Retained surgical sponge (RSS; also known as gossypiboma, textiloma, and cottonoid) refers to a mass of cotton matrix retained in the body. Despite the use of sponges made of synthetic materials, the terms gossypiboma and textiloma are still commonly used. Surgical sponges are commonly used to keep the surgical field clean and dry or to aid in countertraction.

**EPIDEMIOLOGY**

Although rarely reported, RSS represents a continuing problem, mainly in human surgery and, to a much lesser extent, in small animal surgery, in which few reports have appeared in the literature. The true incidence of RSS is unknown, possibly because of rare occurrence or reluctance to admit errors that may have medicolegal implications. In humans, RSS reportedly occurred in one of 1,000 to 1,500 laparotomies. In humans, RSS occurs mainly in emergency, general surgical, gynecologic, and obstetric procedures.

**PATHOPHYSIOLOGY AND CLINICAL SIGNS**

Intraabdominal RSSs made of cellulose fibers may cause foreign body reactions resulting from their lack of inertness and inability to disintegrate. Two types of reactions have been described in human medicine:

- **Aseptic serofibrinous responses** leading to adhesion formation, complete encapsulation, and foreign body granuloma.
- **Exudative responses** leading to abscessation.

Septic complications may manifest in the early postoperative period in contrast to aseptic encapsulations, which may go undetected for long periods. Fifty percent of RSSs have reportedly been found 5 years or more after surgery; one-third of humans with RSSs remain asymptomatic, and their RSSs are detected incidentally. RSSs may also penetrate hollow viscera such as the intestine, bladder, or vagina because of pressure necrosis, resulting in intestinal obstruction, infection, or gastrointestinal (GI) hemorrhage due to vessel erosion. The most common clinical signs in humans include malaise, fever, anorexia, weight loss, signs sec-
ondary to intestinal obstruction, and bleeding from the digestive or urogenital tract.\textsuperscript{3,6–8} RSS in dogs is associated with the infective, exudative form of foreign body granuloma, resulting in clinical signs that appear within months after surgery.\textsuperscript{12} Clinical signs reported in dogs and cats with intraabdominal RSS include sinus discharge, palpable abdominal mass, elevated temperature, vomiting, diarrhea, painful abdomen, depression, anorexia, and weight loss.\textsuperscript{12,13} In addition, foreign body osteomyelitis\textsuperscript{9} and sarcoma formation\textsuperscript{10} associated with RSS have been reported in dogs.

**CLINICAL PATHOLOGY**

In a recent report involving eight dogs with RSS, neutrophilia, microcytic anemia, leukopenia, thrombocytopenia, hyperglobulinemia, hypoalbuminemia, and elevated alkaline phosphatase levels were detected.\textsuperscript{12} Cytologic examination after fine-needle aspiration of the abdominal mass may allow identification of the granulomatous nature of the tissue response.\textsuperscript{13}

**DIAGNOSTIC IMAGING**

Because of localized gas lucency resulting from air trapped between sponge fibers, conventional abdominal radiography may be used to detect RSS.\textsuperscript{8,12} Gas lucency may appear speckled or vortex-like, persist for a long time, and be mistaken for feces if recognized as a GI structure.\textsuperscript{12,14}

Including radiopaque markers in sponges can make them easier to detect on plain radiographs.\textsuperscript{1,5} The size and pattern of such markers may influence detection of RSS.\textsuperscript{2} However, some markers may twist, fold, or disintegrate over time or be superimposed over bony structures, making them difficult to see on plain radiographs.\textsuperscript{3,5} In addition, surgical clips may mimic the pattern of radiopaque markers.\textsuperscript{14}

Abdominal computed tomography (CT) in humans may reveal a well-defined mass surrounded by a thick wall and internal heterogeneous densities, all representing the various contents of RSS: the synthetic-fiber foreign body, granuloma formation, and abscessation.\textsuperscript{8} A spongiform pattern has resulted from gas bubbles trapped between the synthetic fibers of RSSs.\textsuperscript{4,14,15} This pattern is considered to be characteristic of RSS. On CT, most RSSs demonstrate a variable-density appearance that makes interpretation difficult.\textsuperscript{16} A thin or, less often, thick capsule that surrounds a low-density center has also been reported.\textsuperscript{4,15} Another rare sign on CT is calcifications on the fibrous capsule or in the center of the RSS. Calcifications are commonly found in sponges that have been retained for a long time and have been in contact with the GI or urinary tract.\textsuperscript{15}

