Utility of Telecytology for Performing ROSE at a Cancer Center

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Disclosures

• No conflict of interest or disclosures
Expansion of Healthcare Systems into Smaller Communities
Balancing ROSE

ADVANTAGES

• Rapid adequacy Assessment
• Reduces need for additional passes
• Improves diagnostic yield
• Enables triage of specimens
• Builds relationships between the aspirator and pathologist

DISADVANTAGES

• Increased time for pathologist performing ROSE
• Increased cost 💰
• Requires experienced pathologist/cytotechnologist
Planning a ROSE

• WHAT are…
  – The GOALs of ROSE for location
  – Set up for ROSE
  – Immediate impact of ROSE
  – Role of telepathology

• HOW will…
  – Feedback be given
  – Material for ancillary studies and mutational analysis be triaged
  – Material be transported

• WHO will…
  – Perform ROSE
  – Sign out the case
Telepathology

• Tremendous advances in digital pathology
• Uses of telepathology
  – ROSE
  – Consultations
  – Teaching/education
  – Archive material

• Telecytology is now used for ROSE
  – In-house
  – Remote locations
Dynamic Telepathology

• Whole slide scanner, motorized microscope with robotic remote control and video camera
  – Allows the remote viewer to operate and control the view of the slides independently
Robotic Telecytology for Remote Cytologic Evaluation without an On-site Cytotechnologist or Cytopathologist: An Active Quality Assessment and Experience of Over 400 Cases

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- Robotic TC for IA is effective without cytotech staff
- IA of smears & touch preps
- 439 cases; variety of CT- & US-guided specimens
- No downgrades, minor upgrades
- High concordance

Table 3: Comparison of robotic microscope assisted adequacy with final adequacy assessment

<table>
<thead>
<tr>
<th>TC adequacy assessment</th>
<th>Final assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adequate</td>
</tr>
<tr>
<td>Adequate</td>
<td>362</td>
</tr>
<tr>
<td>Inadequate</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>391</td>
</tr>
</tbody>
</table>

*Downgraded cases (adequate initially on TC, inadequate on final assessment). TC: Telecytology

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Implementation of Telecytology

• Organizational structure / Workflow
• Financial commitment
• Technical factors
• Regulatory requirements
• Guidelines
Internet Connection & Secure Screen Sharing

• Several secure screen sharing sites available (examples)
  – Epiphan Lecture Recorder – IP address (MDACC)
  – Webex – Screen sharing via meeting
  – Bombar – Remote access to laptop attached to microscope; allows adjustments to image by both parties
Telecytology In-House

- Bronchoscopy suite contains a lab prep area & microscope
- ~3 min from main cyto lab
- Cytotech performs ROSE
  - Adequate sampling of LN
  - Malignant ancillary studies
- Telepathology capability; not used on every case
Telecytology Remote Location

- West Houston Regional Imaging Center is ~25 miles from main cyto lab (at least 1 hr commute)
- Telepathology since 2014
- 1 cytotech on-site
- Courier system 2X day
- Medical director goes at least 4X/yr
- Cytology oversees for CAP
Firewall at MDACC
Selection of RTIS™ System

Functional Requirements

• GOAL: Facilitate rapid utilization & evaluation to perform off-site ROSE similar to on-site (<10 min)
  – No pre-scanning of entire slide
  – Does not require “remote desktop control software” to launch prior to viewing
  – Minimal delay in focusing, lens power changes, & navigating slide movement
  – Allows for judicious movement, i.e., rapid movement in non-cellular areas
Selection of the RTIS™ System

- Review multiple slides (3 to 20; avg 9)
  - Does not require additional pre-scans if the slide limit is exceeded
- Review large area of slide
- Accommodates viewing 3-D groups
- RTIS™ cost less than robotic systems
- Presence of CT ensures that adequacy can be performed at the minimum if technical problems occur
Cost to Set Up MDACC Telecytology

- **RTIS™ system** ($30,000 system and ~$50,000 total set up)
  - HD true high-definition 3-CCD medical grade camera
  - Cables
  - RTIS codec device
  - 42” monitor with wall mount

- **Microscope**
- **Computer station & monitor**
- **2 network (Ethernet) connections**
- **High speed network, plus configuration of hospital network**
- **Large widescreen monitors that support high definition**
Selection of RTIS™ System

Initial Design for Remote Telecytology

- Start with 1-2 cases/day
- Anticipated growth of the service to 10-15 cases/day
- Add pathologist when >10 cases/day and use RTIS™ for consultations as needed

Telepathology Update

- No significant volume ↑, ~2 cases/day (range 0-6)
- Adding telecytology at other remote locations
WH Imaging Center ➔ Main Campus

