Percutaneous artery embolization of bleeding rectus sheath hematomas in hemodynamically unstable patients: Outcomes of 43 patients in a tertiary referral hospital

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Abstract

Rectus sheath hematoma (RSH) is an uncommon cause of abdominal pain that can lead to life-threatening bleeding, particularly in elderly patients receiving anticoagulation therapy. Type III RSHs, based on computer tomography (CT) evaluation, is characterized by active bleeding with intramuscular or intraperitoneal extension and hemodynamic instability. Medical contemporary knowledge of this condition is contentious and overall 20% of acute mortality has been reported. The purpose of this study was to retrospectively review our experience and outcomes in the management of RSHs treated with percutaneous arterial embolization of the epigastric vessels. We retrospectively analyzed 43 patients with RSH type III, submitted to percutaneous epigastric artery embolization from 2007 to 2015. Percutaneous arterial embolization was feasible and successful in patients with a high burden of comorbidities and receiving anticoagulation therapy. There was no acute mortality and a late mortality at 3 months of 9.1% (4/43) was not directly related to RSHs or arterial embolization. Patients with late mortality had lower ejection fraction, prolonged PTT, greater RDW and warfarin in overlapping with low-molecular-weight heparins. Transcatheter arterial embolization of the epigastric vessels was safe, feasible and effective in stopping the bleeding. Despite anti-platelets/anti-coagulation therapy and a high burden of comorbidities, there was no acute mortality related to RSH.

Introduction

Rectus sheath hematoma (RSH) is an uncommon condition resulting from blood accumulating within the sheath of the rectus abdominis secondary to the disruption of the epigastric arteries.[1] Coughing spells, iatrogenic injuries and trauma in the background context of an elderly anticoagulated patient with muscle tissue atrophy and frailty due to comorbidities, can result in a relentless bleeding.[2-4] Based on radiological evaluation by CT, Berna *et al.*[5,6] differentiate RSH into three types: type I and type II hematomas, are intramuscular and self-limiting. Type III is characterized by a marked intramuscular or intraperitoneal hematoma with active bleeding and hemodynamic instability. Treatment depends on the RSH classification type, patient's underlying medical conditions and identification of potential complications. Conservative treatment such as rest, analgesics, and reversal of anticoagulation are utilized for nonexpanding and small hematomas (RSH type I and II), while blood products and fluid resuscitation are needed for RSH type III. The mainstay of treatment for RSH unresponsive to conservative therapy has been surgical exploration and ligation of the bleeding vascular lesions. However, the mortality rate of elderly patients who undergo abdominal surgery is very high with a risk of re-bleeding from impaired hemostasis.[7] In 1980, Levy first reported the transcatheter gelfoam embolization technique in the treatment of rectus sheath hematoma.[8] This interventional therapy can produce hemostasis of the bleeding vessels, reduce the size of the hematoma and decrease the need for blood transfusions. Arterial embolization is a promising therapeutic option for bleeding from a variety of sources, mainly in the abdomen and pelvis and embolization through a coaxial microcatheter enables selective distal embolization of small-vessel bleeding points. Although the mainstay of treatment for rectus sheath hematomas with hemodynamic compromise has historically been the surgical option, trans-catheter arterial embolization of the bleeding arteries has been suggested as a fast, less invasive and resourceful technique.[9-11]

Aim of the study

The purpose of this retrospective study was to analyze our experience and outcomes of patients with RSHs type III submitted to percutaneous arterial embolization of the epigastric vessels.

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Key words: rectus sheath hematoma; percuteanous arterial embolization; epigastric artery; life threatening abdominal bleeding; anticoagulation.

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Materials and Methods

We retrospectively analyzed the clinical records of 43 consecutive patients with RSH affected by RSHs and evaluated at our hospital, a tertiary referral center for trauma and medical emergency, from January 2007 to December 2015. We reviewed all the interventional radiological procedures of percutaneous epigastric artery embolization in patients with RSH type III. The inclusion criteria were the followings: clinical diagnosis of RSH type III associated with hypotension or hemodynamic instability not manageable only with conservative medical therapy, acute bleeding necessitating fluid resuscitation and/or blood components, documentation of active bleeding at abdominal CT scan. The following clinical and radiological variables were collected and recorded in a dedicated dataset: age, etiology of RSH (spontaneous, trauma, post-paracenthesis, post endovascular trans-femoral procedures, heparin related), left ventricular ejection fraction (EF), HASBLED score (a cardiac risk score used to estimate the 1-year risk for major bleeding in patients with atrial fibrillation), laboratory values just before embolization: hemoglobin, hematocrit, red cell distribution width (RDW%), platelets, renal function, coagulation (PT and PTT), albumin and total protein. RSH was defined spontaneous in absence of a specific cause and in absence of a history of trauma. Heparin-related RSH were defined when one or more RSH developed at the

