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FULL PAPER

Gossypibomas, a surgeon's nightmare—patient demographics, risk factors, imaging and how we can prevent it

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Objective: Gossypibomas are a cottonoid matrix left behind following surgery. Owing to the legal issues associated with it, very few literature studies are available online, most of them being case reports. The purpose of our study was to identify the patient demographics, risk factors and imaging features.

Methods: Six surgically identified and histopathologically confirmed cases of gossypibomas recorded over a period of 5 years from a single tertiary institution were retrospectively evaluated for patient demographics [sex, age, body mass index (BMI)], type of surgery and duration from time of surgery to onset of symptoms. Ultrasound and CT images obtained from our hospital database were evaluated for their characteristic pattern. Statistics used included percentage and frequency.

Results: Females formed the bulk of our patients and the mean BMI of our patients was 24.25. The interval between

surgery and symptom presentation ranged from 2 months to 7 years. The most common imaging patterns observed on ultrasound and CT were a thick-walled hypoechoic lesion with a strong posterior acoustic shadowing and a "spongiform pattern", respectively.

Conclusion: A detailed patient history, taking into account radiologist–surgeon interaction, along with familiarization of the various risk factors and imaging patterns can bring about an accurate diagnosis of a gossypiboma.

Advances in knowledge: Our study showed that the female sex, especially those undergoing gynaecology-related surgery such as hysterectomy and patients with a high BMI were at risk of gossypibomas. The combination of a hypoechoic lesion with strong posterior shadowing on ultrasound along with a spongiform pattern on CT was highly characteristic for gossypiboma on imaging.

INTRODUCTION

Gossypiboma, also known as textiloma, refers to a mass of cotton matrix left behind in a body cavity following surgery. They are most commonly diagnosed in the intra-abdominal cavity. Other documented locations include—the chest, extremities, central nervous system and breast. Abdominal surgery, cardiovascular surgery, orthopaedic surgery and neurosurgery are some of the surgical procedures known to be associated with gossypibomas. Owing to the legal and ethical issues concerned with this condition, limited number of publications are available, most of which are case reports. The condition is most commonly seen following emergency surgeries or laparoscopic procedures. The time duration for the diagnosis of gossypibomas may range from the immediate post-operative period to several decades after surgery.^{1–4}

METHODS AND MATERIALS

Data of six surgically identified and histopathologically confirmed cases of gossypibomas treated at a single tertiary institution from January 2011 to January 2016 were assessed retrospectively. Patient demographics, symptoms, type of surgery and location of the foreign body were recorded. Detailed imaging patterns on radiographs, ultrasound and CT (plain and post-contrast) were recorded. All the patients were evaluated by ultrasound on a Philips IU22 machine. Further evaluation was carried out by multidetector CT (GE BrightSpeed 16-slice scanner); initial plain abdominal CT images were acquired at 120 kV and 200 mAs. Post-contrast images were obtained after the administration of 90 ml of non-ionic contrast (350 mg% w/v) injected at the rate of 3 ml/s with the help of a Mallinckrodt pressure injector. Arterial phase and portovenous-phase images were acquired at 18–22 s and

60–65 s, respectively. Three-dimensional reconstruction using thin sections (1 mm) was performed in coronal and sagittal planes for better depiction of the lesion and its extent and involvement of adjacent structures.

RESULTS

In all the six cases, the gossypibomas were surgically removed. Females formed the bulk of the patients (five out of six patients). The longest interval between surgery and presentation of symptoms was 7 years, while the shortest was 2 months. The mean body mass index (BMI) of our population was 24.25 with four of the six patients being overweight and one patient obese. All patients were symptomatic, with the most common presentation being abdominal pain. Five of the six patients underwent gynaecological surgery (mostly hysterectomy), while the other was related to urological surgery (ureter reimplantation). Based on the history, physical examination and imaging features, five out of the six cases were accurately diagnosed pre-operatively. One patient presented with an atypical imaging pattern on CT, mimicking a haemorrhagic cyst and was diagnosed only post-operatively. On imaging, the lesions showed no specific pattern on radiographs; however, on ultrasound, four of the six lesions appeared as thick-walled hypoechoic lesions with strong posterior acoustic shadowing. On CT, the most common feature observed was a spongiform pattern (Figures 1–3), the others being a fluid density lesion with hyperdense content (Figure 4) and a fluid density lesion with undulating internal septations (Figure 5). The incidences of the most common imaging patterns on ultrasound (thick-walled hypoechoic lesion with strong posterior

shadowing) and CT (“spongiform pattern”) were 66.6% each (Figures 6).

