility of thinprep monolayer preparation in the evaluation of thyroid lesions by fine needle aspiration biopsy: Comparison with conventional smear method. Cancer Cytopathol 2008;114:437-8.
299. Saleh HA, Hammoud J, Zakaria R. Comparison of thin-prep and cell block preparation in thyroid fine needle aspiration biopsy. Cancer Cytopathol 2008;114:439.
300. Saleh HA, Aulicino M, Saleh SM, Khan AZ. The utility of immunocytochemical panel in discriminating hepatocellular carcinoma from metastatic adenocarcinoma on aspiration biopsy cytology of the liver. Cancer Cytopathol 2009;117:406.
301. Saleh HA, Giorgadze T, Al-Zohaili O. Differential expression of galectin-3, ck19, hbme1 and ret oncoprotein in the diagnosis of thyroid neoplasms by fine needle aspiration biopsy. Cancer Cytopathol 2009;117:424.
302. Saleh HA, Saleh SM, Makki H. Best practice immunocytochemical panel in differentiating reactive mesothelial cells from metastatic adenocarcinoma in serous effusions. Cancer Cytopathol 2009;117:364.
303. Jin B, Saleh H. Pitfalls in the diagnosis of adult rhabdomyoma by fine needle aspiration: Report of a case and a brief literature review. Diagn Cytopathol 2009;37:483-6.
304. Saleh HA, Baker H. Aspiration biopsy cytology of tumoral calcinosis: A case report. Acta Cytol 2009;53:323-6.
305. Saleh HA, Hammoud J, Shah MB. Aspiration biopsy cytology of ectopic thyroid tissue in the lateral chest wall: A case report. Acta Cytol 2009;53:313-5.
306. Saleh H, Bassily N, Hammoud MJ. Utility of a liquid-based, monolayer preparation in the evaluation of thyroid lesions by fine needle aspiration biopsy: Comparison with the conventional smear method. Acta Cytol 2009;53:130-6.
307. Arabi H, Shah M, Saleh H. Aspiration biopsy cytomorphology of primary pulmonary germ cell tumor metastatic to the brain. Diagn Cytopathol 2009;37:715-9.
308. Saleh HA, Aulicino M, Zaidi SY, Khan AZ, Masood S. Discriminating hepatocellular carcinoma from metastatic carcinoma on fine-needle aspiration biopsy of the liver: The utility of immunocytochemical panel. Diagn Cytopathol 2009;37:184-90.
309. Saleh HA, El-Fakharany M, Makki H, Kadhim A, Masood S. Differentiating reactive mesothelial cells from metastatic adenocarcinoma in serous effusions: The utility of immunocytochemical panel in the differential diagnosis. Diagn Cytopathol 2009;37:324-32.
310. David D, Clayman L, Saleh H. Value of fine-needle aspiration biopsy in initial evaluation of floor of the mouth masses: Report of a case of low-grade mucoepidermoid carcinoma. Diagn Cytopathol 2010;38:81-4.
311. Jin B, Pickens A, Shah MB, Turrisi A, Saleh H. Primary large cell neuroendocrine carcinoma of the vagina: Cytomorphology of previously unreported case. Diagn Cytopathol 2010;38:925-8.
312. Eilers S, Facik M, Mukunyadzi P, Wakely P, Spiczka AW, LaPolice P, *et al*. Cytopathologic interpretative variation of nodular goiter of the thyroid on fine needle aspiration cytology: Synopsis of 1050 responses from the ASCP NonGyn assessment program. Cancer Cytopathol 2010;118:347-8.
313. Beraki E, Sauer T. Determination of HER-2 status on FNAC material from breast carcinomas using *in situ* hybridization with dual chromogen visualization with silver enhancement (dual SISH). Cytojournal 2010;7:21.
314. Sauer T. Fine-needle aspiration cytology of extra mammary metastatic lesions in the breast: A retrospective study of 36 cases diagnosed during 18 years. Cytojournal 2010;7:10.
315. Sauer T, Ebeltoft K, Pedersen MK, Kåresen R. Liquid based material from fine needle aspirates from breast carcinomas offers the possibility of long-time storage without significant loss of immunoreactivity of estrogen and progesterone receptors. Cytojournal 2010;7:24.
316. Bofin AM, Nygård JF, Skare GB, Dybdahl BM, Westerhagen U, Sauer T. Papanicolaou smear history in women with low-grade cytology before cervical cancer diagnosis. Cancer 2007;111:210-6.
317. Sauer T. Breast cytopathology: Fine needle aspiration cytology of mammographic microcalcifications with emphasis on the cytologic features of ductal carcinoma *in situ*. Acta Cytol 2007;51:259.
318. Sauer T, Keramzadeh M. Characteristic cytologic features of histologic grade 1 breast carcinomas in fine needle aspirates. Acta Cytol 2007;51:309-10.
319. Karimzadeh M, Sauer T. Diagnostic accuracy of fine-needle aspiration cytology in histological grade 1 breast carcinomas: Are we good enough? Cytopathology 2008;19:279-86.
320. Sauer T, Karimzadeh M. Characteristic cytological features of histological grade one (G1) breast carcinomas in fine needle aspirates. Cytopathology 2008;19:287-93.
321. Anshu, Herbert A, Cochand-Priollet B, Cross P, Desai M, Dina R, *et al*. Survey of medical training in cytopathology carried out by the journal Cytopathology. Cytopathology 2010;21:147-56.
322. Beraki E, Sauer T. Determination of her-2 status on fnac material from breast carcinomas using duoSISH. Acta Cytol 2010;54:414.
323. Ebeltoft K, Pedersen MK, Sauer T, Karesen R. LIQUID-based material from fine needle aspirates of breast carcinomas is an optimal pre-procedural handling of the tumor cells and offers the possibility of long time storage without significant loss of antigenicity of estrogen and progesterone receptors. Acta Cytol 2010;54:442.
324. Kocjan G, Cochand-Priollet B, de Agustin PP, Bourgain C, Chandra A, Daneshbod Y, *et al*. Diagnostic terminology for reporting thyroid fine needle aspiration cytology: European Federation of Cytology Societies thyroid working party symposium, Lisbon 2009. Cytopathology 2010;21:86-92.
325. Thrall MJ, Giampoli EJ. Routine review of ascites fluid from patients with cirrhosis or hepatocellular carcinoma is a low-yield procedure: An observational study. Cytojournal 2009;6:16.
326. Thrall M, Kjeldahl K, Gulbahce HE, Pambuccian SE. Liquid-based Papanicolaou test (SurePath) interpretations before histologic diagnosis of endometrial hyperplasias and carcinomas-study of 272 cases classified by the 2001 Bethesda System. Cancer Cytopathol 2007;111:217-23.
327. Alsharif M, Andrade RS, Stelow EB, Thrall MJ, Pambuccian S. Endobronchial ultrasound-guided (EBUS) transbronchial fine needle aspiration (FNA): The university of Minnesota initial experience. Cancer Cytopathol 2007;111:408-9.
328. Thrall MJ, Miller L, McKeon D, Stelow EB, Gulbahce HE, Pambuccian SE. The effect of changing the threshold for atypical squamous cells under the Bethesda 2001 classification system. Cancer Cytopathol 2007;111:369.
329. Thrall MJ, Pambuccian SE, Stelow EB, McKeon DM, Miller L, Savik K, *et al*. Impact of the more restrictive definition of atypical squamous cells introduced by the 2001 Bethesda system on the sensitivity and specificity of the papanicolaou test-A 5-year follow-up study of papanicolaou tests originally interpreted as ASCUS, reclassified according to Bethesda 2001 criteria. Cancer Cytopathol 2008;114:171-9.
330. Thrall MJ, Giampoli EJ. Routine review of ascites fluid from patients with cirrhosis or hepatocellular carcinoma is a low-yield procedure. Cancer Cytopathol 2008;114:354-5.
331. Thrall MJ, Smith DA, Mody DR. Women>or=30 years of age with low grade

