Gastrointestinal complications related to retained surgical foreign bodies (RSFB): A concise review

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ABSTRACT

Although rare, retained surgical foreign bodies (RSFB) continue to be a significant patient safety challenge. Retained surgical foreign bodies have the potential to cause significant harm to the patient. While there are many studies and isolated reports of RSFB, there are few adequate literature sources specifically addressing potential clinical consequences of retained foreign bodies. In order to fill this information gap, we set out to perform a literature review that focuses specifically on gastrointestinal complications of RSFB and related topics. In addition to categorizing RSFB by retained surgical object type and describing their radiographic characteristics, this review discusses each major gastrointestinal complication associated with RSFB – Abdominal pain, abscess formation, fistula formation, gastrointestinal bleeding, transmural migration of RSFB, intestinal obstruction and perforation, among other topics.


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INTRODUCTION

The incidence of retained surgical foreign bodies (RSFB) after abdominal operation is a low and likely underreported.1 Retained surgical foreign bodies may be detected acutely (i.e., during the immediate postoperative period), produce serious early or intermediate-term postoperative complications, or remain dormant for months or even years postoperatively.2

Because of its widespread use, small size, and amorphous structure, the surgical sponge is the most frequently encountered retained foreign body after open abdominal surgery.3 When not immediately recognized or incorrectly diagnosed, RSFB can lead to significant harm to the patient, including various complications, additional diagnostic tests, surgical procedures, and even mortality.4 Furthermore, exorbitant medico-legal rewards are the norm when litigation is precipitated on RSFB.5 Since the abdomen and pelvis are the most common sites for RSFB, this review focuses on gastrointestinal complications related to retained surgical sponges, instruments, and other objects.5

TERMINOLOGY

Various descriptive terms have been applied to different types of retained surgical objects. For retained sponges (Figure 1) and towels, the most frequently used terms include soft tissue textiloma, gossypiboma, muslinoma, and gauzoma.5-6 There are no specialized medical terms for retained surgical instruments and needles. For the purpose of uniformity, the authors of this report will refer to RSFB as follows: (a) textile-based type as tRSFB; and (b) non-textile objects as nRSFB. Various catheters (i.e., urinary, vascular) and other devices (i.e., pessaries, negative pressure wound therapy sponges) left in place unintentionally constitute additional, less frequently encountered subtypes of nRSFB.

Table 1. Factors associated with the occurrence of retained surgical foreign bodies.

<table>
<thead>
<tr>
<th>Risk Factors Associated with Retained Surgical Foreign Bodies</th>
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<tr>
<td>• Complex surgical procedures</td>
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<tr>
<td>• Damage control (open abdominal procedure, staged/abbreviated procedures)</td>
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<td>• Emergency surgical procedures</td>
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<td>• Increasing body mass index (BMI)</td>
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<td>• Involvement of more than one surgical team</td>
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<td>• Procedures involving more than one body cavity</td>
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<td>• Prolonged surgical procedures</td>
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<td>• Unexpected change in the course of a surgical procedure</td>
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<tr>
<td>• Use of unusually large number of instruments and/or sponges</td>
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<tr>
<td>• Use of small sized sponges</td>
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Others classify RSFB into exudative (early) and delayed (fibrinous) types.5-6 The exudative type (Figures 2 and 3) is characterized by earlier clinical manifestations due to the higher likelihood of superinfection with subsequent sepsis and/or formation of abscess/fistula. The delayed or fibrinous RSFB usually present as soft tissue masses or granulomas, and while their clinical manifestations usually appear at approximately two years following the index surgical procedure, they may remain latent for a prolonged period of time (often as long as decades).5-6
METHODOLOGY
A literature review was performed using PubMed, Google™ Scholar, OpenMED, ScientificCommons, and Public Knowledge Project medical-scientific search engines. Search terms included “RSFB”, “retained surgical foreign body”, “retained surgical instrument”, “retained surgical sponge”, “retained surgical gauze”, “gossypiboma”, “textiloma”, and “surgical complications”. Relevant cross-referenced publications not included in the above search engines but listed in source articles were also included. All articles were evaluated for the overall relevance and goals of this review.

