Trans-catheter arterial embolization in the management of spontaneous thoraco-abdominal hemorrhages secondary to anticoagulant therapy

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Authors: A. Spina, V. Pollastri, C. Albieri, A. Clarizia, E. Salviato, R. Galeotti; Cona (FE)/IT
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1. Spontaneous thoraco-abdominal hematomas not related to trauma or an underlying disease, represent a rare clinical condition [1]. They usually have a benign course, but occasionally they can be fatal [2-5]. Such hematomas are often associated to anticoagulant treatment [2, 6].

2. Most of these spontaneous hemorrhages are self-limiting, due to tamponading of the arterial leakage by the hematoma, which is why they are usually treated conservatively [2, 3, 6, 7-9]. Nevertheless, an extended haemorrhage can lead to marked hypovolemia and hemodynamic instability. Although surgical evacuation of hematoma and ligation of bleeding vessels are common interventional procedures performed in cases of extensive blood loss, sometimes surgeons have difficulties in identifying bleeding sites, so percutaneous treatment with selective arterial embolization can be performed as an effective alternative treatment.

3. The objective of the present study was to evaluate the efficiency of the percutaneous arterial embolization for spontaneous thoraco-abdominal hemorrhages secondary to anticoagulant treatment, diagnosed by elective or urgent CT performed before digital subtraction angiography (DSA).
Methods and Materials

Materials:

This study focused on 47 spontaneous bleedings within the thoraco-abdominal wall or the retroperitoneum treated with percutaneous trans-catheter arterial embolization after a first assessment with contrast-enhanced MultiDetector-CT study (MDCT). All these spontaneous hematoma developed in 29 patients who were referred to our department between January 2008 and December 2012. Multifocal hemorrhages were found in 14 patients. Age and sex of patient examined were as follows: age, 75±12.3 years (range 37-90 years); male/female 52%/48%, and all patients were previously treated with anticoagulant therapy.

Inclusion criteria:

- Development of hematoma during anticoagulant therapy
- Spontaneous origin of hematoma without apparent trauma or injury
- Clinical significance of the hematoma, i.e. arterial hypotension and/or persistent bleeding even after reversal of anticoagulation status.

At the time of admission and embolization, some these patients had renal failure: 6 patients had chronic renal failure (3 of them after previous nephrectomies), 1 had acute renal failure (ARF) and 2 developed ARF after the embolization procedure.

Blood hemoglobin, hematocrit and International Normalized Ratio (INR) of the patients were recorded to evaluate the clinical condition of the patients. Mean values were as follows: 8.4 mg/dL (range 3.7-15.1), hematocrit 28% (range 12-47) and INR 1.87% (range 1.03-3.62).

Radiological methods:

Patients who met all inclusion criteria underwent a CT study after IV injection of 100-120 mL of iodinated non-ionic contrast material. In all patients CT findings confirmed the clinical suspicion of hematoma. In all patients CT studies clearly demonstrated active bleeding(s) noticeable as a jet of contrast material within the hematoma on arterial phase images (Figure 1) or as a layering of contrast material between the corpuscular (below) and fluid (over) components of the hematoma on the delayed phase images (Figure 2).
CT studies showed active bleeding arteries in all cases. Angiography was performed after suspension of anticoagulant therapy, even in unstable patients (i.e. with arterial hypotension).

Vascular access was obtained by placement of a 5-French sheath with Seldinger technique in the common femoral artery. Vascular anatomic features were carried out through catheterization of the abdominal aorta with a pigtail catheter.

After a panoramic angiography (Figure 3a), a superselective catheterization of the affected vessels was performed (even through a 3-French co-axial microcatheter system) to demonstrate the active bleeding, seen as a contrast material extravasation (Figure 3b).

The embolic agents we used in order to occlude the arterial bleeding sites included platinum coils and microcoils, gelatine sponge and polyvinyl alcohol microspheres (diameter 150 up to 450µm). Embolic agents were chosen according to anatomic features of bleeding arteries, such as vessel size and location (Figure 4).

Trans-catheter embolization procedure was considered technically successful if there was no contrast material extravasation at the bleeding site on a repeated superselective DSA.

In case of hematoma of the paramedian anterior abdominal wall, DSA was performed through the ipsilateral and contralateral external iliac arteries to ensure there was no arterial contrast extravasation from the collateral pathways.

Internal mammary and superior epigastric arteries were evaluated with superselective angiography only if there was evidence that bleeding had not stopped after the first embolization in case of abdominal bleedings.

Equally, in case of retro-peritoneal hematomas, DSA was carried out through the selective catheterization of lumbar arteries, intercostal arteries, iliolumbar and cirumflex iliac arteries to assess the presence or absence of more bleeding vessels and in case, to proceed with embolization.

After embolization all patients were transferred to their departments for clinical monitoring.