DISCUSSION

Gossypibomas or textilomas are retained surgical sponges. The word gossypiboma is derived from two words—the Latin word “gossypium”, meaning cotton, and the Swahili word “boma”, meaning place of concealment.⁵ Wilson, in 1884, reported the first case of gossypiboma.⁶ The incidence of gossypibomas may range from 1 in 100–5000 for all surgical procedures, while for intra-abdominal surgeries, it may range from 1 in 1000–1500. It accounts for nearly 50% of all lawsuits for retained foreign bodies.^{7,8} Gossypiboma may occur as a complication following any surgical procedure such as exploratory laparotomy, gynaecological surgery, cardiothoracic surgery, fracture fixation and even neurosurgery.^{2,9} The condition is more commonly seen in the developing nations with a higher incidence in females as compared with males. Gawande *et al*,¹⁰ in their article published in the *New England Journal of Medicine*, identified eight risk factors for gossypibomas, namely—emergency surgeries, unexpected change in surgery, involvement of more than one surgical team, change in the nursing or operation theatre staff during an operation, BMI, volume of blood loss, female sex and surgical counts. Among these, they found only three that were statistically significant and they were emergency operations, unexpected change in operation and BMI. What impressed them the most was the ninefold increase in risk associated with emergency surgeries for gossypibomas. Clinical symptoms in these patients are non-specific and may present several decades after the surgery and include—nausea, vomiting, fever, anorexia,

Figure 1. A gossypiboma in a 28-year-old female patient who presented with left lower quadrant pain for 2 weeks. She had a history of having undergone a caesarean section 2 months earlier: an erect abdominal radiograph (a) is inconclusive. Ultrasound of the abdomen and pelvis (b) are revealing a thick-walled lesion with strong posterior acoustic shadowing. Post-contrast abdominal CT (c) is showing the lesion, which has a spongiform pattern (thick arrow) with an enhancing thick wall.

Figure 2. A complicated gossypiboma with a fistulous communication with the anterior abdominal wall in a 40-year-old female patient. She underwent hysterectomy 5 years back: the abdominal radiograph (a) is normal. Abdominal ultrasound (b) is revealing a thick-walled lesion (thick arrow) measuring 8.6×3.2 cm with the internal echogenic linear area causing posterior dirty shadowing suggestive of air. Post-contrast CT axial (c) and coronal (d) images are revealing a peripherally enhancing lesion with a “spongiform pattern” (thin arrows) in the central pelvis with a fistulous communication (arrowhead) to the anterior abdominal wall.

weight loss, a palpable mass, rectal bleeding or an altered bowel habit.^{10,11} Pathophysiologically, there are two types of foreign body reactions associated with gossypibomas, the most common being a fibrous aseptic inflammatory reaction and adhesion that encapsulates the gossypiboma in the omentum and surrounding organs. These patients usually remain asymptomatic and are detected incidentally. The other is an exudative inflammatory reaction leading to an abscess or fistula formation. The pressure exerted by the foreign body on the abscess can lead to an external opening or force it through an opening into an adjacent hollow organ. This erosive process may occur over several years and patients present with complaints of abdominal pain, vomiting, a palpable mass, anaemia, altered bowel habits or an intestinal obstruction. Rarely, owing to the peristaltic activity of the intestine, the foreign body may even be spontaneously expelled through the rectum without any sequelae over a period of 10 days to even 15 years.^{12–14}

Radiography is the initial modality used to detect gossypiboma. The diagnosis will be straightforward if the sponge contains a radio-opaque marker and appears as a soft-tissue opacity/density mass with curved or banded radio-opaque/dense lines on radiography or CT. However, surgical sponges without radio-opaque markers are used in several institutions around the world and this proves to be a challenge to imaging. Some of the features suggestive of gossypibomas are—the presence of a whorl-like pattern or an area of opacity with superimposed mottled air densities/gas bubbles. On ultrasound, gossypiboma may be classified as cystic or solid types, with the former

presenting as a cystic lesion with a zig-zag hyperechoic bundle and the latter as a complex mass having mixed echotexture areas. Strong posterior acoustic shadowing is a prominent finding on ultrasound and may be due to the retained sponge itself, calcifications or air bubbles.¹⁵ CT is the investigation of choice for identifying gossypiboma and its complications when present. The most characteristic finding for gossypibomas on CT is a cystic lesion with entrapped gas bubbles known as the “spongiform pattern”. Kopka et al,¹⁶ in their study involving 13 patients with gossypibomas, found the “spongiform pattern” with entrapped gas bubbles as the most significant and specific CT finding with an incidence of 54%. They also noted that the gas bubbles decreased with time. Another imaging appearance of gossypiboma described on CT by Lu et al¹⁷ in a case report is the “calcified reticulate rind” sign, where the gossypiboma appears as a cystic lesion with a thick calcified rind, exhibiting a reticulate appearance. This appearance has been attributed to the gradual accumulation of calcium deposits along the fibre network of the surgical sponge. Post-contrast administration, these lesions tend to show a strong wall enhancement. MRI has limited role in the evaluation of retained sponges with radio-opaque markers, the reason being that these radio-opaque filaments are impregnated with barium sulfate, which has no magnetic or paramagnetic properties and hence causes no artefacts. Also, these filaments give a poor MR signal, as they contain limited free protons.¹⁸ MRI features of gossypiboma, which have been described in few case reports, include a well-circumscribed mass which is hypointense on T_1 weighted images (T_1 WI) and hyperintense on T_2 weighted images (T_2 WI), with a dark capsule