site of low-molecular-weight heparin (LWMH) injections and other possible causes were excluded. All past medical history were reviewed and the following comorbidities were taken into account: cardiac disease (hypertensive, ischemic, valvular, pulmonary embolism, history of atrial fibrillation), chronic liver disase in patients with liver failure requiring recurrent paracenthesis, chronic renal disease, evidence of oncological disease during the past five years. Digital subtraction angiography was performed through the common femoral artery after administration of local anesthetic on the contralateral side to the hematoma. Vascular access was obtained by placement of a 5-French sheath. The choice of the diagnostic catheter was based on the anatomy of iliac vessels. A supraselective catheterization of the affected artery through a 3-French coaxial microcatheter system was used to embolize the distal artery with synthetic glue and/or spiral coils to stop the bleeding. Statistical analyses were performed using R software. Results are expressed as mean±standard deviation (SD). Measurements are standardized for body surface area. Data are presented as mean±SD and categorical data are presented as number and percentage. The differences of the mean of continuous variables of patients survived and dead after three months have been compared by using the exact Fisher-Pitman permutation test. All the performed statistical tests are one-tailed and P<0.05 was chosen to establish statistical significance.

Results

The mean age of the population with RSH was 70±13 with a slight female prevalence (55%). Patients had a mean HAS-BLED score of 3 (Table 1).

There was no acute mortality related to RSH, survival at 3 month was 91.9% (39/43 patients). Cause of death in four patients within 3 months were related to comorbidities and not directy to RSHs or the embolization procedure. Deceased patients had a lower ejection fraction (EF 40.5±20.6% *versus* 56.1±3.9%, P=0.006), a prolonged PTT (PTT 71.2 secs versus 41.8±18 secs, p value 0.011), valvular cardiac disease (75% *versus* 17.9%, P=0.04) unrelated to the type of cardiac prosthesis (biologic or mechanical). All deceased patients were on warfarin and 3 out of 4 were on bridge therapy with LWMH plus warfarin.

The etiologies of RSH were the following: endovascular procedures (4.7%), paracenthesis (9.3%), subcutaneous heparin injection (13.9%), post-surgery (16.3%), trauma (18.6%) and spontaneous (37.2%).

Our population is characterized by a high burden of comorbidities, 32.6% have a chronic liver disease, 20.9% an oncological disease, 55.8% were suffering from heart disease. The majority of patients (60.4%) were in therapy with antiplatelets (aspirin or clopidogrel) and/or OACs. Six out of 43 patients were in therapy with both heparin and warfarin as a bridge therapy (Table 2).

Six patients had a bilateral epigastric artery involvement and there were no differences between right and left epigastric vessels involvement. Embolization was performed with gelfoam in all patients and in 11 cases spiral coils were added to obtain a more stable hemostasis. In 4 patients a surgical approach was chosen: in two patients, surgery treatment as first choice was unsuccessful and embolization was used as rescue therapy, in only two patients percutaneous embolization failed to stop the bleeding and a surgical approach was performed as salvage therapy (Table 3).

Discussion

RSH is an uncommon and misdiagnosed potentially life-threatening condition.[13] Our patients with RSH have an high prevalence of liver disease (32.6%), oncological disease (20.9%) and have a cardiac condition from which derived in most cases the indication to antiplatelets and/or OACs. None of our patients were in therapy with new oral anticoagulants.[14] Despite comorbidities, in our work frailty is emphasized by a low level of albumin and a higher values of RDW%.

Frailty is a biological syndrome that not solely results in deterioration of one single system, but multiple systems such as musculoskeletal, cardiovascular, metabolic or immunological systems. Serum albumin is the main protein synthesized by the liver and is considered a good surrogate of frailty and low plasma albumin is associated with sarcopenia.[15] Nevertheless, there was no difference in albumin levels between the survived and dead (Albumin: 3.27±1.03 g/dL in survived *versus* 3.75±0.5 in deceased, ns).

