Research Article

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Features of Diagnosis and Treatment of Spontaneous Extraorganic Hematomas of the Soft Tissues of the Neck and Chest

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ABSTRACT The possibilities of computed tomography in the diagnosis of spontaneous hematomas (SH) of the soft tissues of the neck and chest and the features of their treatment are shown. Computed tomography with intravenous bolus contrast enhancement is the main method for diagnosing SH, which allows you to specify its exact localization, distribution, determine the structure and volume of the hematoma, the contrast agent exiting the contours of the vessel, and, taking into account the data obtained and the clinic, determines the tactics of treatment.

Stable SH does not require surgical treatment. In the case of a large volume of chest hematoma, compression syndrome, hemothorax, drainage is indicated. Unstable SH dictate the need for angiography and, if necessary, endovascular embolization.

Keywords: spontaneous hematomas of various location, diagnostic methods, treatment

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i/v — intravenous
CT — computed tomography
SH — spontaneous hematoma

Spontaneous hematomas (SH) are the accumulation of blood in soft tissues due to impairment of the integrity of the vessel, not associated with trauma or iatrogenic damage [1–4].

Predisposing factors for the development of SH may include coagulopathy, high blood pressure, cough, vasculitis, and exercise [2, 5]. Sometimes SH develops in the absence of causes [6–10]. In addition, there is evidence of the presence of *COVID*-19-associated coagulopathy as a cause of SH [11–15].

A powerful etiological factor in SH is anticoagulant, thrombolytic therapy, widely used for the prevention and treatment of patients with acute vascular thrombosis (coronary vessels, pulmonary artery, peripheral arteries, etc.). The incidence associated with coagulopathy and soft tissue hematoma is increasing annually [1,16–21, 22].

Therapeutic tactics in SH is determined by its location, its distribution, size and stability. For small SH, conservative treatment is performed [1, 3, 8]. Large SHs are rare. They can lead to hemodynamic instability and be life-threatening. These observations may require angiography and targeted endovascular embolization [6, 7, 23]. The mortality due to SH is 4–30% [6, 8, 9, 24].

Spontaneous hematomas of the chest and neck are a rare complication of anticoagulant therapy; there are isolated cases described in the literature [6, 25–30]. There are no clear criteria for the diagnosis and treatment of SH of this location.

The aim of the study was to identify the features of diagnosis and treatment of neck and chest SH.

MATERIAL AND METHODS

The article is based on the analysis of the results of a clinical examination, computed tomography (CT), conventional angiography, laboratory data and treatment of 15 patients with SH, who were treated in the N.V. Sklifosovsky Research Institute for Emergency Medicine in 2018–2021, of which 6 patients were hospitalized in the Thoracic Department and 9 patients were admitted to the Infectious Disease Department for the Treatment of *COVID*-19.

The inclusion criteria for the study were as follows:

1. the presence of SH of the soft tissues of the neck and chest, etiologically not associated with trauma, including iatrogenic damage.

Exclusion Criteria:

1. pathology of internal organs anatomically related to the hematoma area;
2. age up to 18 years;
3. location of the hematoma outside the analyzed area;
4. multiple hematomas of various anatomical regions.

General characteristics of patients are presented in Table 1

The mean age of the patients was 66 (52–85) years; there were 12 women (80%) and 3 men (20%) in total. Cardiovascular diseases such as hypertension occurred in 11 patients, myocardial infarction – in 2, oncological diseases – in 3, concomitant diseases – in 14, of which *COVID*-19 – in 9.

The diagnostic algorithm included: examination of the patient, computed tomography (CT) of the chest and neck with intravenous (i/v) bolus administration of a contrast agent, direct angiography was performed for large hematomas (more than 500 cm^3) and/or signs of extravasation.

All patients underwent CT scan on the first day of admission to the hospital. The repeated study was performed on day 3-6. The examination was performed by *Aquilion CXL* CT scanner manufactured by *Toshiba* (Japan). Patients with *COVID -19* underwent CT scans in the infection ward using an expert-class tomograph *Philips Ingenuity CT* (Netherlands).