The sonographic appearance of RSS varies, depending on the type of reaction (i.e., abscess or granuloma) that the sponge provokes and the presence of trapped fluid or gas.\textsuperscript{12,13} High amplitude echoes with acoustic shadowing may be representative of an RSS with trapped gas or may be produced by the large number of interfaces resulting from sponge fibers.\textsuperscript{4,12,15} However, in cases of purely granulomatous lesions without abscessation, the acoustic properties may differ and the strongly echogenic interfaces associated with acoustic shadowing have not been identified.\textsuperscript{13}

When sinus tracts are present, sinography may reveal an RSS by filling its network of fibers.\textsuperscript{3,12}

**DIFFERENTIAL DIAGNOSIS**

The differential diagnosis of intraabdominal RSS may include the presence of a hematoma or an intestinal mass.\textsuperscript{12,16} The speckled gas pattern due to RSS, as visualized on plain radiographs, may be misinterpreted as feces unless it is recognized as a non-GI mass.\textsuperscript{12} On CT, an RSS with a radiopaque marker could be mistaken for a calcified hematoma.\textsuperscript{14} With ultrasonography, an RSS can be differentiated from an intestinal tumor, although they have similar signs. With tumors, the gas-filled cavity communicates directly with the intestinal lumen on an ultrasonogram. This is not usually the case with RSS granulomas unless migration into the intestinal lumen has occurred.\textsuperscript{12}

**DIAGNOSIS**

The presence of nonspecific clinical signs and difficulty identifying RSS radiologically are responsible for difficulties in making the correct diagnosis. Diagnosing RSS
Sponge Counts in Human Medicine

In human medicine, sponge, sharps, and instrument counts are relied on to eliminate the potential to leave foreign bodies in patients. The Association of periOperative Registered Nurses (AORN) recommends counting instruments and sponges four separate times during a procedure, but the counting process has not been standardized. The scrub and circulating nurses share the legal responsibility for counting and confirming the number of sponges, but surgeons are often named in lawsuits involving RSSs.

**Recommendations**

- Sponges should be counted in all procedures.
- Sponges should be counted concurrently in the operating room by a nurse and another scrubbed person.
- Sponges should be counted before a cavity or any part of a cavity is closed.
- Types and sizes of sponges should be kept to a minimum. All sponges used should be detectable radiographically.
- Counted sponges should not be removed from the operating room during a procedure.
- Radiographically detectable sponges should not be used as dressings.

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without radiopaque markers is more challenging than when markers are present. The diagnosis must be based on a history of surgery as well as survey abdominal radiography, ultrasonography, CT, sinography, and cytology of fine-needle aspirates showing the granulomatous lesion.\(^7,12,13\)

**TREATMENT**

In cases of RSS, failure to establish a diagnosis may prompt surgeons to perform inappropriately aggressive surgical therapy.\(^3\) Surgically removing an RSS and associated adhesions is the treatment of choice considering the extremely high complication rate.\(^5\) On rare occasions, when vital structures are involved in the adhesions, en bloc resection of the obstructed bowel or nephrectomy for hydronephrotic kidneys may be needed.\(^17\)

**PREDISPOSING FACTORS**

Several factors may lead to RSS. In a recent human study, patients at high risk of RSS included those undergoing emergency surgery with an unexpected change in a surgical procedure and those with a high body mass index.\(^18\) A long, complex operation may cause a surgeon to lose track of a surgical sponge. Time constraints may lead to incorrect sponge counts, especially in emergencies and unstable patients.\(^5,7\) In addition, personnel changes between the initial and last sponge count may increase the possibility of an incorrect count.\(^5\) The risk of RSS might be less in dogs than in humans because of the smaller abdominal cavity and shorter, less complicated surgeries in dogs.\(^12\)

**PREVENTION**

Using radiopaque-marked sponges is recommended to prevent RSS.\(^7,12\) The surgical team, including surgeons and nurses, is responsible for following proper surgical procedures and handling sponges correctly, including counting sponges at the beginning of a procedure and before closing the incision\(^8\) (see box on this page). After a change in personnel, the new personnel should perform two sponge counts.\(^5,7\) The abdomen should be meticulously explored before closure to ensure that all sponges have been removed.\(^5,7\) In emergency or high-risk surgery or when a sponge count is uncertain, routine intraoperative radiographic screening should be conducted before closing an incision.\(^5,7,18\)
From January 1998 to December 2001, six dogs in which RSSs were found during surgery were investigated. Data extracted from medical records included signalment, history, clinical signs, clinicopathologic findings, radiologic findings, surgical and pathologic findings, and outcome. Clinical data on the six dogs are presented in the table on page 640. Among the six cases, one had been previously reported. Historical data included anorexia and depression (dogs 1, 2, and 3), weight loss (dog 2), vomiting (dog 3), hemorrhagic diarrhea (dog 2), and hemorrhagic vaginal discharge and recurrent estrus (dog 4).