Improvement in hemodynamic parameters and in blood hemoglobin concentration were considered as evidence of clinical success of the trans-catheter arterial embolization.
Images for this section:

**Fig. 1:** MD-CT axial image after IV injection of contrast material. Arterial phase image showing a large hematoma in the anterior and left lateral abdominal wall. Active extravasation of contrast material within the hematoma (arrow).

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Fig. 2: MD-CT axial image on delayed phase showing a rectus sheath hematoma in median region. Scan on delayed phase underlines the layering of contrast material on a fluid-fluid level (arrow), due to inferior epigastric artery bleeding.

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**Fig. 3:** Digital Subtraction Angiography study in patient with retroperitoneal hematoma. 3a) Panoramic DSA image showing multifocal bleedings with different sites of contrast material extravasation (arrow heads). Involved arteries are distal vessels from anastomotic branches between left iliolumbar and left IV lumbar arteries. 3b) DSA image after superselective catheterization of left iliolumbar artery. Multiple contrast extravasations on distal branches (arrow heads) pointed out all bleeding vessels.

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Fig. 4: Patient with retroperitoneal spontaneous hematoma within the right iliopsoas muscle. a) MD-CT image showing a large hemorrhage within the muscle sheath with active extravasation of contrast material. b) Angiography after selective catheterization of right first lumbar artery and detection of bleeding site with shaded deposition of contrast material within the hematoma. c) Angiography after embolization of the bleeding artery with polyvinyl alcohol microspheres and release of platinum coils. No bleedings detected.

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Results

CT studies revealed large hematomas within the thoraco-abdominal wall or the retroperitoneum in all 29 patients, and contrast-enhanced CT provided information about signs of active bleeding.

DSA revealed one or more bleeding vessel(s) in 27 patients. The other 2 patients with no active bleeding detected on angiography were treated with trans-catheter arterial blind embolization on the basis of a previous CT study.

Selective catheterization of bleeding arteries was effective in all patients and embolization was feasible in all cases. Details on bleeding arteries are summarized in table 1.

Trans-catheter arterial embolization was technically successful in all patients with spontaneous hematomas (success rate: 100%) because no active bleeding was detected on follow-up angiography, and no complications related to the embolization were observed during or after the procedure (Figure 5; 6). None of the treated patients needed additional embolization after the first procedure because none of them had clinical evidence of continuous or recurrent bleeding.

During follow-up, which lasted for 15±14 days, a considerable overall clinical improvement was observed, with an increase in mean haemoglobin level from 8.4 mg/dL before the embolization to 10.0 mg/dL after procedure.

Seven patients underwent surgical intervention, after embolization, in order to evacuate a hematoma that caused abdominal compartment syndrome.

During the hospital stay (from 1 to 29 days after the embolization) six patients died because of multi-organ failure due to hemodynamic complications related to the hematoma and hemodynamic shock with subsequent acute renal failure (3 patients). Other causes of death were severe sepsis (2 patients) and cerebral malignancy (1 patient). The remaining 23 patients were discharged from hospital in good clinical conditions.
Table 1: Bleeding arteries in patients with spontaneous hematoma.

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**Fig. 5:** Patient with a spontaneous hemorrhage of the right thoracic wall. a) MD-CT image showing the contrast material leak and its layering on a fluid-fluid level within the hematoma. b) DSA after selective catheterization of right 10th intercostal artery with visible contrast material extravasation from small branches (arrow head). c) Angiography of right 10th intercostal artery after embolization. Multiple platinum coils released in the proximal part of the artery.

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Fig. 6: Patient with spontaneous rectus sheath hematoma on the left side of abdominal wall. a) MD-CT image showing a large hematoma with a jet of contrast material within the inhomogeneous components of the hematoma. b) Angiography after superselective catheterization of the left deep circumflex iliac artery with multifocal bleedings from different small branches (arrow heads). c) Angiography after embolization of the left deep circumflex iliac artery and release of a platinum coil. No more extravasation of contrast material from damaged vessels.

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Conclusion

1. Spontaneous hematomas of the thoraco-abdominal wall represent a rare and often misdiagnosed cause of acute abdomen, in particular in patients treated with anticoagulant therapy [7, 10, 11].
2. Contrast-enhanced CT performed before angiography has a high diagnostic accuracy in identifying spontaneous arterial bleedings and in assessing the extent of the hematomas [2, 10].
3. Trans-catheter arterial embolization, after DSA study, is a safe and effective procedure to identify and control the source of arterial bleedings in large spontaneous thoraco-abdominal hematomas, when conservative management is not successful in stabilizing the hemodynamic status [2, 12].
4. Percutaneous embolization procedure appears to be preferable to surgery in the management of spontaneous hemorrhages in anticoagulated patients, and it leads to significant reduction in intra-operative and post-operative mortality even in patients with hemodynamic instability.