OVERVIEW OF GASTROINTESTINAL COMPLICATIONS OF RSFB
The abdominal and pelvic cavities are the most frequent locations of retained surgical foreign bodies, account for nearly one-half of all RSFB. Clinical manifestations of abdominal RSFB are due to a multifactorial interaction between the following elements: (a) the nature of the RSFB; (b) the presence of infection; (c) various patient factors; and (d) the precise anatomic location of the RSFB. The most frequently encountered symptoms associated with abdominal RSFB are nonspecific abdominal pain and intestinal obstruction. In general, external extrusion of RSFB results in less severe manifestations while internal erosion may lead to more significant complications, including abscess, fistula formation, and intestinal obstruction.

Temporal presentation of gastrointestinal complications of RSFB varies widely – they may present acutely or their manifestations may be delayed by months or years. Metallic instruments left behind tend to cause acute clinical symptoms at an earlier time postoperatively, while retained surgical sponges frequently cause a chronic progression of symptoms over months to years. Acute presentation is usually associated with pain, intestinal obstruction, ileus, sepsis, abscess, and/or granuloma formation. Chronically, abdominal RSFB may manifest as a mass (often mistaken for a tumor) or intermittent/progressive bowel obstruction associated with encapsulation of the tRSFB and subsequent adhesion formation. Clinical presentation of RSFB may also include various types of fistulae.
same emergency surgical cases are more likely to be conducted without organized instrument counts when compared to elective surgical cases, potentially placing the patient at an increased risk for RSFB. Increased body-mass index has also been cited as being linked with RSFB, but this association remains to be further determined. Damage control laparotomy in conjunction with frequent bedside abdominal procedures has also been proposed as a risk factor for abdominal RSFB.

The diagnostic utility of performing surgical counts was quantified in a study that analyzed 1,062 count discrepancies in 153,263 cases. In that study, count discrepancies identified 77% of RSFB but prevented only 54% of RSFB occurrences. Although patients who undergo procedures without instrument counts are at increased risk for RSFB, count alone is not sufficient in the elimination of RSFB, and approximately 70% of RSFB cases are associated with a correct surgical count.

RSFB: PREVENTIVE STRATEGIES
Retained surgical foreign body prevention requires constant vigilance of the surgeon and the surgical team to this potential surgical safety threat. The surgeon must account for an incorrect sponge count by adequate examination of the operative field. Despite the limitations of manual surgical counts, discrepancies should always prompt an instrument re-count as well as a thorough search of the operative field.

As previously stated, a correct sponge count does not fully preclude an RSFB. Inspection of the abdominal cavity prior to closure should be routine in all patients, with particular attention to patients defined to be in high-risk for RSFB. Retained instruments or sponges often become concealed within the fatty tissues of the abdomen or pelvis and can be very difficult to find, even upon very detailed wound exploration. One way to reduce such concealment of RSFB is clear verbal communication between the operating surgeon(s) and the operating room staff regarding the precise number and location of each intra-abdominally placed sponge, instrument, or other surgical object. Any such intentionally placed surgical objects should then be recorded on a clearly visible writing board in the operating room and specifically accounted for before abdominal closure.

The implementation of an automated intraoperative inventory system such as passive radiofrequency identification (RFID) may help decrease the risk of RSFB. Another more recent patient safety advance is the use of a hand-held scanning device that allows for quick and accurate detection of radio frequency tagged sponges before abdominal closure. Some surgeons even go as far as employing metal detectors to routinely search for retained instruments at the end of surgical procedures. In addition to performing surgical counts, thoroughly exploring the surgical wound, and using radiofrequency tagged instruments/sponges, intraoperative detection of potential RSFB may be performed by using abdominal radiography or ultrasonography. Although more effective than many of its alternatives, intraoperative imaging may be less reliable in the detection of surgical foreign bodies than previously believed. An experienced radiologist is needed to differentiate RSFB from pathologic processes or iatrogenically placed objects that may radiographically resemble the appearance of various retained surgical objects. Such processes and objects include abscesses, hematomas, cystic lesions, surgical staple lines, as well as other surgically placed objects. It is important to correlate any nonspecific findings discovered on imaging performed to rule out RSFB in the context of the patient’s past surgical history and the current surgical procedure. In addition, all intraoperative radiograms performed for unrelated reasons should be carefully reviewed, even when surgical counts are correct.