Abdominal radiography was conducted in dogs 1, 2, 3, and 4. Radiologic examination in dog 1 revealed an opaque, metallic density, non-GI foreign body encased in a well-circumscribed, 4.5-cm-diameter, soft tissue density located in the right ventrolateral aspect of the caudal abdominal cavity (A). In dog 2, abdominal radiography revealed a linear opacity containing speckled and tubular gas lucencies at the middle aspect of the abdomen dorsal to the descending colon. Bone fragments in the dilated colon, which was displaced ventrally, and an air-filled small intestine compatible with bowel obstruction were also evident (B). A barium study confirmed the presence of bowel obstruction. Abdominal radiography in dog 3 revealed the presence of a semilunar-shaped, poorly defined mass caudally, which ventrally displaced the colon (C). Speckled gas lucencies throughout the mass were visible. Air-filled small intestine with no signs of obstruction were also seen. Radiologic examination of the caudal abdomen of dog 4 showed a poorly defined mass with a vortex-like gas lucency in the center (D). Mild ventral displacement of the descending colon was also evident. Lack of serosal detail around the mass was noted, and no signs of intestinal obstruction were detected. Radiologic examination was not conducted in dogs 5 and 6.

Surgical exploration was performed in all dogs. Midline exploratory celiotomy was performed in dogs 1, 2, 3, and 4. In dogs 1 and 3, an RSS incorporated in a mass was removed (E). There

were extensive adhesions between the mass and omentum. Abdominal lavage was performed, and the celiotomy was closed routinely. In dog 2, a sponge encased in a mass was found adhering to jejunum and causing extraluminal intestinal obstruction. The mass was removed en bloc with the intestinal segment, and an end-to-end intestinal anastomosis was made using 3-0 polydioxanone (PDS, Ethicon) in a simple-interrupted appositional pattern. The abdominal cavity was lavaged and closed in the usual manner. In dog 4, an RSS incorporated in a mass and adhering to the urinary bladder dorsally and vaginal stump was located and excised (F and G). A residual left ovary was also removed. Following lavage, the celiotomy incision was closed in a routine fashion. Dogs 5 and 6 underwent surgical exploration of their discharging sinuses through a revision of the original herniorrhaphy incision (H). RSSs were located and removed. Adhesions between the sponge, levator ani, anal sphincter, and retroperitoneal fat in dog 1 and obturator muscle and retroperitoneal fat in dog 6 were found. The pelvic diaphragm was reconstructed by using interrupted sutures of 2-0 polypropylene (Prolene, Ethicon). Histopathology of the mass was conducted in dog 2, confirming the presence of an infective granulomatous lesion.

**Recovery**

All patients had a good recovery from anesthesia. Mean hospitalization time was 2.4 days (range: 2 to 4 days). Dog 4 appeared depressed and anorectic 24 hours after surgery. Physical examination revealed abdominal distention, and abdominocentesis detected uroperitoneum. The owner declined further surgery and decided to have the dog euthanized. At necropsy, rupture of the right ureter was revealed. Follow-up information was obtained by reexamination and telephone calls to owners or referring veterinarians. Mean follow-up time was 12.2 months (range: 1 to 24 months). Dogs 1, 2, 3, 5, and 6 were said to be in good health.

**Discussion**

RSS following surgery is a continuing problem in humans and animals. Reasons for a falsely low incidence, particularly in animals, include misdiagnosis, failure to pursue a diagnosis, and a
## Clinical Data for Six Dogs with Retained Surgical Sponges

