Percutaneous Arterial Embolization in the Management of Rectus Sheath Hematoma

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OBJECTIVE. Spontaneous rectus sheath hematoma can become clinically relevant and necessitate hemostatic intervention. The aim of this study was to describe the efficacy of percutaneous arterial embolization in the management of this condition.

CONCLUSION. Selective transcatheter embolization is effective hemostatic treatment of patients with large, clinically relevant rectus sheath hematoma.

Spontaneous nontraumatic rectus sheath hematoma usually is not a severe condition. In some patients, however, it can be a complication due to massive or persisting bleeding or be a diagnostic error in confusion with intraabdominal problems, particularly in pregnant women [1]. Deaths have been reported [2–4]. The most frequent cause of spontaneous rectus sheath hematoma is anticoagulation therapy [5, 6]. The number of patients undergoing anticoagulation therapy is increasing because of the benefits of anticoagulation in the management of a variety of conditions, such as atrial fibrillation, and in prophylaxis against deep venous thrombosis. Spontaneous abdominal rectus sheath hematoma, usually resulting from rupture of the inferior epigastric artery and in some cases the deep circumflex iliac artery, is an uncommon but well-known complication of anticoagulation therapy [7–11]. Symptoms range from slight abdominal pain to hypovolemic shock.

The natural course of most rectus sheath hematomas is typically self-limited as the bleeding tamponades itself, and management usually is conservative [5, 12–17]. Nevertheless, a large hematoma can develop and cause marked hypovolemia, necessitating prompt and accurate diagnosis, reversal of anticoagulation status, fluid resuscitation or transfusion, and hemostatic treatment [16, 17]. In some patients, persistence of bleeding despite adequate reversal of anticoagulation necessitates hemostatic intervention [3, 16, 18]. Although surgical evacuation of hematoma and ligation of bleeding vessels are the hemostatic procedures most commonly indicated for severe rectus sheath hematoma [12, 18, 19], percutaneous management by selective transcatheter arterial embolization may be a therapeutic option. A few anecdotal reports [20–22] have described percutaneous embolization in patients with rectus sheath hematoma. Our series, although small, included more patients than described in those reports.

Materials and Methods

We retrospectively reviewed the charts and radiologic images of all patients with rectus sheath hematoma consecutively registered at our institution between January 2001 and March 2005. The inclusion criteria were as follows: development of rectus sheath hematoma during anticoagulation therapy; spontaneous origin of rectus sheath hematoma without apparent trauma or penetrating injury to the abdominal wall; and rectus sheath hematoma considered clinically relevant, that is, associated with arterial hypotension necessitating fluid resuscitation or with persistent bleeding despite reversal of anticoagulation status. A total of 19 patients met all the criteria. Twelve of the 19 patients were transferred to our interventional radiology section, and these patients constitute the study group. Clinical and laboratory data on the 12 patients (four men and eight women; mean age ± SD, 69 ± 8 years) are detailed in Table 1. Ten patients presented with lower abdominal pain, abdominal wall mass, or both. Five patients were in a state of hypovolemic shock, and seven had persistent bleeding.

In all patients, imaging findings confirmed the clinical suspicion of rectus sheath hematoma. In 11 cases, the diagnosis was confirmed with emergency abdominal CT (Asteion single-detector scanner, Toshiba, or Sensation 16-MDCT system, Siemens Medical Solutions). The twelfth hematoma was confirmed with abdominal sonography (Applio 3.5...
TABLE 1: Clinical and Laboratory Data on Patients with Large Rectus Sheath Hematoma