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Figure 3. Picture of a surgically removed surgical sponge that was retained for approximately one week. Note several areas of exudative reactive changes (arrows).

Figure 4. An example of a retained nRSFB (white arrow) discovered on a surgical foreign body “screening” film prior to performing abdominal closure during an emergency trauma laparotomy. The object (chest tube cap) was subsequently removed and the abdomen closed.
RSFB: RADIOGRAPHIC CHARACTERISTICS

Plain abdominal roentgenogram may help reveal any radiopaque material that was incorporated into the retained surgical sponge or it may demonstrate the radiographic outline of a retained surgical instrument or needle. Performing both anterior-posterior and lateral abdominal radiographs may be helpful in more precisely localizing the position of the RSFB within the abdomen/pelvis (Figure 1). This practice may also help reduce false positive radiographic interpretations by decreasing the incidence of misinterpretation of foreign objects that are either on top of the patient or between the patient and the film cassette as being inside the patient’s body cavities on a single-view anterior-posterior radiograph. Ultrasonography, although not used routinely, may also be helpful as an adjunct to direct visual inspection of the abdominal cavity before fascial closure.

The most specific sign for computed tomographic (CT) detection of a retained surgical sponge is the presence of gas bubbles within the RSFB. However, this characteristic pattern is not always present. Quite often, a heterogenous, complex mass is found, but this pattern is also nonspecific. The widely variable appearance of retained surgical sponges on CT can lead to diagnostic misinterpretations. On magnetic resonance imaging, the retained surgical sponge may be seen as a soft tissue density or a non-specific mass with a thick, well-defined capsule and a whorled internal configuration on T2-weighted imaging. In addition, RSFB have been detected by angiography, endoscopy, laparoscopy, or upon surgical re-exploration.

RSFB: CLINICAL MANAGEMENT

Surgical retrieval of RSFB may be performed in an open or laparoscopic fashion. Rarely, endoscopic approach may be indicated (i.e., cases where the RSFB eroded into the bowel lumen). In one case, laparoscopic removal of a subphrenic encapsulated granuloma surrounding a retained surgical sponge has been successfully performed more than 20 years after the index abdominal procedure. Even intra-abdominally retained large retractors may be laparoscopically removed. Retained intraabdominal foreign bodies that are amorphous may be removed though a small incision, such as that of a previous open appendectomy. Reoperation for RSFB has been associated with overall mortality rates between 11% and 35%. Endoscopic RSFB extraction may be done to retrieve retained surgical sponges that migrated/eroded into the intestinal lumen. However, intervention is not always necessary in such cases. With close follow-up, carefully selected asymptomatic patients may spontaneously pass a retained sponge rectally.

RSFB: SPECIFIC GASTROINTESTINAL COMPLICATIONS

UNEXPLAINED ABDOMINAL PAIN

RSFB may cause an aseptic reaction without significant symptoms, or an exudative reaction resulting in nonspecific abdominal symptoms. Unexplained, persistent or intermittent abdominal pain and recurrent or persistent postoperative ileus may occur several months after the index laparotomy in which a surgical sponge was left behind in the abdominal cavity. Diagnosis of RSFB is too often made incidentally upon review of imaging performed while searching for other pathologic causes of these nonspecific gastrointestinal symptoms. In order to most efficiently (i.e., using the least number of diagnostic studies) and correctly identify RSFB as the cause for nonspecific abdominal pain, it is important that clinicians be open to the possibility of RSFB even when the patient presents months or years postoperatively. Once the diagnosis is made, these patients almost always require procedural retrieval of the RSFB.
ABDOMINAL MASS
Abdominal, pelvic, or retroperitoneal mass is a fairly common presentation of RSFB (Figures 5 and 6). Not infrequently, and most often in the chronic RSFB setting, the mass is initially thought to represent a suspected tumor (i.e., retroperitoneal sarcoma). When clinical presentation resembles that of a tumor or a cystic lesion, patients often undergo invasive biopsies and extensive imaging that ultimately reveal the mass to be a retained surgical object from a previous laparotomy. In indeterminate cases, it may be only during or after surgical resection that the nature of the mass as a retained foreign body is established.

