DETECTION OF RETAINED FOREIGN OBJECTS IN UPPER EXTREMITY SURGICAL PROCEDURES WITH INCISIONS OF TWO CENTIMETERS OR SMALLER

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ABSTRACT

Background: While the true incidence of retained foreign bodies after surgery is unknown, it has been approximated at 1:5,500 operations overall, with substantially less frequency in hand and upper extremity procedures. Despite the rarity of foreign body retention in hand and upper extremity surgery, universal radiofrequency scanning for electronically-tagged sponges and automatic radiographic evaluation for incorrect sponge counts are employed for all surgical procedures at our institution. We demonstrate the infeasibility of retaining an operative sponge of a standard size in commonly performed hand and upper extremity procedures with incision sizes of two centimeters or less, and establish that visual detection of sponges in these cases is adequate.

Methods: Eighteen trigger finger releases, five carpal tunnel releases, three trigger thumb releases, and three de Quervain's tenosynovitis releases were successfully performed upon five cadaveric specimens by residents under supervision of fellowship-trained hand surgeons for a total of 29 two-centimeter or smaller incisions. Randomized surgical sponge placement was evaluated by a blinded observer at two distances and incision sizes were quantified. Kappa values were calculated to determine the acuity of visual detection versus the actual presence of a sponge.

Results: The maximum length of the standard surgical sponge that could be contained within an incision was three centimeters. When compared with the gold standard (whether the sponge had been placed or not by the operating resident), the placement of a standard surgical sponge could be detected correctly in 100% of cases at both "across the room" and "at the table" distances, for kappa values of 1.0 and 1.0 respectively. This did not vary with incision size or surgical procedure.

Conclusions: The added cost and time from radiofrequency detection of retained sponges and radiographic evaluation in the event of incorrect sponge counts can be safely eliminated if sponges can be reliably visually detected.

Clinical Relevance: This cadaveric study informs patient safety practices by demonstrating that visual detection of surgical sponges is adequate for certain upper extremity procedures.

Keywords: retained foreign body, retained foreign object, radiofrequency, upper extremity, hand, quality improvement, patient safety

INTRODUCTION

Retained foreign bodies following surgery are preventable medical errors that may result in patient harm. The Centers for Medicare and Medicaid Services (CMS) consider these to be "never events," and do not reimburse for any additional care required[1]. While the true incidence of retained foreign bodies after surgery is unknown, it has been approximated at 1:5,500 operations[2]. The majority of these items in the reported literature are surgical sponges with greater than 80% of those being retained in major body cavities such as the abdomen, pelvis and thorax[3]. While standardized counting of surgical instruments and sponges has been widely implemented to help prevent retained foreign bodies, more than half of the retained foreign bodies in the reported literature occurred when the sponge count was pronounced correct at the end of the case[3].

Recently, the use of adjunctive technologies such as radiofrequency sensors and electronically tagged sponges have begun to play an important role in the detection of retained foreign bodies. One study noted that when sponges with a radiofrequency chip were placed behind the abdomen radiofrequency wand detection of the sponges was accurate 100% of the time, even in morbidly obese patients[4].

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The incidence of foreign object retention is rare in the orthopaedic literature, particularly with regard to surgeries with incisions less than two centimeters, such as arthroscopy and hand and upper extremity procedures. An evaluation of the arthroscopy literature reveals one report of a broken outflow cannula removed from a knee arthroscopy patient 10 years post operatively[5] and a single report of a scalpel blade removed from a knee 10 years post operatively[6]. Two additional reports addressing instrument failure or retained foreign bodies in arthroscopy from 1978 and 1988 reflect significantly different arthroscopic techniques and equipment than are used today[7,8].

Regarding hand and upper extremity surgery specifically, there is sparse literature concerning retained foreign bodies. One case report notes a retained catheter fragment in the radial artery after anesthesia insertion of an arterial line9 and another reports retained peg guides on a distal radius locking plate[10]. One large review of 28,737 hand and upper extremity cases performed at a freestanding ambulatory surgery center found no incidences of retained foreign bodies[11].

Despite the apparent extreme rarity of foreign body retention in hand and upper extremity surgery, standard precautions to avoid sponge retention still apply universally to all surgical procedures including upper extremity procedures at our institution. These precautions include radiofrequency scanning for electronically-tagged operative sponges, and in the event that sponge counts are incorrect, automatic radiographic evaluation of the surgical site requiring additional expense and operative delay while an attending-level radiologist evaluates the film. The purpose of this study is to rigorously demonstrate the infeasibility of retaining an operative sponge of a standard size in commonly performed hand and upper extremity procedures with incision sizes of two centimeters or less, and to establish that visual detection of sponges in these cases is non-inferior. We hypothesize that the added cost and time from radiofrequency detection of retained sponges and radiographic evaluation in the event of incorrect sponge counts may be safely eliminated if sponges can be reliably visually detected.

