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Retained Foreign Body

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Abstract

Retained foreign bodies after surgeries or procedures are a rare complication with great consequences. The most commonly retained surgical items are guidewires, surgical sponges, and suture needles. The procedure at highest risk for retained foreign bodies is central venous catheterization. The literature regarding specific risk factors that increase the potential for retained surgical items varies. Evidence suggests that procedures with blood loss over 500 mL, lack of or an incorrect surgical instrument and sponge count, longer procedures, and unexpected intraoperative events all increase the risk of retained surgical items. There is conflicting evidence on the effect that elevated body mass index (BMI) or the emergent nature of a procedure has on retained surgical item risk. Interventions aimed at preventing retained foreign bodies include surgical counts, mandatory imaging after procedures, bar-coding of items used during surgery, and radiofrequency detection systems. These interventions have varying detection rates. Regardless of the safety measures used, none are perfect and a high index of suspicion must be maintained to prevent retained surgical foreign bodies.

Keywords: gossypiboma, retained foreign body

1. Case vignette

A 23-year-old man presented via ambulance to a level 1 trauma center after sustaining multiple gunshot wounds to the chest and abdomen. The patient was in hemorrhagic shock upon presentation to the trauma bay with a heart rate in 140 s and blood pressure of systolic 70 s. The patient had decreased mental status, and he was cool and diaphoretic. On primary survey, he was found to have one gunshot wound to the left thoracoabdominal region and another to the right thoracoabdominal region. Resuscitation efforts were initiated in the emergency department with blood products, and he was emergently brought to the operative theater for exploration. While in the operating room (OR) prior to beginning surgery, the patient underwent



Figure 1. Postoperative chest x-ray demonstrating the radio-opaque markers of the laparotomy pads around the liver. Note the same radio-opaque marker of a laparotomy pad in the left hemithorax.

cardiac arrest from hemorrhagic shock despite resuscitation. A left anterolateral thoracotomy was performed in order to explore the left thoracic cavity and cross-clamp the aorta. Some hemothorax was encountered upon entering the chest. There was no pericardial tamponade. A minor lung laceration secondary to the penetrating injury was encountered during the thoracic exploration. Only after the aorta was cross-clamped and resuscitation continued was return of spontaneous circulation achieved. Exploratory laparotomy was performed, and the patient was found to have a large hemoperitoneum secondary to a shattered spleen and left kidney, and a large liver injury. The patient underwent left nephrectomy and splenectomy, and the liver was packed with laparotomy pads. The aortic cross-clamp was removed, and there was no further surgical hemorrhage. The remainder of the abdomen was explored, and small bowel perforation GIA stapler is resected for damage control to prevent further spillage of succus. By this point in time in the procedure, the patient was cold, acidotic, and coagulopathic due to the major trauma and massive blood loss. Due to the coagulopathy of trauma as well as the need for further massive resuscitation, the decision was made to leave the liver packed with laparotomy pads with a plan for returning to the operating room for repeat abdominal exploration after resuscitation was complete. The abdomen was temporarily closed with a vacuum-assisted abdominal pack dressing. Since there was only minor trauma in the left chest, the pleural space was irrigated and examined for retained surgical instruments and laparotomy pads, two chest tubes were placed, and the thoracotomy was definitively closed. The closing instrument and laparotomy pad counts were not accurate due to the laparotomy pads left in the abdominal

cavity to maintain hemostasis of the liver injury. The patient was taken to the trauma intensive care unit for continued resuscitation, warming, and correction of the coagulopathy. His routine postoperative chest x-ray is shown in **Figure 1**. This was diagnosed with a retained laparotomy pad in the left hemithorax. An extensive discussion and disclosure of this adverse event were performed with the family of the patient. At the time of planned re-exploration of the abdomen, a left video-assisted thoracoscopic surgery was performed to remove the retained laparotomy pad from the thorax and to wash out any retained hemothorax. The patient had a prolonged hospitalization. He underwent multiple subsequent abdominal surgeries for debridement of his abdominal wound. Eventually, he survived to discharge.

2. Overview of retained surgical foreign bodies

Retained surgical foreign bodies are objects typically used in the course of a procedure or surgery that is inadvertently left remaining in the patient after the completion of the procedure. These items range from surgical instruments, to surgical sponges, to needles. Given the increased awareness and promotion of patient safety in medical care, much effort has been devoted to the elimination of retained surgical items in the past several years and several clinical reviews and meta-analyses have been performed to examine this topic.