ABSCESS FORMATION
Patients with RSFB may present acutely with the finding of intraabdominal abscess formation, with associated signs and symptoms of sepsis. Consequently, patients with intraabdominal abscesses due to RSFB most often present with fever and abdominal pain. Perinephric abscess due to a retained surgical sponge has also been reported. Clinical management includes abscess drainage, abdominal washout, and retrieval of the RSFB. If not diagnosed and treated promptly, abscesses associated with RSFB often progress to more serious, perhaps even life-threatening clinical events. These serious complications include bowel obstruction, fistula, stricture, gastrointestinal bleeding, and perforation. These complications are briefly outlined in subsequent sections of this manuscript.

INTESTINAL OBSTRUCTION
Bowel obstruction may be associated with the inflammatory reaction surrounding a retained surgical sponge or migration of a sponge into the intestinal lumen. Intestinal obstruction associated with RSFB may manifest acutely as an apparently simple postoperative bowel obstruction or may take a form an obstruction associated with an abdominal mass in the chronic setting. When a tumor or some other type of mass lesion is seen on presentation, patients often undergo invasive biopsies and extensive imaging only to discover that the mass represents a retained surgical object from a previous laparotomy. Management consists of standard therapy for bowel obstruction and removal of the RSFB. Obstructive symptoms are relieved after operative removal of the retained foreign body.

FISTULA FORMATION
Fistulae may result from migration of the retained surgical foreign body through the gastric or intestinal wall. Laparotomy for RSFB retrieval, takedown of the fistula, and management of any associated abscess are the standard therapy. In selected cases of intraluminal fistulization, surgical intervention may be deferred if the patient is not symptomatic, and the migration of the retained surgical sponge can be safely followed until the sponge in entirely intraluminal. Various radiographic and endoscopic techniques may be useful when following the progression of intraluminal RSFB.

GASTROINTESTINAL BLEEDING
Upper gastrointestinal bleeding can be associated with erosion and migration of a retained surgical sponge into the gastric lumen. Diagnosis and management may involve a combination of upper endoscopy, during which retrieval of the retained sponge as well as sclerotherapy of the bleeding site can be performed, as well as surgery for failures of less invasive techniques or any complications associated with the endoscopic therapy and/or the RSFB itself. Lower gastrointestinal bleeding associated with RSFB has not been reported. It is important to remember that management of gastrointestinal bleeding should follow established clinical diagnostic and treatment guidelines.

INTESTINAL PERFORATION
Severe inflammatory changes surrounding a retained surgical object (both iRSFB and ntRSFB) adjacent to a loop of bowel can cause perforation either directly, secondary to an associated abscess, or as a result of proximal bowel dilation due to obstruction. Dhillon et al describe a case wherein an inflammatory response led to an abscess formation around a surgical sponge between the abdominal wall and a loop of small bowel resulting in perforation one year following an otherwise uneventful hysterectomy. Management of such perforations includes surgery for retrieval of the retained sponge, abdominal washout, and bowel resection when indicated.

