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The use of ultrasound to differentiate rectus sheath hematoma from other acute abdominal disorders

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Abstract
Background: Rectus sheath hematoma (RSH) is a rare entity that can mimic an acute abdomen. Therefore, we designed a study to analyze the etiology, frequency, diagnosis using ultrasound, and treatment of RSH.
Methods: A total of 1,257 patients admitted for abdominal ultrasound for acute abdominal pain or unclear acute abdominal disorders were evaluated.
Results: In 23 (1.8%) patients, an RSH was diagnosed; three of them were not diagnosed preoperatively by ultrasound. Of 13 men and 10 women (mean age, 57 ± 23 years), 13 developed RSH after local trauma, three after severe coughing, two after defecation, and five spontaneously. Fifteen had nonsurgical therapy, and eight underwent surgery. The use of anticoagulants was accompanied by a larger diameter of the RSH ($p < .012$), and surgical therapy was more frequently required in these patients. In the surgically treated group, more intraabdominal free fluid could be detected by ultrasound ($p < .0005$), patients required less analgesics ($p < .001$), and the mean hospital stay was shorter ($p < .001$).
Conclusions: RSH is a rare condition that is usually associated with abdominal trauma and/or anticoagulation therapy. Ultrasound is a good screening technique. Nonsurgical therapy is appropriate but leads to a greater need for analgesics. Surgery should be restricted to cases with a large hematoma or free intraabdominal rupture.

Key words: Rectus sheath hematoma — Acute abdomen — Ultrasound

Rectus sheath hematoma (RSH) is an unusual condition that may mimic acute abdominal disorders [10, 12, 16, 26]. An adequate diagnosis is only made in 30–50% of cases at admission [2, 9, 10, 12, 22, 23, 25, 29]. Several reports of misdiagnosis have been published, and various etiologic factors have been suggested, but local trauma is the main cause in most patients [6, 18, 20, 24–29]. Adequate diagnostic and therapeutic principles are still in debate. Ultrasound (US) has been shown to be a valuable noninvasive screening technique with high sensitivity in assessing abdominal disorders [2, 9, 12, 23].

We have reviewed our 20-year experience with ultrasound in which we diagnosed 23 cases of RSH. Herein we present our clinical findings, with special attention to three cases of misdiagnosed RSH.

Patients and methods

We reviewed all US reports from patients referred to our department (Second Department of Surgery, University of Innsbruck, Austria) between 1976 and 1996. From these reports, we selected patients who presented with acute abdominal pain or unclear acute abdominal disorders and patients in whom a repeat US exam within 12 h was recommended. Patient charts, sonographic reports, and operative reports were used to collect data regarding symptoms, clinical signs, and potential etiological factors. Localization and size of the RSH, white blood cell counts >10,500, hemoglobin (g/dl), hematocrit, prothrombin time (%), and body temperature (°C) were also documented. We identified reasons for false diagnosis on US. In a long-term follow-up conducted with a telephone questionnaire by an independent investigator, we inquired as to patients' satisfaction, length of sick leave, and further need for therapy.

Statistical analysis

Data were analyzed and descriptive statistics calculated with MS Excel (version 7.0). Data are expressed as mean ± standard deviation for all measurements. Between-group statistical differences were examined by two-tailed unpaired Student's *t*-tests. A p value < .05 was considered to indicate statistical significance.

Results

A total of 34,000 US evaluations were performed at our institution between 1976 and 1996. In all, 1,257 were for

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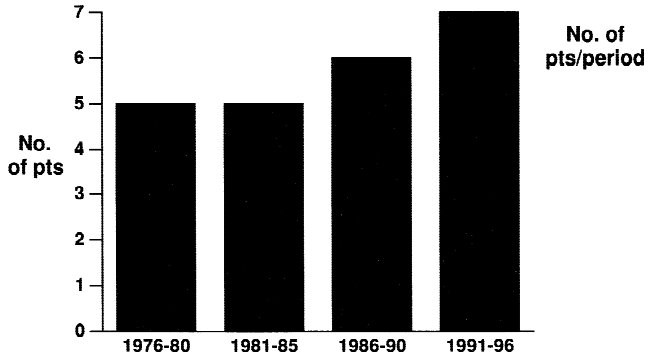

Fig. 1. Prevalence of rectus sheath hematoma (range, 1.2–1.5/year) within a 20-year observation period.

