



Full Length Article

Thrombotic events as incidental finding on computed tomography in intensive care unit patients



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ABSTRACT

Introduction: Intensive care unit (ICU) patients are a risk group to develop thrombosis and/or thromboembolism. The purpose of this study was to analyze the frequency and localization of clinically silent thrombotic events (TE) detected on CT.

Materials and methods: From 2006 to 2013 a total of 370 patients from the ICU of our university clinic were investigated by postcontrast CT. In all cases CT was performed for detecting septic foci. There were 135 women and 235 men. CT scans included cervical, thoracic, abdominal, and pelvic regions. CT images of all patients were re-interpreted by 2 radiologists by consensus. Only thromboses detected for the first time on CT were included into the analysis. Collected data were evaluated by means of descriptive statistics. Frequencies and localizations of TE in surgical and non surgical patients were analyzed by Chi-square test. Significance level was $p < 0.05$.

Results: In 31.9% several TE were diagnosed. There were venous thrombosis (89.8%), cardiac thrombus (2.6%), and pulmonary embolism (7.6%). More often jugular veins were affected followed by brachiocephalic veins, and iliac veins. The frequency of TE in surgical patients was 31.1%, and 32.1% in non surgical patients. Patients after surgery had more often thrombosis of extremities veins in comparison to non surgical patients. In 61.9% of all TE the identified thrombotic complications were not diagnosed at the time of CT investigations.

Conclusion: TE can be identified in 31.9% of ICU patients as incidental finding on CT. There were venous thromboses, pulmonary embolism, and cardiac thrombus. Most frequently neck and thoracic veins were affected. 61.9% of all TE were not diagnosed at the time of CT investigations. Radiologists should check carefully CT scans for presence of different TE.

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1. Introduction

Intensive care unit (ICU) patients are a risk group to develop thrombosis and/or thromboembolism [1–3]. According to the literature, the prevalence of thrombotic events (TE) in ICU patients can be up to 60% [1–4]. Furthermore, as mentioned in many reports, most TE in ICU patients were clinically silent [1–4].

Nowadays, computed tomography (CT) is performed often for a variety of diagnostic pathways [5–7]. The use of CT results in a high frequency of additional or incidental findings (IF), i.e. findings, which are not directly related to the aim of the ordered investigation [5,6]. As suggested by Lumbreras et al., IF can be categorized as major, i.e. clinically significant, moderate or possible clinically significant, and minor or IF without clinical significance [8]. Minor IF were the most common findings [8]. Typical examples of them are liver or kidney cysts, degenerative changes of the spinal column or vessel calcifications [8]. However, some authors mentioned that major IF

have also a relatively high prevalence [9–11]. For example, several studies identified different malignancies on CT performed for other causes [10–12]. In addition, recently, a high frequency of incidental cardiovascular incidental findings, such as thrombosis, aneurysms, and dissection in oncology patients was reported [9].

Presumably, CT may detect more TE in ICU patients than reported previously. Therefore, the purpose of this study was to analyze the frequency and localization of clinically silent TE detected on CT.

2. Materials and methods

This retrospective study has been approved by the Institutional Ethics Committee.

From January 2006 to December 2013 a total of 20,623 critical ill patients were treated in the intensive care units of our university clinic. In 642 cases (3.11%), clinically manifest thrombosis/pulmonary embolism were diagnosed. These patients with known thrombotic events (TE) were excluded from the study.

Furthermore, other 370 (1.79%) critical ill patients without known TE were investigated by body CT because of septic signs for detecting septic foci. These cases were included in the analysis. There were 135

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Table 1
Intensive care unit patients involved into the study.

Patients	n (%)	Male, n (%)	Female, n (%)
Surgical patients	74 (20.0%)	43 (58.1%)	31 (41.9%)
Non surgical patients	296 (80.0%)	192 (64.9%)	104 (35.1%)
Total	370 (100%)	235 (63.5%)	135 (36.5%)

women (36.5%) and 235 men (63.5%) with a median age of 57.6 years. Most of them had no surgical procedures and 20% of the patients underwent several surgical interventions (Table 1).

CT (Somatom Sensation 64, Siemens, Erlangen, Germany) scans included in all cases cervical, thoracic, abdominal, and pelvic regions.

In all patients 1.5 ml of iodinated intravenous contrast medium (Solutrast, Bracco Altana GmbH, Konstanz, Germany) per body mass were given at a rate of 1.5–3.5 ml/s by a power injector (Medtron GmbH, Germany), with a scan delay of 60–90 s after onset of injection. The imaging parameters were 120 kVp, 150–300 mA s and 0.6 to 1 mm slice thickness with a pitch of 0.8–1.0.

CT images of all patients were re-interpreted by 2 radiologists (AS and DS with 12 and 5 years of experience, respectively) by consensus. For the re-evaluation of the images a window of 56/342 was used. All images were re-analyzed in digital form using a PACS workstation (Centricity PACS, GE Medical Systems, Milwaukee, Wis., USA).

The identified venous thromboses were categorized as follows: central thrombus or filling defect; adherent thrombus or filling defect at the venous wall; and, finally, vein occlusion, i.e. complete obstruction of vein lumen.