<table>
<thead>
<tr>
<th>SUGGESTED STRATEGIES FOR REDUCING THE INCIDENCE OF RETAINED FOREIGN BODIES</th>
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<tbody>
<tr>
<td>• Accurate, repeated and reproducible instrument and sponge counts</td>
</tr>
<tr>
<td>• Automated surgical sponge and instrument counting systems</td>
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<tr>
<td>• Avoiding the use of small surgical sponges</td>
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<tr>
<td>• Avoiding the use of surgical sponges or towels that do not contain radio-opaque markers</td>
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<tr>
<td>• Clear real-time communication and record keeping regarding any surgical sponges packed in the abdomen or pelvis</td>
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<tr>
<td>• Detailed exploration of the surgical field prior to wound closure</td>
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<td>• Educational programs designed to reinforce teamwork and adherence to patient safety protocols</td>
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<tr>
<td>• Multiple checks and balances incorporating various RSFB prevention strategies at multiple points in the patient’s surgical care</td>
</tr>
<tr>
<td>• Radiographs of the operative field performed right before or after fascial closure when: (a) intraoperative instrument/sponge counts are inconsistent; (b) performing high risk and/or emergency procedure; (c) every four days and before definitive abdominal (fascial) closure in staged, damage control procedures</td>
</tr>
<tr>
<td>• Simultaneous use of the least number of sponges needed to perform the surgical task</td>
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<tr>
<td>• Strict adherence to appropriate patient safety procedures</td>
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<tr>
<td>• Use of radio-frequency identification system, consisting of specialized radio-frequency detector and radio-frequency labeled surgical sponges. Of note, this system does not detect surgical instruments (ntRSFB)</td>
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Table 2. Strategies for reducing the incidence of retained surgical foreign bodies. Modified from reference 5.

TRANSMURAL MIGRATION
Intra-abdominal RSFB left behind during abdominal operations may erode into the intestinal lumen despite the absence of any concomitant bowel trauma. Clinical presentation of such erosion may vary from mild to life-threatening. Migration of a retained
surgical sponge into the bowel lumen is a rare cause of bowel obstruction. However, it should be considered in the differential diagnosis in a patient with a history of previous laparotomy who presents with non-specific abdominal complaints. Gastrointestinal contrast imaging may demonstrate distended bowel and a contrast-impregnated mass with multiple filling defects. Select patients may be followed endoscopically until the retained surgical sponge is entirely intraluminal. In nearly all cases, however, surgery is required. Symptoms resolve after reoperation for retrieval of the retained surgical object.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Current analysis</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>Patient age</td>
<td>Not significant (p=0.772)</td>
<td></td>
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<tr>
<td>Female gender</td>
<td>Not significant (p=0.357)</td>
<td></td>
</tr>
<tr>
<td>EBL &gt;500 mL or blood transfused</td>
<td>Not significant (p=0.222)</td>
<td></td>
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<tr>
<td>Body mass index</td>
<td>Not significant (p=0.151)</td>
<td></td>
</tr>
<tr>
<td>Shift changes for nursing staff</td>
<td>Intermediate (p=0.058)</td>
<td></td>
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<tr>
<td>Operation after 5 pm</td>
<td>Intermediate (p=0.090)</td>
<td></td>
</tr>
<tr>
<td>Duration of operation</td>
<td>Significant (p=0.038)</td>
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<tr>
<td>Emergency surgical procedure</td>
<td>Significant (p&lt;0.001)</td>
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<tr>
<td>Unexpected change in surgery</td>
<td>Significant (p=0.001)</td>
<td></td>
</tr>
<tr>
<td>Surgical count not performed</td>
<td>Significant (p=0.031)</td>
<td></td>
</tr>
<tr>
<td>Incorrect surgical count</td>
<td>Significant (p=0.038)</td>
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<tr>
<td>&gt;1 major procedure performed</td>
<td>Significant (p=0.001)</td>
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<tr>
<td>&gt;1 surgical team involved</td>
<td>Significant (p=0.007)</td>
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Table 3. Results of recent meta-analysis of risk factors for retained surgical foreign bodies (RSFB). Factors with intermediate and high statistical significance are labeled green and red, respectively.

COMBINATION OF MULTIPLE COMPLICATIONS

Complications described above are not mutually exclusive and may occur concurrently. Intra-abdominal abscesses resulting from retained surgical sponges can lead to multiple subsequent complications, such as intestinal obstruction, fistulae, strictures, bleeding, and/or perforation. A retained surgical sponge has been reported to migrate into the duodenal lumen, causing a subsequent duodenal fistula. Migration of RSFB into the small or large intestinal lumen can also lead to abscess formation, intense localized inflammatory reaction, and associated bowel obstruction. Rumstadt reported a case of a retained surgical sponge that caused multiple intraabdominal interloop abscesses and a chronic small bowel stricture. Patients experiencing a combination of gastrointestinal complications of RSFB may require serial invasive procedures before achieving adequate treatment endpoints.

