Safety in Intra-operative MRI Use
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Abstract

Intra-operative Magnetic Resonance Imaging (iMRI) has gained increasing use and has expanding indications. While initially utilized for purely neurological cases, iMRI is now being utilized in cases jointly managed with the otolaryngologist. Given the expansion of this technology into the field of Otolaryngology, we seek to explore the safety protocols in place and the safety track record of this technology.

Introduction

The initial use of iMRI is credited to the Black group at Brigham and Women’s Hospital in the mid 1990s where the arrangement provided for the first time almost real-time neuro-navigation to the neurosurgeon.1 As with any new technology, there are risks of potential harm; the high magnetic field can result in injury from radiofrequency burns, projectiles and altered device functions to name a few.2 There have been several reports regarding safety, safety concerns, and implementation of safe practices with the use of iMRI in both the radiology and neurological literature.3-5 At our institution Otolaryngology has been doing an increasing number of jointly managed cases with neurosurgery accessing the skull base. However, there is no data regarding intra-operative MRI in the jointly managed case.

There are several safety protocols which are utilized to ensure a safe environment for patients and staff.6 There are inherent safety features built into the design of the area of the Magnetic Resonance Imaging (MRI) suites. Additionally, there is a clearly spelled out Clinical Practice Manual for the MRI suites, which details specific policies pertaining to the use of the MRI operating rooms. All staff who work in the MRI rooms must undergo special training. There are two checklists employed to ensure all the safety requirements for the MRI have been met.

We sought to examine changing trends in intra-operative MRI in the jointly managed patient as well as the safety protocols in place and any necessary changes which had to be undertaken.

Figure 1: MRI OR Count Policy
Surgical Counts Must Follow the Count Policy with the following additions
• Instruments must be counted prior to the procedure on ALL cases in Smilow ORs 9 and 10.
• All instruments, needles, sharps and RF tagged sponges will be counted immediately prior to each MRI scan.
• An incorrect needle / sharp count requires floor search with a magnetic floor sweep.
• An incorrect RF sponge count requires RF scanning of the patient and field
• If the count cannot be reconciled the decision to proceed with the MRI scan is at the discretion of the surgeon and attending radiologist.
• Instruments must be counted at the end of the procedure on ALL cases in Smilow ORs 9 and 10.
• Any dropped item (instrument, needle, etc.) must be picked up immediately and accounted for to ensure it does not get moved into the imaging area when the magnet moves into the room.

Anesthesia Carts
• An initial inventory of items must be completed prior to entering the room.
• All items on top of the anesethic cart will be counted including laryngoscopes/ blades, needles, etc.
• An additional inventory of anesthesia supplies will be completed prior to moving the magnet in the operating room suite.
• A final inventory of anesthesia supplies will be completed at the end of the case.

Figure 2: Checklist Prior to MRI Garage Door Opening

• All MRI Team members complete a pad down and empty
• Bandage scissors are hanging on designated wall hook
• Visual Patient Check
• ESU disposable pad removed
• Pneumatic stocking disconnected
• Verify wire and lead count with neuro monitoring staff; removed from patient
• Anesthesia verifies count of laryngoscope handles, blades, stylets and nerve stimulators
• Anesthesia machine is locked, secured, and cleaned off completely
• If using non-MRI safe temp probe, probe has been removed
• Transport monitor; if used, is behind 5 gauss line
• IV infusion pump secured and behind 5 gauss line
• Non-essential equipment powered down and unplugged
• Surgical counts correct
• Secure Foley bag if it has metal clip
• Remove Blue wire from the Crane Drape

Table 1: Reported RL Solutions Events in the Intra-operative MRI Suites

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Number of Events</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect count</td>
<td>MRI proceeded</td>
<td>Sponge count incorrect x1</td>
</tr>
<tr>
<td>MRI Delay</td>
<td>1</td>
<td>Instrument count incorrect x3</td>
</tr>
<tr>
<td>MRI Canceled</td>
<td>2</td>
<td>MRI machine stopped midscan but ultimately fixed and scan proceeded</td>
</tr>
</tbody>
</table>

Figure 3: Total Transnasal/Septal Excisions of Pituitary Tumor in ENT Section 2014-2016

Methods and Materials

Yale New Haven Hospital has two operating rooms in the Smilow Cancer Hospital with intra-operative MRI compatibility. We reviewed the safety protocols in place for these specific operating rooms and changes to the safety protocols between 2014 and 2016. We additionally conducted a retrospective review of all the intraoperative MRI cases during this same time period. We determined the total number of intra-operative MRIs performed by reviewing the radiology log of intra-operative scans. Additionally, we reviewed over this time period the number of cases involving an Otolaryngologist as determined by a search of billing for CPT code 61548 allowing for determination of number of these cases over time. Finally, the internal event reporting system (RL Solutions) was searched for any safety incidents reported for the intra-operative MRI use and these events were reviewed.

Figure 2: Checklist Prior to MRI Garage Door Opening

Results

There is a well-established protocol for intra-operative MRI utilization which is outlined in the Clinical Practice Manual. All personnel working within the intra-operative MRI suite must undergo a training session prior to enter these operating rooms for the first time. There are specific checklists and safety protocols for each case that is conducted in these rooms; these include special instructions for counting of instruments (Figure 1) as well as pre-MRI checklist which must be completed prior to an MRI being performed (Figure 2). This checklists have been updated recently to include removal of new temperature probes prior to scan since the new probes were not MRI compatible.

A total of 400 intra-operative MRIs were performed in 2014-2016. Over that time period, the number of cases jointly performed with the Otolaryngology Suite steadily increased (Figure 3). Review of safety reporting revealed a total of 6 events. There were no fatalities or serious injuries. Details of the event are tabulated below (Table 1).

Discussion

MRI has become an invaluable tool in surgical procedures and its use continues to expand.3,4 However, like many tools, there is a potential for harm both to patients as well as staff.4,5 As otolaryngology becomes increasingly involved in these types of cases, the safety of the patient as well as of the surgeon and staff are paramount.

Checklists in particular have risen to the top as a reliable and efficient tool to ensure safety.7-8 The use of checklists as part of safety procedures in the intra-operative MRI suite has been evaluated to a limited extent in the neurosurgical and radiology literature.2,3 Safety policies, however, have to have the flexibility to adapt to new situations and be modified to fit changes in use or equipment7 as was shown with changes in the temperature probes being used at Yale New Haven Hospital. Additionally, involvement of Otolaryngology in these cases has meant a two team surgery and additional instrument trays which must also be counted. In one instance of a miscount of instruments, it was due to the ENT tray not being appropriately counted initially. Awareness of the expanded surgical needs has helped prevent a recurrence of this problem.

Familiarity with the safety checklists as well as every staff members’ role in the safety protocol is important to understand and appreciate as otolaryngology becomes increasingly involved in these cases.

Conclusions

Safety in utilizing new technology is of the utmost importance. As otolaryngology becomes increasingly involved in cases utilizing iMRI, it is important that we appreciate the safety protocols in place, as well as make adjustments as needed to accommodate expansion of the surgical team.

References


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