Of the potential items at risk of unintentionally remaining within a patient after a surgery or procedure, guidewires for central venous catheter placement and surgical sponges are the two most commonly reported items [1–3]. Other items at risk are surgical instruments, suture needles, and any other item utilized during a surgery or procedure [2]. These various items can cause a variety of different responses depending on how long and where these items were misplaced. The duration of time between the index procedure and recognition has been found to correlate with symptomatology [4]. Local and systemic signs and symptoms associated with retained foreign objects can include abdominal pain, abscess formation, nausea and emesis, wound complications, palpable mass, systemic inflammatory response, and ileus. Furthermore, fibrosis, purulence, erosion, and fistulization can occur with long-term retention of foreign objects after surgery [4].

Considering all procedures, the median incidence of retained surgical foreign bodies is estimated to be 1.32 events per 10,000 surgical procedures [1]. The highest risk procedure for a retained foreign body is central venous catheter placement at 3.04 events per 10,000 procedures [5]. This is followed closely by 2.98 events per 10,000 surgeries for cavitory explorations for emergent trauma surgery [6].

Beyond the risk to the patient, the medico-legal risks associated with retained surgical foreign bodies are great. Gawande et al. found in their case control series that each retained foreign body that ended in litigation resulted in \$52,581 on average in costs for compensation and legal defense expenses [7]. In contrast, other studies have found that average defense costs for retained surgical sponges were \$572,079 per case with indemnity payments of \$2,072,319 per case [8]. Certainly, differences between these studies can be accounted for by regional differences in tort reform as well as differences in how these cases are handled by the risk

management and legal defense teams of different institutions (e.g., out-of-court settlements versus trial awards). Regardless of the differences, it is clear that these cases are an immense financial burden on physicians and their medical malpractice insurance. Additionally, there are other stressors that are not accounted for by these studies, namely the emotional stress and time demand that these cases have on those physicians involved. These unquantified costs can take an immense toll on the physicians that cared for their patients and could potentially have other repercussions that alter the care that individual doctors provide as well as a systemic effect in the future as the medical community naturally would respond by shifting to a practice of more defensive medicine.

Studies vary in the specific risk factors for an increased risk of retained surgical foreign bodies. The meta-analysis by Moffatt-Bruce et al. identified: an estimated blood loss >500 mL, incorrect surgical counts, multiple operative procedures, longer procedures, lack of performance of a surgical count, and unexpected intraoperative factors that portend a greater risk for retained surgical foreign bodies [3]. Procedures with increased blood loss could necessitate more use of laparotomy pads and instruments. As this blood loss becomes more critical and acute, the stress level in the OR is worsened and would increase the chance of losing track of sponges and instruments. As the number of operative procedures, length of procedures, and involvement of multiple teams in the care of a patient increase, there is heightened potential for miscommunication among the different teams or error during the safety checks already in place to protect patients from these adverse events.

Studies differ on the risk that emergent procedures and elevated body mass index (BMI) portend toward retained surgical foreign bodies [3, 4, 6, 7, 9–11]. In one example, Gawande et al. found that emergent procedures were of very high risk for retained foreign bodies [7]. Emergent procedures intuitively seem a high risk since these procedures are more likely to not have a properly completed sponge and instrument counts prior to the initiation of the surgery. It was additionally found that for each 1 unit increment of BMI increase, the risk ratio of retained foreign bodies increases significantly by 1.1 [7]. In another study on the risk of retained foreign bodies in emergent surgery, Teixeira et al. identified the need for a damage control operation in trauma (i.e., liver packing and temporary abdominal closure) as a risk factor in their case series [6]. In contrast, Moffatt-Bruce et al. found that elevated BMI and emergent surgery were not risk factors for retained sponges or instruments [3]. Regardless of the evidence, a high index of suspicion for retained surgical foreign bodies is warranted in those patients undergoing an emergent procedure or in patients with increased body mass indices.

A retrospective study by Vannucci et al. examined the risk factors associated with retained guidewires after central line placement by anesthesia providers. Through a small case series, their retrospective analysis revealed that worsening of clinical condition during line placement and complex surgical procedures necessitates multiple line placements as risk factors for retained guidewires [5]. This seems to echo the findings of Moffatt-Bruce et al., concerning surgical procedures and risk factors for retained foreign bodies after surgical procedures.

Several interventions have been attempted to reduce the risk of retained bodies in surgical procedures. These interventions include procedural modifications such as mandatory instrument and sponge counts at the start and completion of procedures. Others have attempted

technology utilization to reduce the human error aspects of retained surgical foreign bodies (e.g., automated counting devices and mandatory imaging for foreign body detection).

Surgical counts remain a mainstay in operating rooms in the United States. The process is simple. All sponge and instruments are counted both before surgery and after surgery, and these numbers should be equal. This is a logical starting point to reduce the risk of retained surgical foreign bodies. Unfortunately, this process has much potential for error built into the process. Cima et al. found in their series that 62% of patients with a retained surgical foreign body had a correct postoperative sponge and instrument count [2]. The limitations of this preventative measure result from the reliance upon the accuracy of both a preoperative and postoperative sponge and instrument count. Naturally, any procedure reliant upon human accuracy and performance will be prone to error as seen in the evidence.