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Anticoagulation</th>
<th>Indication for Embolization</th>
<th>Hemoglobin Level (g/L)</th>
<th>Before</th>
<th>After</th>
<th>No. of Transfusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
<td>F</td>
<td>Yes</td>
<td>Hypovolemic Shock</td>
<td>2.3</td>
<td>66</td>
<td>70</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>M</td>
<td>No</td>
<td>Abdominal Mass and Pain</td>
<td>2.6</td>
<td>96</td>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>F</td>
<td>No</td>
<td>Pulmonary embolism</td>
<td>1.7</td>
<td>81</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>F</td>
<td>Yes</td>
<td>Atrial fibrillation</td>
<td>1.9</td>
<td>65</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>69</td>
<td>F</td>
<td>No</td>
<td>Atrial fibrillation</td>
<td>2.5</td>
<td>50</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>66</td>
<td>F</td>
<td>Yes</td>
<td>Myocardial infarction</td>
<td>2.2</td>
<td>84</td>
<td>90</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>77</td>
<td>M</td>
<td>Yes</td>
<td>Atrial fibrillation</td>
<td>1.5</td>
<td>76</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>83</td>
<td>M</td>
<td>No</td>
<td>Atrial fibrillation</td>
<td>1.15</td>
<td>90</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>68</td>
<td>F</td>
<td>Yes</td>
<td>Atrial fibrillation</td>
<td>1.25</td>
<td>58</td>
<td>60</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>55</td>
<td>F</td>
<td>Yes</td>
<td>Systemic lupus</td>
<td>1.8</td>
<td>69</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>72</td>
<td>M</td>
<td>Yes</td>
<td>Atrial fibrillation</td>
<td>1.2</td>
<td>67</td>
<td>90</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>80</td>
<td>F</td>
<td>No</td>
<td>Prophylaxis of deep venous thrombosis</td>
<td>2.1</td>
<td>100</td>
<td>100</td>
<td>2</td>
</tr>
</tbody>
</table>

Note—INR = international normalized ratio, aPTT = activated partial thromboplastin time, LMWH = low-molecular-weight heparin (enoxaparin in all cases), PRBCs = packed RBCs, FFP = fresh frozen plasma.

**Results**

The absence of contrast extravasation at the bleeding site on repeated supraselective digital subtraction angiography was used as a criterion for successful embolization. The indications were hemodynamic instability or persistence of active bleeding in a large hematoma. The indications for embolization were based on the morphologic features of the aortic bifurcation, the presence of a large hematoma, and the absence of contrast extravasation at the bleeding site.

**Discussion**

Catheter-directed injection of local anesthetic (lidocaine) on the side contralateral to the hematoma, vascular access via the common femoral artery depicted the vascular anatomic features. The choice of catheter (Cobra-II 5 French or Simmons-I 5 French, both Terumo Europe) for use depended on the size of the vessel. The choice of embolic agent was based on the anatomic location of the bleeding site. The indications for embolization were hemodynamic instability or persistence of active bleeding in a large hematoma. The indications for embolization were based on the morphologic features of the aortic bifurcation, the presence of a large hematoma, and the absence of contrast extravasation at the bleeding site.

**Conclusion**

The absence of contrast extravasation at the bleeding site on repeated supraselective digital subtraction angiography was used as a criterion for successful embolization. The indications were hemodynamic instability or persistence of active bleeding in a large hematoma. The indications for embolization were based on the morphologic features of the aortic bifurcation, the presence of a large hematoma, and the absence of contrast extravasation at the bleeding site.
in seven patients because extravasation of high-density contrast material was seen. This finding was seen as a jet in six patients and layering on a fluid–fluid level within the hematoma in the seventh patient.

Selective catheterization was possible in all 12 patients. Selective digital subtraction angiography showed active bleeding points in all patients, the site corresponding well with CT findings in the seven cases in which bleeding was detected on CT. The inferior epigastric artery was the primary source of bleeding in all 12 patients. Eight patients had only one bleeding vessel contributing to the rectus sheath hematoma, and the other four had multiple vessels involved. Secondary collateral supply from the superior epigastric artery was found in two patients. The other two patients had concomitant bleeding from the ipsilateral deep circumflex iliac artery. Embolization of the contralateral inferior epigastric artery also was performed in one patient because of hyperemia in the distal branches, although there was no evidence of active bleeding.