WH set up with microscope & monitors

Pathologist log on with IP address and communicate via phone
Documentation

- **Patient Requisition Worksheet**
  - 2 Pt identifiers
  - Site, laterality, size of lesion
  - History

- **Cytotechnologist Assessment Worksheet**
  - Number of IA
  - Preliminary assessments
  - Number of slides (Pap & DQ)
  - Cell block or cytospin
Validation Study at MDACC

• See CAP “Test Method Validation & Verification” in CAP: All Commons Checklist
  – 10 cases selected by medical director for either frequency seen or level of difficulty
  – Cases blinded to participants & viewed by pathologists at main location
  – ROSE rendered independently
  – Data summarized & feedback given
CAP Certification

- Telepathology Procedures & Policies (CAP: Laboratory General Checklist)
  - Ensure correct pt ID & slide/images reviewed
  - Training for all users of the system
  - Reasonable pt confidentiality & security
  - Documentation of results
  - Inclusion of telepathology services into lab QI program
Quality Improvement

• Included in monthly QI conference in cytology
• Remote CT participates through Webex
• Similar quality indicators values as other FNAs
• CT responsible for CAP readiness
Cytotechnologist’s Responsibilities at Remote Location

- Labeling, smearing, & staining of slides
- Communicating pt information
- Driving the microscope with instructions from the pathologist
- Recording assessment
- Accessioning & processing specimen

- Packaging case for transport
- Maintaining laboratory supplies
- Daily quality control for stains
- Monitor equipment maintenance
- Update records for CAP inspection
Remote ROSE for Dx & Ancillary Studies Using Telepathology

- ROSE--Diff Quik & Pap-stained smears
- Cytospin or Cell block
- RPMI
- FLOW--suspected lymphoma
- Microbiology--cultures
- IPOX or Special stains
- Diagnosis
- Molecular Tests
- FISH
- MDL
- IPOX

In vitro cultures

MDL IPOX
Learning and Development

- Develop PT to prepare before using telecytology
- Share experiences about errors
- Plan ahead to know what are possible cases for that day
- Build a strong and supportive team through clear communication
- Have a backup plan
Communication

• Operator and Pathologist
  – 2 patient identifiers & site of FNA
  – Pertinent Hx (shared EHR)
  – Movement of the slide
  – View select fields vs. all of the slides
Communication

• Pathologist and Aspirator
  – Is it adequate to make a dx
  – Does the interpretation correlate with radiographic impression
  – Triage for ancillary studies: cell block, IPOX, FLOW, FISH, and/or molecular studies
  – If indeterminate/suspicious, IS core bx needed
  – Will you change your management based on the diagnosis (i.e. placement of clip or core bx)
Lessons Learned using RTIS™ System

• Problem:
  – Cells of interest may not be seen by the viewer if not in the center of the operator’s microscope
  – Maintain focus of the slides
  – Provide synchronized view with the remote viewer because there is a second delay

• Helpful:
  – Operator have mounted monitor to see what is projected and if in focus
Lessons Learned using RTIS™ System

• Problem:
  – Trouble connecting IP address through intranet

• Helpful:
  – Put test slide on the microscope for viewing before a real case happens
  – No image, then troubleshoot
  – Have backup plan

“Houston We have a Problem!”
Lessons Learned using RTIS™ System

• Problem:
  – Time consuming if there are a lot of slides

• Helpful:
  – Limited number of slides & add to rinse sol’n
  – Transmit cellular slides 1st (prefer Pap-stained smears first)
Lessons Learned using RTIS™ System

• Problem:
  – Feeling nauseated with the movement of the slide

• Helpful:
  – Operator needs practice moving smoothly
  – Look away if moving in non-cellular areas
  – Don’t view slides on an empty stomach
Efficacy of telecytopathology for Preliminary Assessment of FNA at a Remote Facility

- MDACC experience over 2 years
- 674 FNAs from 444 pts (352 F, 92 M; age range 21-92 yrs)
- Evaluated for preliminary assessment vs final dx, ancillary studies, & pt management
Sites of 674 US-guided FNAs Evaluated by Telepathology

- Lymph nodes: 51%
- Breast: 26%
- Thyroid: 19%
- Soft tissue: 16%
- Salivary gland: 5%
Adequacy & Preliminary Assessment

- Adequate cellularity, favor benign
- Adequate cellularity, favor malignant
- Adequate cellularity, further review needed
- Borderline cellularity, further review needed, additional material recommended
- Indeterminate cellularity, adequacy dependent on the clinical/radiographic certainty of representative sampling
- Non-diagnostic specimen
## Preliminary Assessment versus Final Dx