Table 1

Clinical characteristics of patients

Patient characteristics		Indicators
Gender	female male	12 3
Age		66 (52–85)
Background and comorbidities	Cardiovascular: arterial hypertension myocardial infarction	 11 2
	Oncological	3
	Other diseases: positional injury tracheal stricture diabetes burn II–III degree, 25% of body surface *COVID* -19	 1 1 2 1 9
Anticoagulants, *n* (%)	Indirect anticoagulants dabigatran	 2 (13.3%)
	Direct anticoagulants heparin rivaroxaban	 9 (60%) 1 (6.6%)
Computed tomography, angiography, embolization	CT scan Conventional angiography Endovascular embolization	15 5 2
Location and volume of spontaneous hematomas	Soft tissues of the neck Volume, cm^3 Soft tissues of the neck and chest Volume, cm^3 soft tissues of the breast Volume, cm^3	1 60 3 90 (70–710) 11 800 (696–1280)

The studies were performed in the supine or prone position. In order to identify the risk of post-contrast acute kidney injury, prior to intravenous contrast-enhanced CT, serum creatinine levels were assessed in patients over 60 years of age with kidney disease or arterial hypertension, the stage of disease development that requires medical treatment; diabetes mellitus, proteinuria/albuminuria A1 and higher, recent intake of nephrotoxic drugs.

According to CT data, quantitative and qualitative parameters of SH were evaluated (location, volume, structure, density, stability, presence of blood flow).

Conventional angiography was performed in 5 patients. The study was performed by *Siemens Asxiom Artis*, and by *Toshiba Infinix in* the infectious ward. The indication was the presence of signs of extravasation or a large volume of hematoma according to CT. The access was made through the femoral or radial artery using a non-ionic iodine-containing contrast agent (ultravist 370).

In two cases, when direct and indirect signs of active bleeding were found, such as extravasation of a contrast agent, hypervascularization of the area under study, embolization was performed with 500–1000 micron microemboli until a signidicant slow of blood flow in the proximal segment of the target artery and the onset of the "stop contrast" effect in the distal channel.

Anticoagulant therapy was performed using direct anticoagulants in 10 cases (66.7%) and indirect ones in 2 cases (13.3%). Heparin (25,000–30,000 units/day) was used as a direct anticoagulant, under the study of activated partial thrombin time and rivaroxaban, therapy with indirect anticoagulant drugs was performed with dabigatran. Three patients (20%) did not receive anticoagulant therapy.

In 7 cases, conservative treatment was carried out with dynamic monitoring. Treatment in these patients was aimed at correcting hemostasis, hemotransfusion with a decrease in hemoglobin level below 60 g/l, transfusion of plasma and thrombocytate.

X-ray endovascular hemostasis was performed in 2 cases when continued bleeding was detected on CT scan in the form of extravasation of a contrast agent. In 4 cases, in the presence of a large volume of liquid structures in the hematoma, drainage was performed. Hematoma revision and sanitation was performed in 2 cases.

RESEARCH RESULTS

The diagnosis and treatment of 6 patients with SH without *COVID*-19 and 9 patients with SH and *COVID-19* infection were analyzed. The severity of the patients' condition was exacerbated by the infection with *COVID* - 19 and more severe somatic diseases. Lung damage on CT was severe in most patients (Fig. *1A*). There was only one patient with CT-1 lung injury, 3 patients with CT-2, and 5 patients with CT-3.

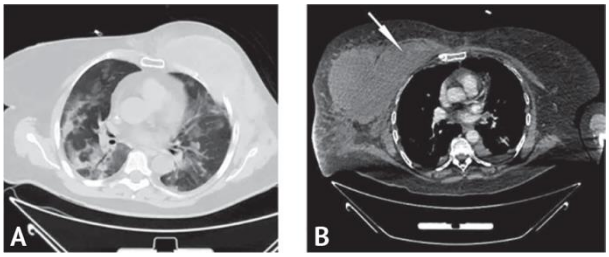

Fig. 1. Computed tomograhy of the chest. A — axial projection in the lung window, pulmonary lesion of viral etiology up to 75% — CT-3, hematoma of the chest wall on the left; B — axial projection in the soft tissue window, chest hematoma on the right with signs of extravasation