OTHER GASTROINTESTINAL COMPLICATIONS

Additional gastrointestinal complications of RSFB include weight loss, ileus, abdominal distension, urinary retention, nausea and vomiting, and fevers of unknown origin. Chronic pelvic pain may be an unrecognized presentation of retained sponge after gynecologic surgery. Because of the generally low index of suspicion for RSFB, early detection is often difficult. In many cases the patient may present with vague constitutional symptoms several years after an otherwise uneventful recovery from abdominal surgery. Kiernan et al reported a case of a patient who presented four years after a gynecologic procedure with fever, syncope, and mental status changes associated with a retained surgical sponge. Zoltan et al describe a patient who underwent a laparotomy for removal of a cystic mass, which upon exploration was discovered to be a retained surgical sponge left in the abdominal cavity during an open cholecystectomy ten years previously. Deger et al reported a case of retained surgical sponge presenting as a “recurrent malignancy” one year after cytoreductive surgery for ovarian carcinoma.

Less commonly encountered are urologic complications associated with RSFB. One report describes a case of an uretero-appendiceal fistula caused by a retained surgical sponge in a patient four years after abdominal surgery. The patient was managed with retrieval of the retained sponge, appendectomy, and ureteral stenting. Acute urinary retention has also been reported in the setting of RSFB.

RSFB: SPECIAL CONSIDERATIONS

Figure 7. An example of retained surgical clamp (ntRSFB). Clinical presentation was characterized by prolonged postoperative ileus and continued abdominal pain.

RETAINED PERCUTANEOUS ENDOSCOPIC GASTROSTOMY INTERNAL BUMPER

At the time of removal of percutaneous endoscopic gastrostomy (PEG) tubes, the internal bumper may break off and thus be left intraluminally, potentially leading to untoward sequelae. Patients may develop a number of complications associated with the migration of retained internal PEG tube bumper. Small bowel obstruction has been reported months after removal of a PEG tube with a retained internal bumper. Migration of the retained internal bumper may also lead to bowel perforation. If retrieval of the internal bumper is not able to be performed at the time of PEG tube removal, patients should be followed closely for any associated symptoms or complications.

TRANSANALLY INTRODUCED RSFB

During colon and rectal surgical procedures, surgical sponges placed transanally may be inadvertently left behind and cause a myriad of postoperative complications. In the majority of rectal
RSFB occurrences, bedside retrieval or operating room retrieval with examination under anesthesia can be successfully performed.\textsuperscript{10} Patients presenting with RSFB located more proximally (i.e., sigmoid colon) are more likely to require operative retrieval via a colotomy.\textsuperscript{15} In cases of retained sponges in the sigmoid colon complicated by colonic perforation, removal of the foreign body and repair of the perforation (with or without fecal diversion) should be performed.\textsuperscript{15}

**CONCLUSIONS**

Despite near-universal implementation of protocols for surgical sponges, instruments, and needles, incidents of RSFB still occur. Retained surgical foreign bodies continue to be an underestimated and poorly studied postoperative complications. Gastrointestinal complications secondary to abdominal RSFB can be catastrophic and complex. This manuscript details the broad spectrum of gastrointestinal complications that have been reported in the medical literature. In addition to instilling a higher index of suspicion, implementation of reliable institutional regulations and strict adherence to these regulations should be emphasized. Heightened surgical team awareness is important in reducing the incidence of human error, but additional prevention methods should also be considered, particularly in cases identified to be at higher risk for RSFB. Manual surgical instrument and sponge counting alone is not a reliable mechanism in eliminating RSFB. The implementation of passive radiofrequency identification tags which allow surgical sponges and instruments to be detectable inside body cavities with the use of a hand-held device may represent one solution in reducing the incidence of RSFB in high-risk cases. Another solution consists of liberal use of intraoperative radiography to verify the absence of RSFB in any procedure that is thought to be high-risk for RSFB or whenever surgical team suspicion for RSFB is present.

**REFERENCES**