<table>
<thead>
<tr>
<th>Preliminary</th>
<th># of Cases</th>
<th>Final Dx</th>
<th># of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate, favor benign</td>
<td>275 (41%)</td>
<td>Negative for malignancy</td>
<td>391 (58%)</td>
</tr>
<tr>
<td>Adequate, favor malignant</td>
<td>182 (27%)</td>
<td>Positive for malignancy</td>
<td>205 (30%)</td>
</tr>
<tr>
<td>Adequate, further review needed</td>
<td>162 (24%)</td>
<td>Atypical Suspicious</td>
<td>24 (4%)</td>
</tr>
<tr>
<td>Borderline/Indeterminate cellularity</td>
<td>37 (5%)</td>
<td>Indeterminate, favor benign</td>
<td>26 (4%)</td>
</tr>
<tr>
<td>Non-diagnostic</td>
<td>18 (3%)</td>
<td>Non-diagnostic</td>
<td>18 (3%)</td>
</tr>
</tbody>
</table>
## Cytology Dx and Triaging of FNAs

<table>
<thead>
<tr>
<th>DX</th>
<th># cases (%)</th>
<th>CB</th>
<th>IPOX</th>
<th>FCM</th>
<th>FISH</th>
<th>CNB</th>
<th>HPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Met carcinoma</td>
<td>132 (35)</td>
<td>14</td>
<td>18</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Breast ca</td>
<td>43 (11)</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Carcinoma, other</td>
<td>23 (6)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>6 (2)</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>1 (&lt;1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Suspicious</td>
<td>10 (3)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Atypical</td>
<td>24 (6)</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>26 (7)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Benign</td>
<td>391 (58)</td>
<td>12</td>
<td>8</td>
<td>20</td>
<td>0</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Non Dx</td>
<td>18 (3)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>374</strong></td>
<td><strong>39</strong></td>
<td><strong>34</strong></td>
<td><strong>30</strong></td>
<td><strong>12</strong></td>
<td><strong>42</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>
## Discrepancy Cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Site</th>
<th>ROSE</th>
<th>FINAL</th>
<th>Review</th>
<th>Type of Discrepancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Breast</td>
<td>Pos</td>
<td>Negative</td>
<td>Abundant single cells, lack of myoepithelial cells</td>
<td>Major</td>
</tr>
<tr>
<td>2</td>
<td>Breast</td>
<td>Neg</td>
<td>Atypia</td>
<td>Proliferative ductal epithelium with cellular atypia</td>
<td>Minor</td>
</tr>
<tr>
<td>3</td>
<td>Thyroid</td>
<td>Neg</td>
<td>Atypia</td>
<td>Rare atypical cells</td>
<td>Minor</td>
</tr>
<tr>
<td>4</td>
<td>Parotid</td>
<td>Neg</td>
<td>Indet</td>
<td>Epithelial neoplasm with basaloid features</td>
<td>Minor</td>
</tr>
<tr>
<td>5</td>
<td>Breast</td>
<td>Neg</td>
<td>Atypia</td>
<td>Proliferative ductal epithelium with focal atypia</td>
<td>Minor</td>
</tr>
<tr>
<td>6</td>
<td>Thyroid</td>
<td>Neg</td>
<td>Non-Dx</td>
<td>Scant colloid with rare follicular cells</td>
<td>Minor</td>
</tr>
</tbody>
</table>
Case 1: Breast FNA
(Major: Malignant to Benign)

Abundant single cells & lack of myoepithelial cells were contributing factors. Note only mild nuclear atypia
Case 3: Thyroid FNA (Minor: Benign to ACUS)

Rare cells with enlarged, irregular nuclei, & suggestion of intranuclear inclusion in a background of lymphocytes. Focal atypia and cellular distortion were contributing factors. No follow-up.
Case 4: Parotid FNA
(Minor: Benign to Indeterminate/Neoplasm)

Thick fragments without myxoid stroma. Final dx epithelial neoplasm with basaloid features. No follow-up.
Case 6: Thyroid FNA
(Minor: Benign to Non Dx)

Specimen very scanty with follicular cells spread out over several slides & minimal colloid. Cytospin acellular.
 Reasons for Discrepancies

• Hypocellular aspirates
• Few atypical/tumor cells
• 3-dimensional fragments
• Overstaining
• Air-drying artifact
Factors Effecting Telecytology

- Experience of the aspirator
- Slide preparations
- Telepathology system
- Skill of the operator
- Experience of the cytopathologist
- Communication
- Time
Summary

• Telepathology from an off-site facility can be utilized for adequacy & preliminary assessment

• ROSE guides acquisition for ancillary studies such as IPOX, FLOW, & molecular studies (FISH & PCR)

• Allows for on-site patient management such as obtaining additional tissue (CNB & clip placement)

• Low-cellularity, overall mild atypia, focal atypia, cellular distortion, & thick fragments are limiting factors
PATHOLOGY DESK OF THE FUTURE

THANK YOU