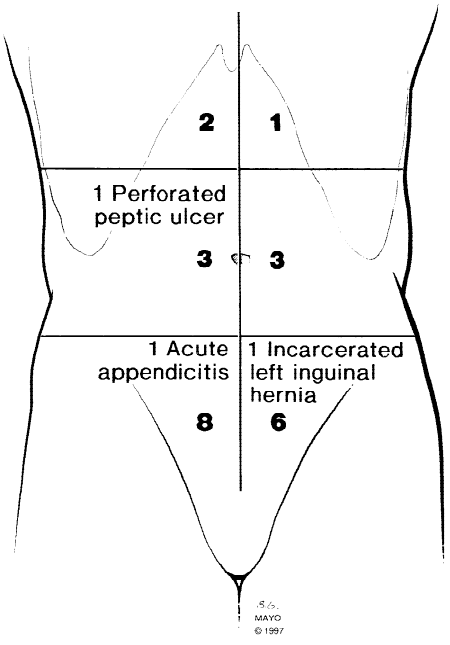

Fig. 2. Total number of rectus sheath hematomas with their distribution along the rectus sheath. The number and location of the three missed diagnoses are shown.

acute abdominal pain, an unclear acute abdominal disorder, or a repeat abdominal US within 12 h. In 23 patients, a RSH was the final diagnosis. In three of these patients, RSH was found at surgical exploration but not by US. The prevalence per year in our experience is shown in Fig. 1. There were 10 women and 13 men with a mean age of 57 ± 23 years. Seven patients were on anticoagulants for various reasons, such as atrial fibrillation, myocardial infarct, and deep vein thrombosis. Thirteen patients developed the RSH after direct local trauma or lifting. In three cases, it was after a cough attack. In two cases, RSH occurred after defecation, and five patients developed a RSH spontaneously. In this latter group, all patients had influenza and two were anticoagulated. In the majority of cases, the RSH was found in the lower abdomen. The distribution is shown in Fig. 2. Computed tomography (CT) was used in only three patients for confirming the diagnosis or for follow-up evaluation. A typical example of a US and CT picture of a RSH is shown in Fig. 3A and 3B.

Fifteen patients were treated nonsurgically with nonsteroidal antiinflammatory drugs (NSAID) as required, together with local coolants and temporary confinement to bed. Eight required surgery for large hematomas, a low hemoglobin or hematocrit, and/or mobility or breathing restricted by pain. Surgery was performed under general anesthesia, except for three patients who underwent local anesthesia. A small cutaneous incision was made over the hematoma, followed by blunt dissection down to the rectus sheath. The incision was opened, and the hematoma was evacuated either by suction or with the help of a finger. After hemostasis, the wound was closed in layers without drainage.