Vascular embolization was technically successful in all cases because no active bleeding was detected on angiography immediately after the procedure. Only one percutaneous embolization procedure was necessary in all 12 patients. After the embolization procedure, patients underwent follow-up for 19 ± 18 days. During this period, there was no clinical evidence of rebleeding, and hemodynamic values returned to normal. Mean arterial pressure after percutaneous embolization (86 ± 13 mm Hg) was significantly higher (p = 0.001, paired Student’s t test) than that before intervention (60 ± 8 mm Hg). Four patients needed additional transfusion of packed RBCs for correction of residual anemia, and one patient needed additional transfusion of fresh frozen plasma after embolization for reversal of anticoagulation status. No patient needed surgical intervention.

No complications related to embolization were found during or after the procedure. Three patients died during the hospital stay (12 hours and 2 and 8 days after the procedure). Causes of death were multiple organ failure as a result of hemodynamic complications related to rectus sheath hematoma in the two first patients and acute renal failure related to hypovolemic shock secondary to rectus sheath hematoma combined with chronic cardiac failure in the third. A fourth patient died of nosocomial pneumonia 1 month after embolization. The other eight patients had an uneventful course after embolization and were discharged from the hospital in good condition. None of these eight patients was readmitted to the hospital for problems related to rectus sheath hematoma or the vascular intervention.

Discussion

Bleeding is a major complication of anticoagulation therapy. The main determinants of bleeding induced by oral anticoagulants are the intensity of the anticoagulant effect, underlying patient characteristics, and the length of therapy. A similar risk of bleeding is associated with treatment with IV or low-molecular-weight heparin [5, 10]. Hemorrhage into the rectus muscle sheath is a well-recognized but relatively uncommon complication of anticoagulant therapy. Bleeding at this location can produce painful, tender swelling mimicking an intra-peritoneal mass with features of acute abdomen. The clinical history, physical examination, and abdominal sonographic or CT findings are used to establish the definitive diagnosis [14, 18, 23, 24]. The pathogenesis of anticoagulation-associated rectus sheath hematoma is unknown. A diffuse microvascular origin has been postulated, either as a result of preexisting diffuse small-vessel arteriosclerosis or heparin-induced microangiopathy. Minor or unrecognized trauma, such as coughing fits, twisting, rapid change in position, and Valsalva maneuvers, have been reported to be precipitating factors that may have a role in the development of rectus sheath hematoma [6, 7, 10, 12, 16, 25].
Rectus sheath hematoma is most commonly found in the lower abdomen. The epigastric vessels lie between the rectus abdominis muscle and the posterior leaf of the rectus sheath. Above the arcuate line, the muscle is supported in the posterior aspect by strong aponeurotic sheaths. Below the arcuate line, only the transverse fascia and the peritoneum support the rectus abdominis muscle. Thus, hematomas in this region can enlarge easily, cross the midline to the opposite side, and dissect down into the prevesical space of Retzius [26, 27].

In cases of large rectus sheath hematoma, as occurred in our patients, standard imaging techniques, mainly CT and sonography, are commonly used to confirm the existence of the hematoma. Sonography can reveal patterns ranging from solid masses to cystic masses with septa. Sonographic findings are nonspecific in some cases and can mimic abdominal wall tumors and inflammatory diseases. Information about the rectus abdominis muscle itself, perimuscular tissue, and peritoneal cavity is best obtained with CT. In addition, contrast-enhanced CT can provide information about active bleeding. Active bleeding can be seen in cases of traumatic expansion of the hematoma, and it can be identified on images obtained in the arterial phase and as layering of contrast material in the delayed phase [15, 18, 24]. Digital subtraction angiography is the most useful imaging technique for identifying active bleeding. It also provides information such as the number of bleeding sites and their exact location [28–30]. In our series, digital subtraction angiography depicted active bleeding in all cases. Contrast-enhanced CT showed active bleeding in only seven cases.

Conservative management is the most common therapy for rectus sheath hematoma because the lesion usually is self-limited. The coagulation profile of patients taking anticoagulation medications can be corrected by withdrawal of these medications and administration of vitamin K and fresh frozen plasma or, in patients being treated with heparin, protamine sulfate. The decision to perform a transfusion depends on the hemodynamic status and presence of comorbid conditions such as active coronary ischemia and severe anemia [12, 13, 17]. Surgical ligation of the bleeding epigastric vessels is commonly considered the only option in the management of uncontrolled bleeding, although this technique can be limited by inability to localize and ligate the bleeding vessel [12, 18, 19]. Surgery has the advantage of evacuation of very large rectus sheath hematomas.