Instead of albumin, RDW was higher in patients with RSH that do not survived (RDW: 16.1±2.8 *versus* 20.5±4.1%, P=0.011). RDW% is a quantitative measure of variability in the size of circulating erythrocytes with higher values reflecting greater heterogeneity in cell sizes. RDW has been shown to predict mortality and adverse outcomes in various clinical conditions, chronic and acute disease. It not clear however if higher RDW values in decesead patients may be explained by acute hemorrhage or the chronic health status, both of them potentially linked to mortality.[16,17]

All non-surviving patients at three months after RSH (4 patients) were in ther-

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Table 1. Demographics and etiology of patients with rectus sheath hematomas.

	All patients	Alive after 3 months	Deceased within 3 months	P
Patients (n)	43	39	4	
Age (years)	70.3±13.6	69.7±14.2	75.5±3.4	ns
Male/female ratio	19/24	18/21	1/3	ns
Cardiac EF (%)	54.7±8	56.1±3.9	40.5±20.6	ns
HAS-BLED score	3 (1-5)	3 (1-5)	3 (3-5)	ns
Etiology of RSH				
Spontanous	16/43 (37.2%)	15/39 (38.5%)	1/4 (25%)	ns
Traumatic	8/43 (18.6%)	8/39 (20.5%)	-	-
Post abdominal surgery	7/43 (16.3%)	7/39 (17.9%)	-	-
Heparin (LMWHs)	6/43 (13.9%)	4/39 (10%)	2/4 (10%)	ns
Paracenthesis	4/43 (9.3%)	4/39 (10.3%)	-	-
Femoral endovascular procedure	2/43 (4.7%)	1/39 (2.6%)	1/4 (25%)	ns

EF, ejection fraction; RSH, rectus sheath hematoma; LMWHs, low-molecular-weight heparins.

apy with at least one antiplatelets and/or OACs. There was a great prevalence in the usage of warfarin and LWMHs plus warfarin in the non-surviving patients. In our study, we observed that *bridge therapy* with LMWHs and warfarin was used in 3/4 patients that died within 3 months (LWMHs + Warfarin: 3/39 in surviving and 3/4 in decesead patients, P=0.006). Bridging therapy with heparin is controversial, although many guidelines recommend interruption of oral anticoagulation therapy and the use of bridging therapy with subcutaneous low-molecular-weight heparin around the time of many kinds of surgeries, this strategy is associated with an increased risk of bleeding.

Although anticoagulation is not probably the cause of RSH but only a possible precipitating risk factors. Oral anticoagulation and in particular LMWHs in overlapping with warfarin, could be a *sword of Damocles* hanging over frail and elderly patients injured by the double-edged sword of anticoagulation. Due to the paucity of medical literature, morbidity and mortality rates of RSH are difficult to estimate. The mortality rate for iatrogenic rectus sheath hematoma is reported to be 18%, whereas the mortality rate for patients undergoing anticoagulation therapy is reported to be 25% regardless of embolization and/or surgery and higher in presence of hemodynamic instability. In our work, in an high risk population of elderly patients, with RSH type III hematomas treated with percutaneous transcatheter embolization, the mortality was lower than that reported in literature, only 4 patients over 43 died within

Table 2. Laboratory values and comorbidities of patients with rectus sheath hematomas.

	All patients	Alive after 3 months	Deceased within 3 months	P
Laboratory values				
Hemoglobin (g/dL)	8.9±1.4	9.1±1.3	8.25±1.7	ns
Hematocrit (%)	27.7±3.6	27.6%±3.8	28.25±2.6	ns
Platelets (10^3/µL)	172.5±87.3	174±87	163±97	ns
RDW (%)	16.7±3.4	16.1±2.8	20.5±4.1	0.011
Creatinine (mg/dL)	1.14±0.5	1,20±0.57	1.24±0.59	ns
Azotemia (mg/dL)	58.73±42.8	58±44.5	63.6±33.3	ns
PT (sec)	1.6±0.6	1.45±0.6	1.75±0.9	ns
PTT (sec)	46.6±26.1	41.85±18.2	71.25±46	0.04
Albumin (g/dL)	3.24±0.8	3.27±1.03	3.75±0.5	ns
Total sieric protein (g/dL)	6.1±0.8	6.0±0.8	6.25±0.5	ns
Comorbidities				
Chronic liver disease	14/43 (32.6%)	13/39 (33.3%)	1/4 (25%)	ns
Neoplasia	9/43 (20.9%)	9/39 (23.1%)	-	-
Cardiac disease	24/43 (55.8%)	20/39 (51.3%)	4/4 (100%)	ns
Type of cardiac disease				
Hypertensive	7/43 (16.3%)	7/39 (17.9%)	-	-
Ischemic	4/43 (9.3%)	3/39 (7.7%)	1/4 (25%)	ns
Valvular	10/43 (23.3%)	7/39 (17.9%)	3/4 (75%)	0.03
Pulmonary embolism	3/43 (7%)	3/39 (7.7%)	-	-
Hystory of atrial fibrillation	16/43 (37.2%)	14/39 (35.9%)	2/4 (50%)	ns
Cardiac valvular prosthesis	5/43 (11.6%)	14/39 (35.9%)	1/4 (25%)	ns
Mechanical cardiac prosthesis	1/43 (2.3%)	0/39	1/4 (25%)	ns