Within the surgically treated group, significantly more intraabdominal free fluid could be detected by US ($p < .0005$) (Fig. 4A). The use of anticoagulants was accompanied by a significantly larger diameter of the RSH ($p < .012$) (Fig. 4B) and significantly lower hemoglobin levels ($p < .004$) (Fig. 4C); in addition, surgical evacuation was more frequently required (Fig. 4D). Sixteen patients (69%) had an abnormal (>10,500) white blood cell count. In seven (30%), the white blood cell count was >12,000, and all these patients required surgery. Seven (30%) of the patients had moderate temperatures at admission. Three patients (13%) underwent surgery since abdominal US failed to detect the RSH. In the total group, there were no mortalities. Two cases (9%) of urinary infection occurred during the hospital stay, one in the surgically and one in the conservatively treated group. Patients within the surgically treated group required less analgesics ($p < .001$). A comparison between the surgically and conservatively treated groups with their analgesic consumption is shown in Fig. 5A. The mean hospitalization stay for surgically treated patients was 4 ± 1.6 days versus 8 ± 2 days in the nonsurgically treated group ($p < .001$) (Fig. 5B). At a mean follow-up of 96 ± 72 months, none of the patients had complaints or discomfort in the area of the previous RSH. There were no recurrences, and all patients were very satisfied with their therapy. From 18 patients (78%), we obtained information about the average length of sick leave, which was 12 days (maximum, 2 months) in the surgical group and 21 days (maximum, 3 months) after conservative therapy.

Three cases of undiagnosed RSH

Localization and kinds of missed diagnoses are shown in Fig. 2.

In three cases, clinical evaluation and US failed to diagnose the RSH. The final diagnosis was made at exploratory surgery for suspected acute appendicitis, incarcerated inguinal hernia, and perforated peptic ulcer disease.

Patient A

A 48-year-old bodybuilder was referred for suspected acute appendicitis. Physical examination revealed acute right lower abdominal pain and tenderness. White blood cell count was 16,200, hemoglobin 14.8 g/dl, hematocrit 41, prothrombin 98%, and body temperature 37.6°C. Abdominal US demonstrated no abnormality. Because of the clinical suspicion of acute appendicitis, an appendectomy was performed. The appendix showed no inflammation, and no other pathologic findings could be demonstrated in the

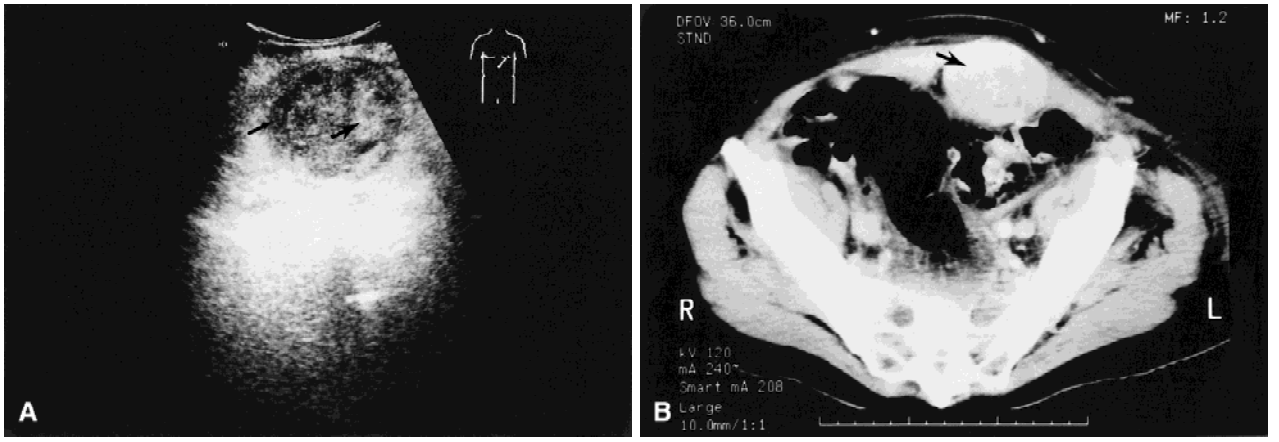

Fig. 3. **A** Abdominal ultrasound image of the left upper abdominal quadrant with a 7.5 MHz sector tracer demonstrating an oval 3–4-cm nonhomogeneous lesion consistent with a rectus sheath hematoma. Both liquid (➞) and solid parts (➔) can be seen. Note the typical echo enhancement behind the hematoma (⇨). **B** Contrast-enhanced computer tomography at the level of the lower abdominal quadrant with asymmetry of the abdominal wall on the left side demonstrating a 4–6-cm rectus sheath hematoma (➔) without free intraabdominal fluid.