Spontaneous hematoma was predominantly observed in the soft tissues of the chest (11 patients). The volume of the hematoma was from 60 to 1,285 cm^3. Isolated SH of the neck, combined with the displacement of the mediastinal organs, required an additional examination of the esophagus. In 3 cases, the hematoma was represented by liquid blood with the phenomenon of sedimentation, in 8 cases, the hematoma was a soft tissue clot (42–58 HU), in 4 cases, a combination of clots and lysed blood (18–62 HU) was noted. The exit of the contrast agent beyond the contours of the vessel (according to CT data) was seen in 2 cases (Fig. 1c*)*.

The dynamic CT scan made it possible to assess the stability of the hematoma due to the preservation of its volume and structure. Thus, CT made it possible to assess SH, its location, prevalence, structure, volume of dense and liquid inclusions, the presence of extravasation, the state of the lung tissue, and the presence of intrapleural changes.

Therapeutic tactics in SH was determined on the basis of CT data. All patients who did not have *COVID-19* infection had no intrapleural changes. Two patients who did not have *COVID*-19 infection, along with the treatment of SH, were also treated for the underlying disease: one patient with positional injury, myoglobulic nephrosis, anuria underwent extracorporeal hemocorrection and renal replacement therapy using sodium citrate, the other patient with a burn of 25% of the body surface received detoxification, anti-inflammatory therapy and local treatment.

Patients with *COVID-19* infection were more severe due to significant changes in the lung tissue, which required specific treatment. They had stable hematomas in 6 cases, and unstable hematomas in 3 cases.

In 2 cases, CT revealed that the agent went beyond the contours of the vessel, and selective angiography was prescribed, in which one patient was found to have an area of hypervascularization in the basin of the left internal mammary artery and embolization was performed. This made it possible to continue anticoagulant therapy. In another patient, angiography revealed two sources of bleeding — the internal mammary artery and the lateral mammary artery, and embolization was performed (Fig. 2).

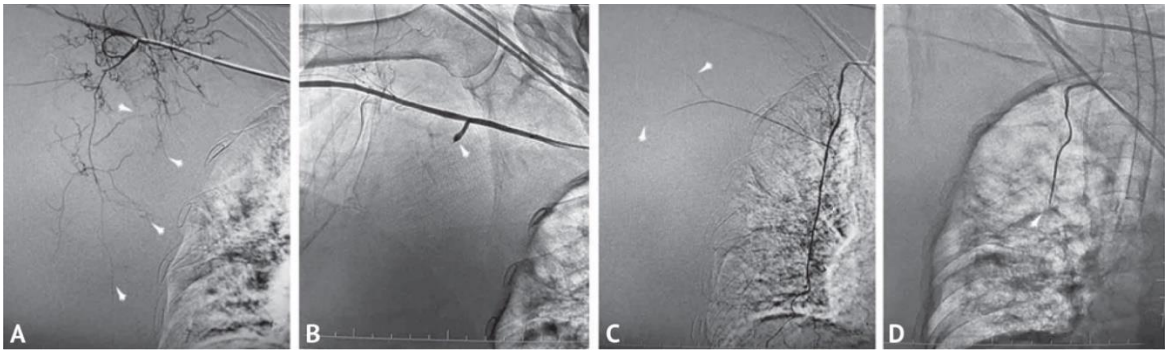

Fig. 2. Angiography of the right lateral and internal thoracic arteries. A, B - spasm of the branches of the lateral and intrathoracic arteries, in the middle third of the internal thoracic artery with signs of extravasation; C, D - after embolization, the distal and middle third of the arteries are not contrasted

Hematoma contents were evacuated in 6 patients: in 4 patients, by external drainage; in one case, cervicotomy was performed; in another case, thoracotomy was performed in case of spontaneous rupture of the intercostal muscles complicated by the formation of SH of the chest and hemothorax. All observations had a favorable outcome.

Three patients aggravated with *COVID-19* infection died. In one case, death was associated with increasing multiple organ failure, while the volume of SH was small (150 cm^3), without grow. Two cases of unfavorable outcome were associated with both growth of hematoma and the presence of a severe course of *COVID*-19. The overall mortality was 20%.