RDW, red cell distribution width; PT, prothrombin time; PTT, partial thromboplastin time; ns, not significant.

Table 3. Antiplatelets and/or anticoagulants therapy of patients with rectus sheath hematomas.

	All patients	Alive after 3 months	Deceased within 3 months	P
Antiplatelets and anticoagulants				
Aspirin	4/43 (9.3%)	3/39 (7.7%)	1/4 (25%)	ns
P2Y antagonist (Clopidogrel)	4/43 (9.3%)	4/39 (10.3%)	-	ns
Heparin (LMWH)	16/43 (37.2%)	13/39 (33.3%)	3/4 (75%)	ns
Warfarin	13/43 (30.2%)	9/39 (23.1%)	4/4 (100%)	0.005
LMWH + Warfarin	6/43 (13.9%)	3/39 (7.7%)	3/4 (75%)	0.006
Epigastric artery involvement				
Right epigastry artery	23/43 (53.5%)	22/39 (56.4%)	1/4 (25%)	ns
Left epigastric artery	14/43 (32.5%)	13/39 (33.3%)	1/4 (25%)	ns
Bilateral (left and right)	6/43 (14%)	4/39 (10.3%)	2/4 (50%)	0.03
Embolisation with hemostatic glue	43/43 (100%)	39/39 (100%)	4/4 (100%)	ns
Embolisation with spiral coil	11/43 (25.6%)	10/39 (25.6%)	1/4 (25%)	ns
Surgical treatment*	4/43 (9.3%)	3/39 (7.6%)	1/4 (25%)	ns
Acute mortality	0/43	0/43	0/43	-
Late mortality within 3 months	4/43 (9.3%)	0/39	4/4 (100%)	ns

LMWH, low-molecular-weight heparin. Embolization was performed in all patients with hemostatic glue, in 11 patients spiral coils were added to obtain a safer hemostasis. *In 2 patients surgery was chosen as first treatment, a subsequent percutaneous embolization was needed. In 2 patients percutaneous embolization failed to stop the bleeding and a surgical approach was performed as rescue therapy.

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three months (late mortality 9.3%).

Specifically, none of the four patients died directly from RSH: one patients #1 (with a mechanical prosthetic mitro-aortic valve demanding treatment with warfarin despite the high risk of re-bleeding) died of a disseminated intravascular coagulation from a gastro-intestinal bleeding 14 days after a successful embolization of RSH, the second patient #2 developed an abdominal compartmental syndrome from RSH and died 45 days later for a multi-organ failure (Figure 1), the third patient #3 died of septic shock after a prolonged hospital stay after two months, the fourth patient died for heart failure after three months.

The percutaneous transcatether embolization with hemostatic gelfoam and/or spiral coils was technically feasible and effective in stopping the bleeding in 41/43 patients, in only two patients surgery was deemed to stop the bleeding.

In conclusion, although surgical evacuation of hematoma and ligation of bleeding vessels are considered the standard surgical procedure for severe RSH, our retrospective study suggests that percutaneous embolization could be a safe and feasible therapeutic option associated with a low mortality in an high risk frail population with RSH type III and could be the first line therapy followed by surgery in case of failure (suggested flow-chart algorithm; Figure 2).

Limitations of the study

Our case-control retrospective study is limited by a relative small number of patients sampled, though in the context of an unusual and underreported condition, without a group of control. Moreover, referral center bias should be also considered as patients were evaluated in a tertiary referral center hospital.

Conclusions

In 43 patients evaluated a RSH type III in a tertiary referral hospital, transcatheter arterial embolization of the epigastric vessels was safe, feasible and effective in stopping the bleeding. Despite anti-platelets/anti-coagulation therapy and a high burden of comorbidities, there was no acute mortality related to RSH, survival at 3 month was 91.9% (39/43 patients). Deaths before 3 months were related to comorbidities, not directly to RSH. Patients who died within 3 months (4/43, mortality 9.1%) have a lower ejection fraction, prolonged PTT, an increased RDW and were more often on warfarin in overlapping with LMWHs.