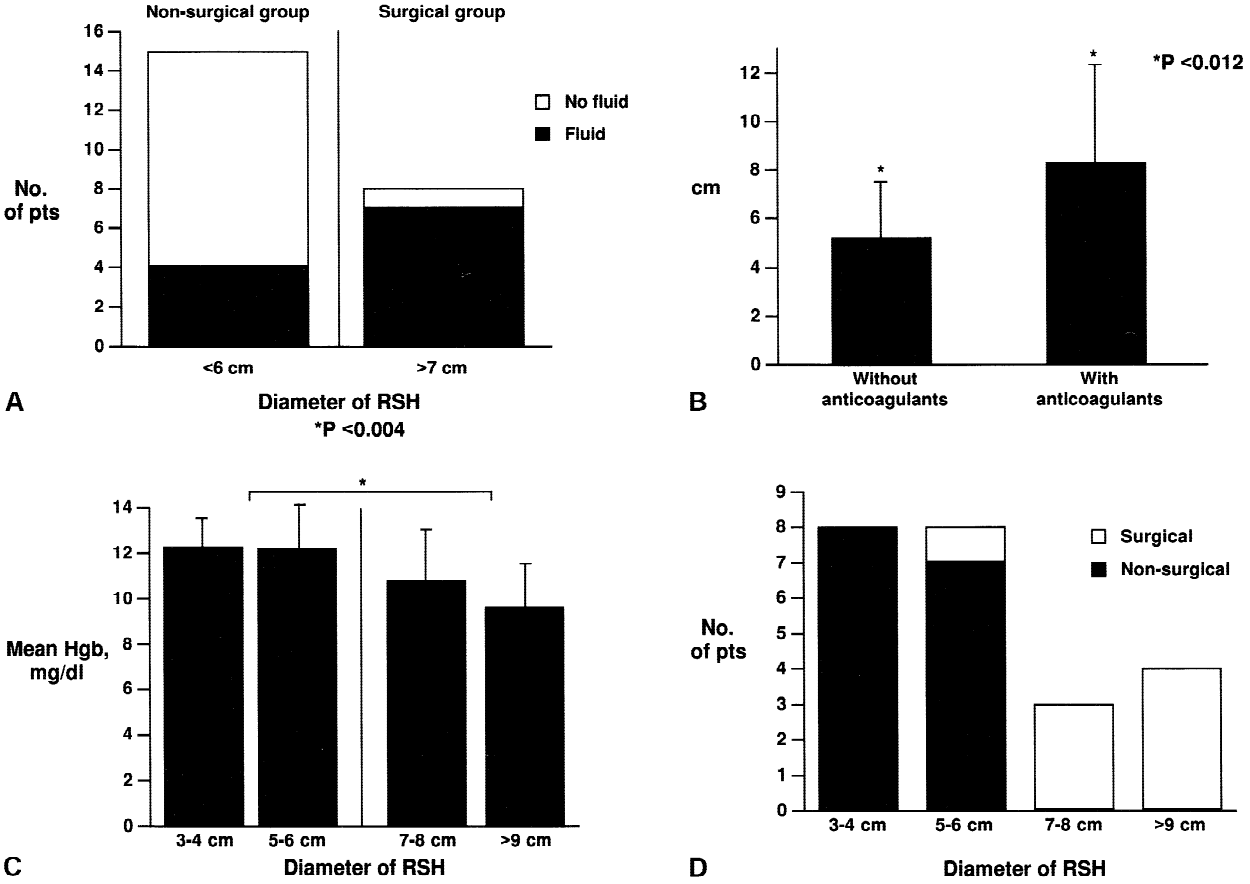

Fig. 4. **A** Patients with free intraabdominal fluid were more likely to have surgery ($p < 0.0005$). **B** Patients with large hematomas were more likely to be on anticoagulation therapy. **C** Large rectus sheath hematomas had lower mean hemoglobin than small hematomas. **D** Surgery was performed more often for large hematomas.

lower abdominal cavity. The abdominal wall was then explored from the same incision, and a 3 × 5-cm RSH was found. A rectus abdominis muscle rupture near the pubis was identified as the cause of hemorrhage. The hematoma was evacuated and the wound closed without drainage. The patient went home on the 5th postoperative day.