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Breed</th>
<th>Sex</th>
<th>Age (y)</th>
<th>Weight</th>
<th>Previous Surgery</th>
<th>Clinical Signs</th>
<th>Duration of Signs (wk)</th>
<th>Clinicopathologic Findings</th>
<th>Results of Culture and Cytology of the Mass</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mixed</td>
<td>FS</td>
<td>10</td>
<td>110 lb (50 kg)</td>
<td>Ovariohysterectomy to treat pyometra</td>
<td>Fever</td>
<td>20</td>
<td>Neutrophilic leukocytosis</td>
<td>No growth Infective granuloma</td>
<td>Normal after 1 mo</td>
</tr>
<tr>
<td>2</td>
<td>Mixed</td>
<td>FS</td>
<td>2</td>
<td>37.4 lb (17 kg)</td>
<td>Elective ovariohysterectomy</td>
<td>Fever Pale mucous membranes Poor body condition Painful palpable abdominal mass</td>
<td>4</td>
<td>Neutrocytic, normochrome anemia of chronic disease Neutrophilic leukocytosis Total protein: 4.28 g/dl Albumin: 1.08 g/dl</td>
<td>Staphylococcus spp Infective granuloma</td>
<td>Normal after 6 mo</td>
</tr>
<tr>
<td>3</td>
<td>Doberman pinscher</td>
<td>FS</td>
<td>3</td>
<td>52.8 lb (24 kg)</td>
<td>Elective ovariohysterectomy</td>
<td>Poor body condition Palpable abdominal mass</td>
<td>4</td>
<td>Normal</td>
<td>Staphylococcus spp Infective granuloma</td>
<td>Normal after 24 mo</td>
</tr>
<tr>
<td>4</td>
<td>Maltese cross</td>
<td>FS</td>
<td>3</td>
<td>11 lb (5 kg)</td>
<td>Elective ovariohysterectomy</td>
<td>Hemorrhagic vaginal discharge Palpable abdominal mass (Figure F, p. 639)</td>
<td>40</td>
<td>Neutrophilic leukocytosis</td>
<td>Aseptic granuloma</td>
<td>Euthanized</td>
</tr>
<tr>
<td>5</td>
<td>Mixed</td>
<td>MC</td>
<td>7</td>
<td>33 lb (15 kg)</td>
<td>Perineal hemorrhaphy (bilateral)</td>
<td>Perineal sinus (right)</td>
<td>40</td>
<td>Normal</td>
<td>—</td>
<td>Normal after 12 mo</td>
</tr>
<tr>
<td>6</td>
<td>German shepherd</td>
<td>MC</td>
<td>7</td>
<td>55 lb (25 kg)</td>
<td>Perineal hemorrhaphy (right)</td>
<td>Perineal sinus (right; Figure H, p. 642)</td>
<td>2</td>
<td>Normocytic, normochrome anemia of chronic disease</td>
<td>—</td>
<td>Normal after 18 mo</td>
</tr>
</tbody>
</table>

*FS = female, spayed; MC = male, castrated.*
lack of necropsies. The abdominal cavity has reportedly been the most common site in which RSSs are found in animals,\textsuperscript{12,13} which agrees with the study findings presented here. However, two cases of RSS after perineal herniorrhaphy were reported for the first time in this article. The most common initial surgical procedure reported here and elsewhere\textsuperscript{12,13} was ovariohysterectomy because it is the most common surgical procedure in small animal medicine.

Clinical signs of RSS in small animals are often vague and nonspecific. Historical data indicating previous surgery are very helpful in making a diagnosis. A palpable abdominal mass has been a common clinical finding in this study and others.\textsuperscript{12,13} Radiographic examination of the abdomen in three of our cases revealed a vortex-like or speckled, localized, gas lucency pattern. Radiologic findings in this study were consistent with previous reports of RSS.\textsuperscript{12} In dog 1, the presence of a radiopaque marker made diagnosis easier, but the characteristic gas lucency pattern was not obvious. The differential diagnosis of abdominal RSS may include granuloma, abscess, hematoma, tumor, or even feces. Abdominal radiography, ultrasonography, or CT may help in differentiation. Two of the dogs in our study that had initially undergone perineal herniorrhaphy presented with discharging sinuses in the perineal region. Common causes of sinus discharge following this type of perineal surgery may include rectal lumen or anal sac penetration due to misplaced sutures or suture reaction.

Surgical exploration and RSS removal were performed in all dogs in our study. Adhesions were sometimes extensive, and vital structures were involved. In one dog, the obstructed bowel was resected along with RSS removal. However, failure to recognize adhesion of the sponge to the right ureter in another dog in this study led to ureter rupture during sponge removal, resulting in uroperitoneum and euthanasia of the patient. This might have been prevented by carefully identifying and preserving vital structures during sponge removal. In three dogs with intraabdominal RSS in our study, the RSSs were encased in an infective, exudative form of granuloma as revealed cytologically or histopathologically. All of these patients presented with clinical signs that developed 1 to
Case Studies (continued)

5 months after initial surgery. As previously reported, granuloma associated with RSS is the most common type of foreign body granuloma in veterinary patients. However, an aseptic, nonexudative type of sponge granuloma in a dog and cat has also been described. In our study, an aseptic form of sponge granuloma was found in one dog that presented with signs of ovarian remnant syndrome without signs of a mass, which was an incidental finding during abdominal palpation and radiography.