squamous intraepithelial lesion (LSIL) have low positivity rates when cotested for high-risk human papillomavirus: Should we reconsider HPV triage for LSIL in older women? Diagn Cytopathol 2010;38:407-12.
332. Smith D, Fairley T, Thrall M.A pilot study of rapid prescreening in liquid-based papanicolaou tests. Cancer Cytopathol 2010;118:342-3.

EDITORIAL/PEER-REVIEW STATEMENT

CytoJournal editorial team thanks the Academic editor: LaVentra E. Danquah, MIS, MLIS, (laventra@wayne.edu) Coordinator for Instruction, Liaison, and Outreach Services, Shiffman Medical Library, Mazurek Medical Education Commons, Wayne State University, 320 E. Canfield, Detroit, MI 48201, (313-577-9083) for completing the peer-review process for the manuscript of this article.


PAPANICOLAOU SOCIETY OF CYTOPATHOLOGY
Dedicated to Clinical Practice - Clinical Education - Clinical Research
George N. Papanicolaou
1883-1962
JOIN THE PSC!
NEW Benefits to PSC members:
Special annual subscription rate of $60 to the journal "Cancer Cytopathology"
Will include the print journal (12 issues in 2014) as well as electronic access
Effective with Volume 122/Publishing year 2014
Discount $50 subscription rate for paper copy of "CytoJournal" (vs. regular $375)
The Membership Committee
APPLY TODAY: http://www.papsociety.org/members.html

PSC Membership - Apply Today!

http://www.papsociety.org/members.html

Membership..

MEMBERS ONLY

Download Membership Directory

Lost Username or Password?

Benefits to PSC members

- **Focus** Newsletter
- **Diagnostic Cytopathology** subscription
  (may donate the copy to pathologist in underserved country)
- **'CytoJ OA Stewards- Plus' benefits :-**
  Waiver of $1500 Article Publication Charge,
  FREE PDF of all **CytoJournal** articles,
  Optional print copy of **CytoJournal** at nominal annual subscription,
  & many other benefits http://www.cytojournal.com/OASteward.asp
- Representation at the **USCAP**
- Representation at the **European Congress of Cytopathology**
- **E-learning** education initiatives
- **Image atlas** access
- **Membership directory**

x all materials to:

Papanicolaou Society of Cytopathology (PSC) is
'CytoJournal OA Stewards'

CYTOJOURNAL
www.cytojournal.com
Peer-reviewed, Open access, Pub-Med indexed
Scholarly Cytopathology Journal

All PSC members entertain 'CytoJ OA Stewards' benefits
(for details visit http://www.cytojournal.com/OASteward.asp).

Papanicolaou Society of Cytopathology

Dedicated to Clinical Practice □ Clinical Education □ Clinical Research
George N. Papanicolaou
1883-1962

By these letters let it be known that

NAME

is a member of the Papanicolaou Society of Cytopathology
YEAR

Martha Bishop Pitman, M.D.
President, PSC

Eric Suba, M.D.
Treasurer, PSC

Join today by downloading and filling the membership form from http://www.papsociety.org/docs/09/pscapp2009.pdf

You will be emailed a certificate as shown here

(Please forward this to your colleagues)