Patient B

A 78-year-old man with chronic cough and anticoagulant therapy (Coumadin) after two myocardial infarcts and atrial fibrillation developed acute left-sided lower abdominal pain 2 h before admission. A diagnosis of an incarcerated left

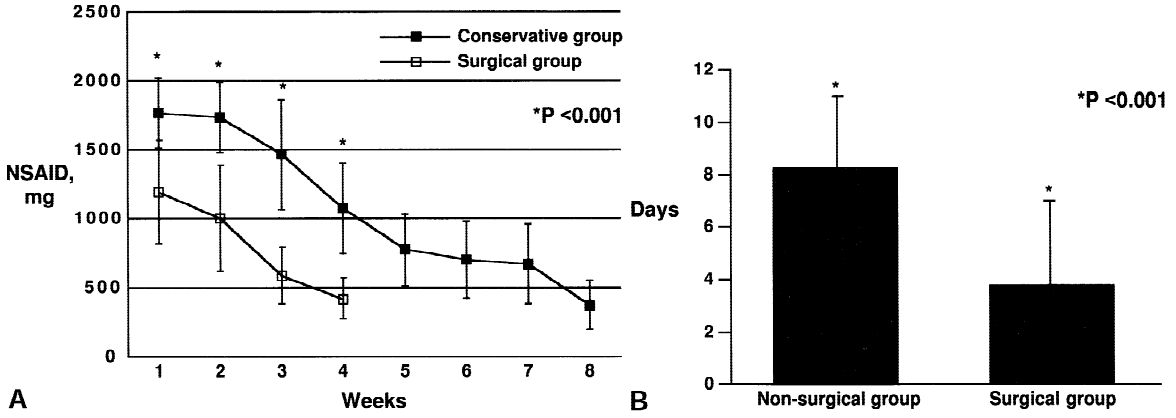

Fig. 5. **A** More analgesics were required in the nonsurgical group. **B** Hospitalization time was longer for the nonsurgical group.

inguinal hernia was made on physical examination. On abdominal US, there was a small amount of free intraabdominal fluid in the small pelvis. White blood cell count was 15,600, hemoglobin 11.3 g/dl, hematocrit 32, prothrombin 10%, and body temperature 37.8°C. Surgical exploration of the left groin showed a 5–10-cm RSH. The source of hemorrhage was a branch of the inferior epigastric artery. This was ligated. After evacuation of the hematoma, the wound was closed without drainage. The patient was discharged at the 7th postoperative day.

Patient C

A 23-year-old man with a history of chronic peptic ulcer disease was referred because of suspected duodenal ulcer perforation. Acute upper abdominal pain and vomiting began 2 h before admission. He had been on Coumadin anticoagulation therapy because of deep vein thrombosis. White blood cell count was 12,800, hemoglobin 8.9 g/dl, hematocrit 30, prothrombin 10%, and body temperature 37.8°C. Sonographic evaluation demonstrated ~500 cc of free abdominal fluid in the right upper abdominal quadrant. Emergency laparotomy revealed no duodenal or gastric perforation but did show ~1 L of blood intraabdominally. There was a 5–12-cm RSH in the right rectus sheath with a short tear in the posterior rectus sheath 3 cm above the navel. The hematoma was removed through the perforation site. After closure of the perforation site and the abdominal wound without drainage, the postoperative course was unremarkable. The patient went home on the 7th day after surgery.