### TABLE 2: Radiologic and Embolization Data

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>CT Finding Before Angiography</th>
<th>Sonographic Finding Before Angiography</th>
<th>Bleeding Site</th>
<th>Embolization Material</th>
<th>Follow-Up Period</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Right rectus sheath hematoma 12 × 6 × 3 cm</td>
<td>Left inferior epigastric artery and DCIA; hyperemia right inferior epigastric artery</td>
<td>Coils</td>
<td>12 h</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Right rectus sheath hematoma 20 × 11 × 5.5 cm with intraperitoneal rupture; active bleeding</td>
<td>NP</td>
<td>Right inferior epigastric artery</td>
<td>Gelatin</td>
<td>14 d</td>
<td>Survival</td>
</tr>
<tr>
<td>3</td>
<td>Right rectus sheath hematoma 15 × 12 × 7 cm</td>
<td>NP</td>
<td>Right inferior and superior epigastric arteries</td>
<td>Coils</td>
<td>13 d</td>
<td>Survival</td>
</tr>
<tr>
<td>4</td>
<td>Left rectus sheath hematoma 9 × 7 × 4 cm; active bleeding</td>
<td>NP</td>
<td>Left inferior epigastric artery</td>
<td>Gelatin + coils</td>
<td>19 d</td>
<td>Survival</td>
</tr>
<tr>
<td>5</td>
<td>Right rectus sheath hematoma 14 × 13 × 7.5 cm with intraperitoneal rupture; active bleeding</td>
<td>Right rectus sheath hematoma 10 × 10 × 5 cm with intraperitoneal fluid</td>
<td>Right inferior epigastric artery</td>
<td>Gelatin + coils</td>
<td>70 d</td>
<td>Survival</td>
</tr>
<tr>
<td>6</td>
<td>Right rectus sheath hematoma 15 × 14 × 6 cm</td>
<td>NP</td>
<td>Right inferior and superior epigastric arteries</td>
<td>Gelatin + coils</td>
<td>30 d</td>
<td>Survival</td>
</tr>
<tr>
<td>7</td>
<td>Right rectus sheath hematoma 10 × 10 × 11 cm with intraperitoneal rupture; active bleeding</td>
<td>NP</td>
<td>Right inferior epigastric artery and DCIA</td>
<td>Gelatin + coils</td>
<td>2 d</td>
<td>Death</td>
</tr>
<tr>
<td>8</td>
<td>Right rectus sheath hematoma 20 × 7.7 × 3.4 cm</td>
<td>NP</td>
<td>Right inferior epigastric artery</td>
<td>Gelatin + coils</td>
<td>16 d</td>
<td>Survival</td>
</tr>
<tr>
<td>9</td>
<td>Left rectus sheath hematoma 22 × 1 × 11 cm with intraperitoneal rupture; active bleeding</td>
<td>NP</td>
<td>Left inferior epigastric artery</td>
<td>Gelatin + coils</td>
<td>8 d</td>
<td>Death</td>
</tr>
<tr>
<td>10</td>
<td>Right rectus sheath hematoma 12 × 8 × 6.5 cm with intraperitoneal rupture</td>
<td>NP</td>
<td>Right inferior epigastric artery</td>
<td>Gelatin</td>
<td>30 d</td>
<td>Death</td>
</tr>
<tr>
<td>11</td>
<td>Right rectus sheath hematoma 25 × 12 × 7 cm; active bleeding</td>
<td>NP</td>
<td>Right inferior epigastric artery</td>
<td>Gelatin + coils</td>
<td>14 d</td>
<td>Survival</td>
</tr>
<tr>
<td>12</td>
<td>Right rectus sheath hematoma 10 × 8.5 × 3 cm; active bleeding</td>
<td>NP</td>
<td>Right inferior epigastric artery</td>
<td>Coils</td>
<td>12 d</td>
<td>Survival</td>
</tr>
</tbody>
</table>