Figure 3. A gossypiboma in a 55-year-old female patient who presented with lower abdominal pain for 3 weeks. She underwent hysterectomy with oophorectomy 1 year back: the abdominal radiograph (a) is inconclusive. Pelvic ultrasound (b) is showing a well-circumscribed collection with air pockets (thin arrows) posterior to the bladder. Post-contrast pelvic CT axial (c) and reformatted coronal (d) images are revealing a peripherally enhancing thick-walled lesion (thick arrows) posterior to the bladder with a spongiform pattern.

on both T1WI and T2WI.¹⁹ Other authors have described the presence of hypointense stripes of gauze fibres as characteristic for gossypibomas.²⁰ Kuwashima *et al*, in their case report involving two patients, documented that the central signal intensity (SI) of gossypibomas varied on T1WI and T2WI depending on the amount of fluid and protein content. They noted that gossypibomas with a hyperintense centre on T1WI and T2WI had a serosanguinous fluid rich in protein content, while the gossypiboma with a hypointense centre was composed of minimal fluid.²¹ Kim *et al*,²² in their study involving seven patients with paravertebral gossypibomas, found that retained foreign bodies tend to have a low to intermediate SI on T1WI and a hyperintense core with a low SI in the periphery on T2WI, when compared with the paraspinal muscles. Post-gadolinium administration, they noted that six of the seven lesions had a non-enhancing core with a strong enhancing wall. On angiography, gossypibomas can appear as a hypervascular mass, thereby mimicking a tumour.¹⁵ Yuh Feng *et al*,²³ in their literature, described gossypiboma to have a low central uptake (representing the actual gauze) with a high peripheral fludeoxyglucose uptake secondary to fibrosis. Differential diagnosis for intra-abdominal gossypibomas (Figure 7, Table 1) includes post-operative haematoma or abscess, faecaloma, intestinal obstruction, gastrointestinal stromal tumours and any newly acquired or recurrent tumours.^{15,24,25} On CT, an abscess usually presents as a fluid density mass with air-fluid level and a well-defined enhancing wall on post-contrast administration as compared

with a gossypiboma which has a characteristic spongiform appearance, although a strong wall enhancement may be seen in the latter as well. In addition, gossypibomas will demonstrate a fixed position of gas bubbles and geometric shape on subsequent CT scans. However, one must note that an abscess can also occur as a complication of gossypiboma. Haematomas are usually seen in the early post-operative period and on subsequent follow-up, it shows resorption. Although faecaloma/intestinal obstruction has a spotted appearance on CT resembling a gossypiboma, it has a recognizable bowel wall with the absence of a well-defined thick capsule of a gossypiboma.^{25,26} Haemostatic agents, which are bioabsorbable materials that are used to control intraoperative bleeding, are intentionally placed during surgery unlike non-degradable surgical sponges that are left inadvertently, which can also mimic a gossypiboma on imaging. The most commonly used haemostatic agents are collagen sponges, gelatin sponges (Gelfoam®; Ethicon, Somerville, NJ), oxidized regenerated (Surgicel®; Johnson and Johnson Medical, Spring House, PA) and microfibrillar collagen. Some features which may help in differentiating a haemostatic agent from a gossypiboma are that in the former air pockets are tightly packed and not scattered unlike in gossypiboma, and these air pockets may show a linear appearance. Also, unlike non-degradable surgical sponges, haemostatic agents get absorbed eventually. Other imaging features which may prove useful are the thick capsule, strong wall enhancement and calcifications that may be seen in

Figure 4. A gossypiboma in a 36-year-old female patient who presented with lower abdominal pain for 1 month. She underwent hysterectomy 4 years back for a uterine fibroid: the erect abdominal radiograph (a) is normal. Ultrasound of the pelvis (b) is showing a well-circumscribed hypoechoic non-vascular lesion (thick arrow) in the right adnexa measuring 44×37 mm with an internal wavy echogenic area. The lesion is showing strong posterior shadowing and no colour flow on Doppler. On post-contrast CT (c), it has an atypical appearance, presenting as a right adnexal fluid density lesion with a central non-enhancing hyperdense component. The lesion is in close proximity to the right ovary and a diagnosis of haemorrhagic cyst has been suggested on CT.