Discussion

The principle structures that compromise the anterior abdominal wall are the rectus abdominis muscle, external and internal oblique muscles, and transversus abdominis muscle with their aponeuroses. The rectus abdominis muscle lies within an aponeurotic sheath together with the inferior and superior epigastric vessels and is usually crossed by three transverse intersections. The lowermost segment between tendinous intersections is the longest; hence, muscle shortening with contraction is the greatest at this level. This explains the higher incidence of RSH in the lower abdomen [15, 16].

RSH is reported to be the most common nonneoplastic disease of that anatomic region [10]. It is usually caused by direct trauma or occurs spontaneously in association with anticoagulant therapy [2, 20, 22, 25] or systemic diseases such as hemophilia, leukemia, or collagen disease [8, 16, 26]. Other reported causes for RSH include infectious disease [3, 16, 19], a complication of conventional or laparoscopic operations [1, 14], and the subcutaneous injection of low-dose heparin [24] or insulin [13]. Frequently, however, hemorrhage occurs without obvious direct trauma or systemic disease. In these cases, the hematoma follows muscular straining, as in coughing and sneezing [16, 25, 29]; it may even develop after sports or childbirth [10, 17, 18, 27]. The inelasticity of the artery and vein within the rectus sheath, which prevents the vessels from accommodating to sudden variations in length during contractions of $\leq$20 cm, has been proposed as an underlying factor (in addition to other conditions such as atherosclerosis, arteritis, aneurysm, or hypertension [10, 15, 16, 19, 22, 29].

RSH is reported to be three times more frequent in women than in men; it rarely occurs in children. Its peak incidence is found in the 5th decade [16, 20, 22]. In our series, we had slightly more men, and the peak age was 97 years. RSH has been mistaken for many common acute abdominal diseases, such as appendicitis [8, 12, 16], incarcerated inguinal hernia, [16, 23], urinary obstruction [29], acute cholecystitis, mesenteric vascular insult [25], dissecting aortic aneurysm [9, 19, 25], pregnancy [5], and torsion of ovarian cysts [10]. Other, more infrequent differential diagnoses should include desmoid tumors and sarcomas [10, 23], echinococcal cysts in the muscle layer or fat tissue of the abdominal wall [3, 7, 13], and an interparietal hepatic fat pad [4].

The main symptom of RSH is pain. It is sudden in onset and sharp and may be progressively severe. The pain is felt to the side of the hematoma, but it may be diffuse over the abdomen [10, 15, 16, 20]. Fothergill summarized the typical signs as a painful, palpable mass in the abdominal wall that does not cross the midline and remains palpable when the patient tenses the rectus muscle. This has been called "Fothergill's sign" [5]. Discoloration of the skin over the hematoma may be present. This finding usually occurs 3 or 4 days after the event [16, 20, 22]. We saw this in only one case.

Fourteen patients (61%) in our experience complained of diffuse abdominal pain, and nine (39%) had localized abdominal pain. More than two-thirds of the cases with diffuse abdominal pain had an RSH >3–5 cm. Pain together with increased activity of stretch receptors may explain why some patients complain of tachycardia, anorexia, nausea, or vomiting [16, 20, 22]. We observed almost all these clinical signs in our patients.

Surgery was performed exclusively in those cases with an RSH of >5 cm. Patients experienced severe pain and had restricted mobility and breathing. With increasing diameter, there was a significant decrease of hemoglobin (Fig. 4C). When patients were under anticoagulant medication, they were more prone to develop a larger RSH (Fig. 4B).