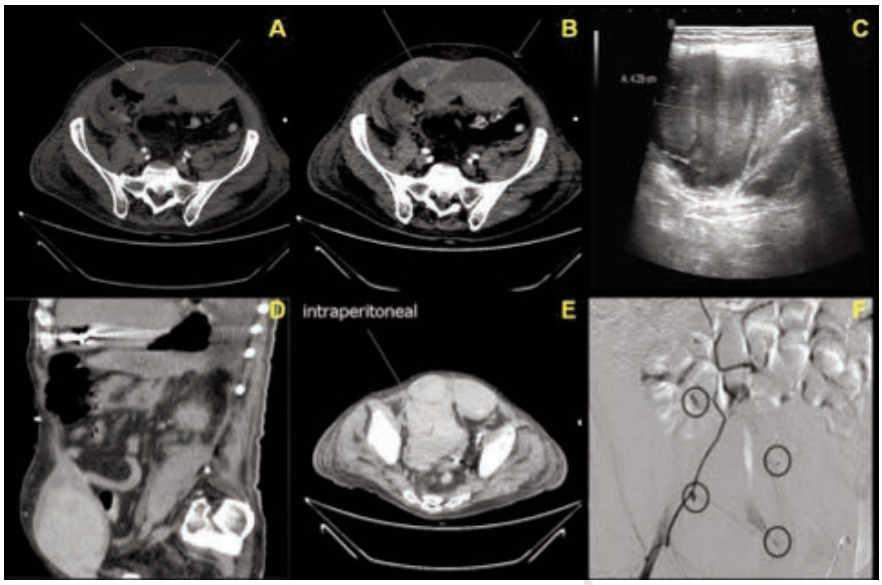

Figure 1. Computed tomography (CT) imaging of the bilateral rectus sheath hematomas (RSHs) of patient #2. He was 72 years old with a known cardiac ischemic disease (ejection fraction 25%), and he was admitted for a persistent atrial fibrillation. Low-molecular-weight heparins (LWMHs) and warfarin were initiated. After 2 days there were periumbilical and flank ecchymosis at the sites of LMWHs injections due to RSHs (A with intraperitoneal extension (white arrowhead). RSHs were complicated from an abdominal compartment syndrome and acute renal failure. CT images of RSHs without and with contrast (A and B). Ultrasound image of one RSH (C). Abdominal sagittal plane (D) and intraperitoneal expansion of RSH (E). Angiography of the right epigastric artery with several bleeding points encircled (F).

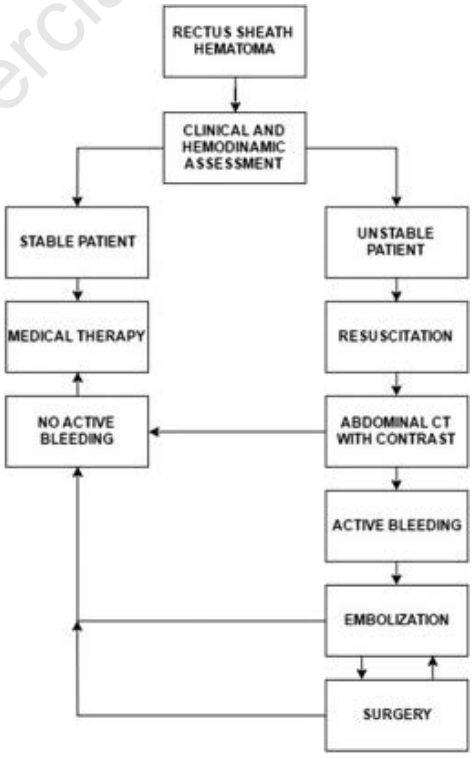

Figure 2. Proposed and flowchart of rectus sheath hematoma (RSH) treatment. Clinical examination is crucial for diagnosis, risk stratification and hemodynamic stability. In unstable patient, after fluid and blood resuscitation, computed tomography (CT) with contrast should be indicated to rule out the etiology bleeding and confirming the diagnosis of RSH. In a case of active bleeding recognized from contrast blushing on CT, we suggest percutaneous arterial embolization as first approach, if not successful embolization could be repeated otherwise referring patients to surgery.

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