Since the standard surgical sponge and instrument count have much potential for error such as miscounting by staff, improper recording of the counts or additional surgical supplies introduced after the start of the procedure, some have attempted to remove the potential of human error via computer tracking. Greenberg et al. compared a computer-based bar-coded sponge system to standard surgical counting protocols [12]. The bar-coding of surgical sponges significantly improved the error detection rate in surgical counts compared to standard counting protocols. The difficulty of the bar-coding approach is that it is labor intensive to scan every single surgical instrument and sponge and it still relies upon accurate scanning of these items by the OR staff. Furthermore, there is a lack of availability of the bar-coded technology for all surgical instruments which prevents its wide acceptance.

Another approach attempted has been to utilize mandatory intraoperative or postoperative imaging. Intraoperative imaging has been found by Cima et al. to only detect 67% of the retained surgical foreign bodies [2]. This lower than expected detection rate was attributed by the authors of that study to the poor resolution of portable imaging equipment, poor communication of the purpose of the imaging study to radiology, or multiple other objects obscuring the imaging field. They found that the intraoperative imaging was better at detecting larger items compared to small items such as needles. Routine screening imaging has been advocated prior to definitive closure of body cavities after damage control surgery [6]. Furthermore, some have advocated for routine imaging in those patients at high risk of retained foreign bodies [7]. This specific protocol would assist in the identification of retained laparotomy sponges since these have very noticeable radio-opaque indicators within the sponge. Gawande et al. calculated that the number needed to treat for routine postprocedural imaging to prevent one retained foreign body was 300 [7]. With the average cost of legal defense and indemnity payments ranging from \$52,000 up to over \$2 million per case, and the NNT for routine imaging being 300, it has been argued that routine imaging in high-risk patients would be a cost-effective measure to reduce medical malpractice costs [7]. The downside to mandatory postoperative imaging includes increased radiation exposure as well as the reliance upon the need for human interpretation of the imaging study, and this is not perfect.

Radiofrequency detection systems (RFDS) have been used to aid in the detection of retained surgical foreign bodies. These devices come in various configurations, from RF detection wands waived over the patient to mats on the OR table that the patient is positioned upon.

Regardless of differences, they all utilize a radiofrequency signal to detect tagged devices or sponges that remain in vivo. Rupp et al. enrolled 2285 consecutive surgical patients into a prospective study where they utilized RFDS to detect foreign bodies, near-miss events, and to resolve miscounts [13]. They found that the RFDS assisted in the detection of one near-miss event (a Raytec sponge in the surgical drapes) despite a correct surgical count. Furthermore, they found that in the 35 miscounts that were identified, the RFDS aided in the detection of 11 items retrieved from a surgical site or body cavity. These systems seem to be effective in the prevention of retained foreign bodies and have the added benefit of having rapid and reliable feedback to the team on the presence or absence of retained surgical items. The downside to these systems is the initial cost but in a study by Williams et al. that examined the implementation of an RFDS in five healthcare systems. They found that upon the implementation of the RFDS, there was a 77% reduction in the rate of retained foreign bodies [14]. Furthermore, taking into account the cost savings from avoidance of x-rays, the decreased time in the OR, and the avoidance of litigation, the cost-benefit analysis favored the implementation of the RFDS [14].

Future surgical technologies remain to be developed to improve the detection of retained surgical foreign bodies. Some potential avenues of development include the use of near-infrared coatings on surgical instruments to allow their detection. Other potential systems combine aspects of the prior described technologies. For example, the ASSIST system combines the RFDS technology with bar-coding. In an automated way, all sponges and instruments are electronically logged and tracked in a spatial and time manner to prevent retained surgical foreign bodies [15]. This future technology among many others will hopefully improve patient safety through decreasing the rate of retained surgical foreign bodies.

In conclusion, retained surgical foreign bodies are rare events for which all surgeons should have a high index of suspicion. Surgeons should recognize those risk factors that impart a greater risk of retained surgical foreign bodies such as increased blood loss, incorrect surgical counts, multiple procedures, changes in the surgical team, or unanticipated intraoperative events. They should also consider those factors that have been inconsistently found to be potential risk factors of retained foreign bodies such as emergent surgery and increased BMI. Furthermore, surgeons and other staff must recognize the limitations of the surgical count and be wary of a normal count when multiple risk factors exist for retained surgical foreign bodies. Finally, some technology and protocols exist that attempt to decrease this risk in surgical patients and hopefully more will come in the future. These interventions potentially decrease the risk of retained foreign bodies but do not replace the role of the surgeon and other staff in having a high index of suspicion for this to occur, and a desire to prevent these events from occurring in the future.

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