For statistical analysis the SPSS statistical software package was used. Collected data were evaluated by means of descriptive statistics (absolute and relative frequencies). Continuous variables were expressed as mean \pm standard deviation (SD) and categorical variables as percentages.

Frequencies and localizations of TE in surgical and non surgical patients were analyzed by Chi-square test. Significance level was $p < 0.05$ and p -values were adjusted for multiple testing by using the Bonferroni correction.

3. Results

Overall, in 118 (31.9%) of 370 patients several thrombotic events (TE) were diagnosed on CT (Table 2). There were venous thrombosis, cardiac thrombi, and pulmonary embolism (Figs. 1–3). Most frequently, venous thrombosis was identified (Table 2). More often jugular veins were affected followed by brachiocephalic veins, and iliac veins (Table 3). Other localizations were rare. In most cases (65.1%) central localized thrombus was seen.

The frequency of TE in surgical patients was 31.1% (23 of 74 patients), and 32.1% in non surgical patients (95 of 296 patients) (Table 4). Patients after surgery had more often thrombosis of extremities veins in comparison to non surgical patients (Table 5). Furthermore, although statistically non significant, surgical patients showed often complete vein occlusion (21.0% vs 14.9%), whereas non surgical patients adherent non-occlusive thrombi (18.4% vs 5.3%) (Table 5).

In 73 cases (61.9% of all TE) the identified thrombotic complications were not diagnosed by the radiologist who initially assessed the investigation, since this was discovered retrospectively (Table 6). Most

Table 2
Identified thrombotic events in critical ill patients.

Thrombotic events	n (%)
Venous thrombosis	106 (89.8)
Pulmonary embolism	9 (7.6)
Heart thrombosis	3 (2.6)
Total	118 (100)

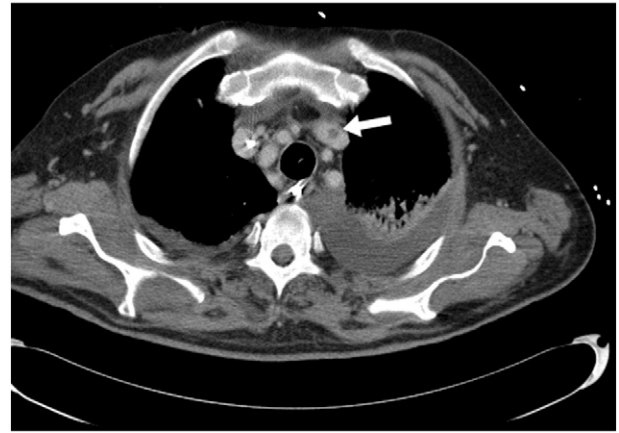


Fig. 1. Computed tomography documenting a small thrombus within the left brachiocephalic vein (arrow).

frequently different venous thromboses were underdiagnosed, especially thromboses of the jugular vein (Table 7).

4. Discussion

The present study showed that TE can be diagnosed on CT in almost one third of the intensive care unit patients. Most frequently, thrombosis of several veins occur.

It is well known that critically ill patients have multiple risk factors for occurrence of TE, such as prolonged immobility owing to pharmacologic sedation, cardiac failure, dehydration, obesity sepsis and mechanical ventilation therapy [1–4,13,14]. Moreover, TE, especially pulmonary embolism cause a high mortality rate ranging from 3% to 8% in ICU patients [15,16].

According to the literature, the frequency of TE in ICU patients varied significantly depending on investigation protocols [1,2,4,17]. Overall, previous analyses showed that the frequency of TE ranged from 0.4% to 60.0% [1,2,17–21]. Furthermore, it also depends on the investigated population. For example, Fraisse et al. reported thrombosis frequency of 28% in patients with chronic obstructive pulmonary disease, who underwent mechanical ventilation [22]. According to Ray et al., the frequency of TE was 18% in neurosurgical patients after subarachnoid hemorrhage [23]. In addition, it was 21% in severely injured patients [24].

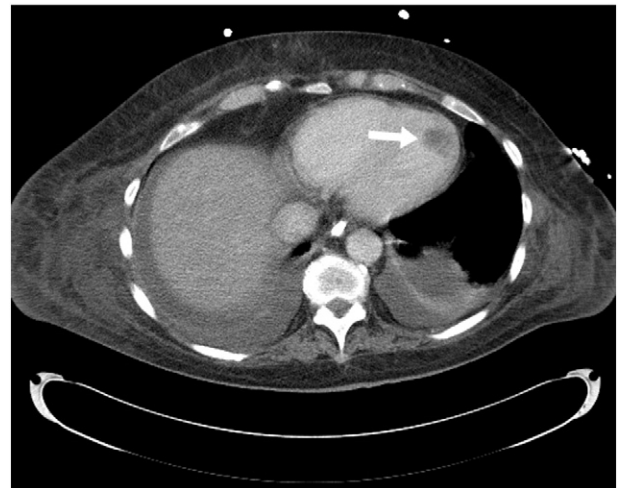


Fig. 2. Computed tomography in a 70 year old woman with sepsis showing a large filling defect (thrombus) in the left ventricle (arrows).

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