To prevent the serious problem of RSS, sponges with radiopaque markers can be used (I and J), laparotomy sponges instead of small sponges can be used for celiotomy, and standards for sponge counting should be established and followed in every practice.

REFERENCES


ARTICLE #4 CE TEST

This article qualifies for 1.5 contact hours of continuing education credit from the Auburn University College of Veterinary Medicine. Subscribers who wish to apply this credit to fulfill state relicensure requirements should consult their respective state authorities regarding the applicability of this program. To participate, fill out the test form inserted at the end of this issue. To take CE tests online and get real-time scores, log on to www.VetLearn.com.

I. Which statement regarding the pathophysiology of RSS in humans is false?
   a. Intraabdominal RSS may result in aseptic encapsulation.
   b. Intraabdominal RSS may cause an exudative response.
   c. Aseptic encapsulations may go undetected for long periods.
   d. In most patients, RSSs are detected incidentally.
2. Which statement regarding the pathophysiology of RSS in animals is false?
   a. An infective, exudative form of foreign body granuloma is frequently discovered.
   b. Reported cases of RSS in dogs are most often associated with an aseptic foreign body granuloma.
   c. Reported cases of RSS in dogs are most often associated with an infective, exudative type of foreign body granuloma.
   d. Clinical signs of RSS in animals with an infective, exudative granuloma may appear within months after surgery.

3. Which clinical sign does not occur in animals with RSS?
   a. Stertorous breathing
   b. A palpable abdominal mass
   c. Sinus discharge
   d. Vomiting

4. Which statement regarding radiopaque-marked sponges is false?
   a. Marked RSSs may be easier to detect on plain radiographs.
   b. RSS markers may disintegrate, making them easier to detect on plain radiographs.
   c. Surgical clips may mimic the pattern of radiopaque markers.
   d. RSS markers may migrate over bony structures, making them difficult to visualize on plain radiographs.

5. Which statement regarding radiographic signs of RSS is false?
   a. Gas lucencies resulting from air trapped between the fibers of an RSS facilitate radiographic detection.
   b. Gas lucencies caused by RSSs may be mistaken for feces.
   c. Gas lucencies may result from air produced when cellulose sponge fibers disintegrate.
   d. Gas lucencies caused by RSSs may appear in a vortex-like pattern.

6. Which statement regarding the differential diagnosis of RSS is false?
   a. If recognized as a non-GI mass, the speckled gas pattern due to an RSS may be mistaken for feces on plain radiographs.
   b. The differential diagnosis of intraabdominal RSS may include the presence of an intestinal mass or a hematoma.
   c. A marked RSS can be mistaken for calcified hematoma on CT.
   d. On an ultrasonogram, an RSS may be differentiated from an intestinal tumor.

7. Which statement regarding RSS prevention is false?
   a. Proper handling of sponges is an important part of RSS prevention.
   b. Using sponges without radiopaque markers may increase the risk of retention.
   c. In emergencies, routine intraoperative, radiographic screening before closing an incision is advised.
   d. Meticulous abdominal exploration before closing an incision is advised.

8. Which statement regarding predisposing factors associated with RSS is false?
   a. Risk factors that have been identified in humans include emergency surgery, high body mass index, and an unexpected change in a surgical procedure.
   b. A long, complex operation may cause a surgeon to lose track of a surgical sponge.
   c. The risk of RSS might be less in dogs than in humans because of the high body mass index of dogs.
   d. In emergencies, time constraints may lead to an incorrect sponge count.

9. Which statement regarding the retrospective study reported in this article is true?
   a. The median duration of clinical signs was 12 weeks.
   b. Radiographic examination in one dog revealed a metallic density, GI foreign body.
   c. No palpable masses were detected during physical examinations of the dogs.
   d. Hydronephrosis was detected during abdominal exploration in one dog.

10. ________ did not cause perineal sinuses following perineal herniorrhaphy in the study reported in this article.
    a. Rectal penetration due to misplaced sutures
    b. Constipation
    c. Anal sac penetration due to misplaced sutures
    d. RSS