long-standing gossypibomas which are not seen in haemostatic agents.²⁶ Recommendations suggested by experts to prevent gossypibomas include—a quiet and well-organized operating

room with minimal distractions, thereby providing the surgeon as well as the supporting staff with an optimum environment for maximum concentration, and carrying out two careful

Figure 5. A gossypiboma in a 60-year-old male who presented with 1 month of abdominal pain and palpable right lower abdominal mass. He underwent right ureter reimplantation and bilateral Double-J (DJ) stenting 7 years back for a right ureter stricture and bilateral renal calculi: the abdominal radiograph (a) is showing bilateral Double-J (DJ) stents and soft-tissue opacity in the right lower quadrant (arrowhead) displacing the adjacent bowel loops medially and inferiorly. Ultrasound (images not available) showed a hypoechoic lesion with internal echoes and strong posterior shadowing. Post-contrast axial (b) and coronal (c) reformatted images are revealing an enhancing thin-walled fluid density lesion with non-enhancing undulating hyperdense internal septations. Intraoperative exploration revealed a surgical sponge with surrounding pus.

Figure 6. A gossypiboma in a 38-year-old female patient who underwent hysterectomy 6 months earlier and presented with hypogastric abdominal pain: the erect abdominal radiography (a) is showing midline soft-tissue opacity with a central metallic density area (arrow). Ultrasound (panoramic view) of the pelvis (b) is showing a hypoechoic mass with multiple internal echogenic areas causing strong posterior acoustic shadowing, lying superior to the urinary bladder (UB). Post-contrast CT axial (c), reformatted coronal (d) and sagittal (e) images are showing a large pelvic mass with a spongiform pattern. The lesion is showing a metallic structure in the centre.

sponge counts, one at the beginning and the second prior to closure of the wound by at least two nurses, with the counts being audible. Some institutions even include a third interim

count during surgery. Nevertheless, owing to the natural tendency for humans to err, studies have shown that manual counting of sponges even under the most stringent conditions

Figure 7. Differentials for gossypibomas include—a hepatic abscess (a) in a 30-year-old male patient, small bowel obstruction (b) in a 46-year-old male patient, (c) duodenal (D3 segment) exophytic gastrointestinal stromal tumour with necrosis in a 40-year-old male patient and (d) a resorbable haemostatic collagen sponge seen in the gallbladder fossa of a patient who underwent open cholecystectomy.

Table 1. Patient demographics and imaging patterns of gossypibomas seen in our study group

Patient	Age (years)	Sex	BMI	Type of surgery	Date of surgery from	Ultrasound Features	CT Features
Patient 1 (Figure 1)	28	Female	18	Caesarian section	2 months	Hypoechoic lesion with strong shadowing	Spongiform pattern
Patient 2 (Figure 2)	36	Female	17	Hysterectomy	4 years	Hypoechoic lesion with strong shadowing	Fluid density lesion with hyperdense contents
Patient 3 (Figure 3)	60	Male	26.5	Right ureter reimplantation	7 years	Hypoechoic lesion with strong shadowing	Fluid density lesion with hyperdense septations
Patient 4 (Figure 4)	40	Female	27	Hysterectomy	5 years	Thick walled hypoechoic lesion with internal linear echogenic area causing dirty shadowing	Spongiform pattern
Patient 5 (Figure 5)	55	Female	26	Hysterectomy with oophorectomy	1 year	Collection with air pockets	Spongiform pattern
Patient 6	38	Female	31	Hysterectomy	6 months	Hypoechoic lesion with strong shadowing	Spongiform pattern

BMI, body mass index.

may be incorrect leading to a retained sponge despite a reportedly normal count.^{25,26} Hence, the 2009 World Health Organization guidelines for safe surgical procedures advocates using only surgical textile materials impregnated with a radio-opaque marker in body cavities.²⁷ In case of a discrepancy during the sponge count, an intraoperative radiography of the entire operating field should be performed prior to closure.^{25,28} Recent advances that help identify and avoid gossypibomas are—the use of an electronic surveillance system which uses a microchip or radiofrequency-tagged surgical sponges that can be identified electronically and the counting of sponges with barcodes by using barcode scanners.^{25,29–33} Although this may sound expensive, a recent cost analysis by Sloane³⁴ showed that the cost of a retained sponge to a medical institution was

approximately nine times the cost of sponge-counting technology.

CONCLUSION

Gossypibomas should definitely be considered as a possible differential in patients presenting with an abdominal mass with a history of prior surgery. Our study identified that patients who undergo gynaecological surgery, belong to female sex and those with a high BMI were at the highest risk for gossypibomas. A detailed patient history, taking into account a combination of patient-radiologist and radiologist–physician/radiologist–surgeon interaction, along with awareness of the characteristic imaging appearance is critical to bringing about an accurate diagnosis.

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