METHODS

Five cadaveric upper extremity specimens were obtained for educational purposes using departmental funding. Orthopaedic residents, supervised by fellowship trained hand surgeons, performed simulated operations including a total of 18 trigger finger releases, five carpal tunnel releases, three trigger thumb releases, and three de Quervain's tenosynovitis releases on these specimens. Carpal tunnel incisions were measured at two centimeters, and all other incisions were less than two centimeters. Following completion of each individual procedure, the operating resident was randomized to place or not place a standard Ray-tec® 8" x 4" operative sponge into the surgical incision, packing as much of the sponge into the incision as reasonably possible. Randomization was performed via a random number generator with an even number prompting sponge placement and an odd number prompting no sponge placement. Clean, unused, non-sterile surgical discard sponges were used for this study.

A second resident blinded to sponge placement then entered the lab and from a pre-marked 10-foot distance "across the room" visualized the cadaver specimen, then indicated verbally whether there was visual detection of a retained sponge. This was repeated for a closer "at the table" distance. If a sponge had been placed in the wound it was then removed and the length in centimeters contained within the wound was recorded.

Verbal consent was obtained prior to participation from all involved orthopaedic surgery residents, and data collection occurred during regularly scheduled resident cadaver labs. An analysis of inter-rater agreement (at "across the room" and "at the table" distances) was compared with the gold standard (sponge placement by the operating resident) and kappa values were calculated, as a function of both distance and incision size.

RESULTS

Eighteen trigger finger releases, five carpal tunnel releases, three trigger thumb releases, and three de Quervain's tenosynovitis releases were successfully performed upon five cadaveric specimens by residents under supervision of fellowship-trained hand surgeons. All carpal tunnel incisions were measured at two centimeters, and all additional incisions were determined to be less than two centimeters, for a total of 29 incisions two centimeters or smaller in length. The maximum length of the standard eight-inch surgical sponge that could be contained within any surgical incisions was three centimeters for a carpal tunnel release. When compared with the gold standard (whether the sponge had been placed or not by the operating resident), the placement of a standard surgical sponge could be detected correctly in 100% of cases at both "across the room" and "at the table" distances, for kappa values of 1.0 and 1.0 respectively. This did not vary with incision size or surgical procedure.

DISCUSSION

With the increasing focus on cost of medical care and optimizing the utilization of available operative room time, there has been renewed enthusiasm for implementing cost and time saving measures that do

not negatively impact patient safety. At our institution, radiofrequency scanning for electronically tagged surgical sponges been instituted for all operative cases as an addition to standard counting procedures to evaluate for retained sponges. Additionally, incorrect sponge counts still automatically prompt radiographic examination of the involved extremity, which causes a mandatory surgical delay until the radiograph can be read by an attending-level radiologist.

Many commonly performed hand surgical procedures have a brief surgical time between five and ten minutes, with some surgeons performing as many as 10 cases per day. Especially with full operative schedules, quick turnover times, and often concurrent or staggered rooms, the elongation of surgical case time for additional scanning or radiographic safety procedures can create significant delays leading to measurable decreases in surgical efficiency and increased costs with operating room time valued at $62 per minute by some estimates[12].

Radiofrequency scanning is not without additional expense. Radiofrequency sponges cost an additional $0.55 per individual sponge, and each use of a radiofrequency wand requires the placement of a $1.95 ($2.11 at our institution) disposable sterile sleeve[13]. While this may not appear to be a significant expense, the use of radiofrequency scanning for cases that have no possibility of sponge retention would prove quite costly over time at high volume surgical institutions.

Intraoperative count discrepancies are estimated to occur in as many as one percent of cases, causing an average time of 18 minutes of surgical delay[13]. The cost of a single intraoperative radiograph has been estimated conservatively at $122, but may in fact be closer to $450 when consideration is given to the cost of a radiography technician and radiologist fees[13].

Our results suggest that the use of radiofrequency sponges and scanning procedures is unnecessary to ensure patient safety in common hand and upper extremity cases with surgical incisions of two centimeters or less. Additionally, we have demonstrated that radiographic evaluation of an upper extremity wound two centimeters or less does not provide any benefit over visual inspection if the operative sponge count is incorrect at the end of the case.

This study has several limitations. It does not address retained foreign objects other than standard surgical sponges. It is a cadaveric study that uses cadaver tissues which can only simulate living surgical patients. Additionally, we have evaluated a specific subset of upper extremity procedures which may have similar wound sizes but different wound characteristics compared to other upper extremity procedures and may have uncertain generalizability as a result.

CONCLUSION

The results of this study suggest that radiofrequency scanning and radiographic evaluation of hand and upper extremity wounds with incisions two centimeters or less provide no additional benefit to the detection of standard operative sponges when compared with visual detection.

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