A comparison of the sonographic findings of free abdominal fluid between the surgical and nonsurgical groups (Fig. 4a) shows that about one-third in the conservative group had free abdominal fluid, whereas almost all in the surgical group did. In all of these cases, the RSH diameter was >5 cm. In smaller RSH, we did not detect free intraabdominal fluid, suggesting that larger hematomas are more prone to perforate intraabdominally. These results led to the conclusion that an RSH >5 cm should be treated surgically. Removal of the hematoma reduced pain sensation, diminished the need for analgesics, and increased mobility. In the majority of patients with RSH, we concluded that nonsurgical management was appropriate. However, good pain management with high doses of analgesics, together with local coolants, is necessary to increase these patient's mobility with less morbidity.

The failure rate to make a clinical diagnosis has been reported to be >50% [10, 20, 22]; even when imaging techniques such as ultrasound are used, failure rates of ≤30% occur [6, 16, 23, 25, 28, 29]. For this reason, some authors recommend a CT scan for unclear abdominal disorders because of its high accuracy in diagnosing RSH [12, 19, 23, 29]. In our experience, clinical and sonographic misinterpretation were the two most important factors leading to a failure to diagnose the RSH. In one case (patient A), a failed diagnosis was obtained by nonevaluation of the abdominal wall. In patient B, the sonographic finding was misinterpreted. Both errors were made by inexperienced investigators. But in one case (patient C), even an experienced surgeon and sonographer were misled by the clinical history, physical examination, and sonographic findings of intraabdominal fluid. A CT scan or a Gastrografin swallow would have been helpful to define the diagnosis, but it would not have changed the indication for surgery because of the ruptured large RSH with continuous bleeding into the free abdominal cavity. This has to be regarded as severe hemorrhage and treated surgically [20, 22, 25, 29] or with interventional radiologic techniques [11]. The latter method can selectively occlude the bleeding vessel. However, the technique may be demanding, requires experience, and is not always available. A further disadvantage is that much of the hematoma remains in place, whereas surgery may control hemostasis and removes the hematoma [22, 25, 29].

We found it practical and convenient to perform surgery under general anesthesia, especially in cases of large RSH and in patients on anticoagulant medication. In three cases, we successfully performed the removal of the hematoma through a small incision under local anesthesia. This procedure was well tolerated by the patient, but it should be reserved for RSH with a maximum diameter of <5 cm since the evacuation of larger hematomas will require more extensive surgery. In regard to pain management, we found less need for nonsteroidal analgesics in the surgically treated group than the nonsurgical group, since the removal of the hematoma probably takes away the tension on the peritoneum and reduces the activity of stretch receptors. On the other hand, reabsorption of the hematoma, depending on its extent, may take several weeks. The fact that we avoid drain placement after surgery may further explain the reduced postoperative irritation and pain. Drains should also be regarded as a potential source of infection [21].

All patients in both treatment groups were very satisfied with their final outcome. None experienced secondary inflammation or recurrence.

Although we experienced a misdiagnosis in 13% of our cases, no RSH was missed by sonography in the last 10 years. Several reasons account for this high degree of accuracy. All surgeons are extensively trained by an experienced sonographer before performing US independently. Improvements in software and tracer equipment have helped to increase our diagnostic accuracy, particularly in the last 10 years. We routinely use low-frequency and high-frequency sectors and/or planar tracers for abdominal US. Since the mid-1980s, a standardized protocol for an abdominal US evaluation has been followed in our department. This protocol is supported by specific computer software (Cubus 3.0) that guides the investigator through an entire abdominal US investigation, including the abdominal wall and groin. A sonographic report is immediately available and may be used in follow-up studies.

Conclusions

Rectus sheath hematoma should be included as a differential diagnosis in all acute abdominal disorders. It is a rare condition with an estimated prevalence of 1.2–1.5 cases per year in our experience. Ultrasound is a good noninvasive screening technique for RSH. Initially, treatment should be nonsurgical, but this option entails a greater need for analgesics. Surgery is reserved for large hematomas with pain, restricted mobility and/or breathing, and for cases with free intraabdominal rupture or uncertain diagnosis. Surgery should be performed under general anesthesia with complete removal of the hematoma, control of hemostasis, and wound closure without drainage.

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