Thus, the severity of the condition of patients with SH was determined by the volume of the hematoma, location, the nature of the compression syndrome, distribution, somatic diseases, and the course *of COVID* infection. X-ray endovascular hemostasis made it possible to transfer SH from an unstable to a stable category, which made it possible to perform further conservative treatment while maintaining antiplatelet therapy.

DISCUSSION

We conducted a study of patients with rare location of SH in the neck and chest. At present, there are single descriptions of SH of the neck and chest [6, 22, 25, 26, 31, 32]. Most often, SH is observed in the retroperitoneal space — 54% of all cases of SH [1, 6, 32], in the muscles of the anterior abdominal wall — 37% [7, 20, 34, 35].

The average age of our patients was 66 years, the ratio of women to men was 3:1. The same data are presented in the works performed by other authors [6, 8].

The cause of SH of the soft tissues of the neck and chest during *COVID-19* infection in most of our observations was the intake of anticoagulants, however, in some cases in patients who did not receive anticoagulant drugs, the cause remained unclear.

It is assumed that the impairment of coagulation factors and microangiopathy with capillary rupture may be the cause of bleeding [8, 14, 33, 35,]. In addition, microtrauma of muscles and blood vessels is possible on the neck and chest during swallowing and phonation [6, 16, 36, 37]. The source of bleeding can be several small vessels of different anatomical regions at once [6, 9, 38, 39].

To date, there are no criteria for assessing the severity of SH, which can cause a sudden deterioration in the patient's condition and become life-threatening.

CT plays an important role in the diagnostic and tactical management of patients and is the “gold standard” of diagnosis [1, 3, 17, 38]. The method allows to determine the location, distribution, volume, stability or instability of SH, the presence of extravasation.

In our study, contrast-enhanced CT showed extravasation in two cases (13.3%), while extravasation was found in the literature in 88% [6]. The discrepancy in the indicators can be explained by the fact that most of our patients underwent CT scan after bleeding and SH was stable. The CT performed over time indicated the stability of the hematoma volume in 7 patients, the volume of the hematoma did not grow, its structure was predominantly a soft tissue clot (42–58 HU), without signs of extravasation of the contrast agent.

Conservative management of SH includes treatment of hemostasis disorders, administration of anticoagulant antagonists, stabilization of hemodynamics. The hematoma itself in these cases is a hemostatic

factor due to the compression effect. The indication for SH drainage is compression of the nerve trunks, ischemia of the skin [8, 33, 34]. The issue of surgical tactics in SH requires further research.

In our observations, with stable SH without coagulation disorders, but with large volumes and the presence of a compression syndrome, drainage was performed. In cases where conservative treatment was ineffective and an increase in hematoma was observed, angiography and, if necessary, X-ray endovascular hemostasis were performed.

Endovascular embolization of the bleeding vessel was performed and effective in two cases. According to a number of authors, angiographic success in embolization was 75–95.6%, while clinical success was only 57–83% [8, 19, 32]. This is explained by the fact that most patients had a different location of SH, with a different source of bleeding (retroperitoneal space and rectus abdominis muscles).

When comparing the results of treatment of patients without *COVID-19* infection with patients with *COVID-19* who had a large volume of unstable chest wall hematomas, the latter had a more severe course with a worse prognosis. The mortality was 20% (3 out of 15), but this figure is lower than in case of SH of the retroperitoneal space and abdominal wall (27–30%) [1, 6, 7].

CONCLUSION

Computed tomography with intravenous bolus contrast enhancement is the main method for diagnosing spontaneous hematomas of the chest and neck, which allows you to specify its exact location, determine the structure and volume of the hematoma, evaluate signs of ongoing bleeding, taking into account the data obtained and the clinic, it allows the tactics of treatment to be determined as well.

Stable spontaneous hematomas do not require surgical treatment. In the case of a large volume of chest hematoma and compression syndrome, as well as hemothorax, surgical treatment is indicated. Unstable spontaneous chest hematomas require conventional angiography and, if necessary, endovascular embolization.

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