Note—NP = not performed, DCIA = deep circumflex iliac arteries.

aDeath from nosocomial pneumonia, unrelated to hemorrhagic event.
Arterial embolization is a therapeutic option for bleeding from a variety of sources, mainly in the abdomen and pelvis [14, 28, 29, 31, 32]. Embolization through a coaxial microcatheter to enable selective or supraselective distal embolization of small-vessel bleeding points at various sites has been described in the management of rectus sheath hematoma [22, 30]. In our patients, indications for angiography and further embolization were persistent bleeding and hemodynamic instability despite reversal of anticoagulation and conservative management with fluids, fresh frozen plasma, or RBC transfusion.

Rectus sheath hematoma is sometimes multifocal and involves collateral pathways. Vessels collateral to the inferior epigastric artery can arise from the superior epigastric artery [26, 27]. For this reason, we performed embolization of the inferior epigastric artery supply to the rectus sheath, although embolization of the superior epigastric artery also was necessary in two patients in whom the hemorrhage did not stop. The inferior epigastric artery was embolized at sites proximal and distal to the site of active bleeding. In our patients, absorbable gelatin sponge pledgets were used to embolize distal and small vessels, and coils were favored for occlusion of proximal vessels.

Our experience was similar to that reported in the literature in isolated cases of embolization of spontaneous extraperitoneal hemorrhage with marked hemodynamic alterations [14, 28, 29, 31, 32]. After embolization, the hemorrhage ceased in all of our patients, and clinical success, that is, favorable course with hospital discharge, was achieved in 75% of the patients. This 100% rate of hemostasis after embolization may suggest that this radiologic procedure should be considered first-option therapy for clinically relevant rectus sheath hematoma that cannot be controlled by conservative management.

Twenty-five percent of our patients died after embolization. Most of the deaths were related to complications of hemodynamic disturbances secondary to rectus sheath hematoma. No death was related to the radiologic procedure. This finding suggests that earlier diagnosis and intervention might have been associated with better clinical results. Therefore, in the care of patients with rectus sheath hematoma, not rapidly controlled by conservative treatment, it may be appropriate to recommend early referral to an interventional radiology service. This recommendation may be especially important in the cases of patients with comorbid conditions that can lead to an adverse outcome.

The role of surgery in the management of rectus sheath hematoma is difficult to ascertain owing to the scarcity of data in the literature. The largest series on this topic was described in 1972 by Titone et al. [2], and more recent reports have involved isolated patients [3, 4, 7]. In these studies, death occurred after surgery (for example, an 18% mortality rate in the study by Titone et al.). However, little or no information was provided on hemodynamic status and cause of death. Furthermore, in a number of patients, surgery was performed for incorrect diagnoses, mainly after confusion of rectus sheath hematoma with intraabdominal problems. Published results and our results therefore are insufficient for comparison of embolization and surgery in terms of efficacy and safety. Nevertheless, because percutaneous embolization and surgical treatment are not mutually exclusive, it can be suggested that surgery be reserved for patients with embolization failure or need for evacuation of a very large rectus sheath hematoma because of infection or marked impairment of breathing or mobility [2, 4].

Although to our knowledge our series of percutaneous embolization procedures in the management of rectus sheath hematoma is the largest thus far reported, the number of patients is small. Therefore, our suggestions should be taken cautiously. Further studies involving larger series of patients are necessary to confirm our results.

In conclusion, digital subtraction angiography with arterial embolization is an effective and safe procedure for detecting and controlling the arterial bleeding sources in cases of large rectus sheath hematoma when conservative management is unsuccessful in stabilizing hemodynamic status. Although a few case reports have been published, to our knowledge our evaluation of the efficacy and safety of this procedure was conducted with the largest series of patients described thus far.

References

3. Ducatman BS, Ludwig J, Hurt RD. Fetal rectus sheath hematoma. JAMA 1983; 249:924–925


