Case Report

A Way to Predict an Imminent Cardiac Arrest on Abdominal CT Scan: About a Case

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Keywords

Imminent cardiac failure · Abdominal angiogram · Vascular retrograde opacification

Abstract

Imaging of a patient undergoing cardiac arrest is not common but the abnormal hemodynamics due to the pump failure have characteristic imaging features on CT-scan. The main imaging features include stasis and pooling of blood in the dependent organs of the body, the inferior vena cava, the right renal vein, the right hepatic vein and the right hepatic parenchyma. Knowledge of these signs is essential in order to start resuscitating the patient and can have important survival implications. We report the contrast-enhanced CT-scan features of the case of a critically-ill patient having imminent cardiac arrest few minutes after the examination.

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Introduction

Contrast-enhanced abdominal CT scans are commonly used to diagnose a wide range of pathologies and abdominal conditions [1]. With the increasing number of contrast-enhanced CT performed in hemodynamically unstable patients, features of imminent cardiac arrest and cardiogenic shock can be seen more frequently [1, 2]. Nevertheless, the exact incidence of cardiac arrest during or after the performance of a CT scan is not known precisely, but it is not thought to be a very frequent occurrence [3]. Although described in just a few articles, imaging

features of impending cardiac arrest are characteristic. It is important to be familiar with these CT features in order to start immediate cardiopulmonary resuscitation and subsequently increase the chances of the patient survival [2, 3].

We report in this article the case of a hemodynamically unstable 91-year-old female patient who underwent an abdominal CT angiogram showing imaging features of acute right cardiac failure and hypoperfusion followed by a cardiac arrest few minutes later.

Case Report

This is the case of a 91-year-old woman with hypertension, chronic renal failure, and paroxysmic atrial fibrillation treated with acenocoumarol (Sintrom®), and a history of pancreatic cancer diagnosed in 2018 treated with chemotherapy (Gemzar® and Abraxane®), radiation therapy and a biliary stent. She presented to the emergency department for unconsciousness following head trauma. The non-enhanced head CT scan performed upon admission showed bilateral temporo-parieto-occipital subdural hematomas (acute to subacute) with 7 mm left midline shift (Fig. 1.) To be noted that the Prothrombin Time (PT) for this patient on admission was 0%. The patient received Fresh Frozen Plasma (FFP) and underwent bilateral trepanation and evacuation of the extra-axial collections. Then she was admitted to the ICU, sedated and intubated.

During her ICU stay, the patient was non-responsive with progressive increase of the serum creatinine dosage. On day 9, the patient developed persistent hypotension, oliguria, metabolic acidosis and refractory atrial fibrillation. High doses of Norepinephrine Bitartrate (Levophed®) (9 cc/h) were administered continuously with double intravenous antibiotic coverage. Due to the clinical deterioration of the patient who developed anuria the next day and worsening of the metabolic acidosis, an abdominal CT angiogram was performed in order to rule out mesenteric ischemia. Intravenous iodinated contrast agent was administered through a left central femoral catheter.

The abdominal CT angiogram performed at a 40-s delay from initial contrast bolus injection (at a rate of 4.5 cc/s) showed opacification of the aorta as well as retrograde dense flow of the contrast agent in the inferior vena cava (IVC) (Fig. 2), to the right renal vein, the right hepatic vein and the gravity-dependent right hepatic lobe (Fig. 3).

During the examination, measured blood pressure was 110/70 mm Hg (under 9 cc/h of Levophed®) with a pulse of 90/min. Then the blood pressure started to drop progressively on the way back to the ICU reaching 80/50 mm Hg. The patient had a cardiac arrest few minutes later, upon arriving to the ICU, manifested by asystole, and died after 30 min of resuscitation.

Discussion

These imaging features described earlier are characteristic of acute right cardiac failure and hemodynamic alterations with no other differential diagnosis of this imaging appearance.

Hence, contrast-enhanced abdominal CT-scan can help us predict an imminent cardiac arrest or acute heart failure in critically-ill patients and subsequently undergo urgent interventions to optimize the patient's survival chances [1, 2].

A number of constant imaging features have been described by several authors in a few number of case reports in patients undergoing CT-scans with intravenous contrast administration who had cardiac arrest during the examination or shortly after [4].

These CT findings include contrast reflux and pooling in inferior vena cava, right renal vein and right hepatic vein associated sometimes with opacification of the portal vein [1]. Pooling and parenchymal enhancement of the dependent portion of the liver (right lobe) is also constantly described in this condition [5].

Accumulation of the contrast agent in the dependent lumbar veins, epidural and dorsal veins of the back was reported in a case series of Jana et al. [3]. Clark and Subylong added to this another feature which is venointerstitial reflux in the left renal vein [5] and poor abdominal visceral enhancement [5, 6].

As for arterial and cardiac chambers enhancement, it may be variable from a case to another depending on the patient's condition [6]. On one hand, in cases of complete cardiac arrest, there is no opacification of the left cardiac chambers with opacification of the right atrium and systemic veins only [1, 6, 7]. On the other hand, in cases of imminent cardiac arrest and right heart failure, opacification of the left chambers and the aorta can be achieved [6]. This is best explained by the fact that in these cases, cardiac activity is present, allowing mixing of blood with contrast in the cardiac chambers. Opposingly, during complete cardiac arrest there is no intermixing of blood and contrast so cardiac chambers remain un-opacified [8].

In our case, abdominal CT angiogram showed signs of imminent cardiac failure with retrograde dense opacification of inferior vena cava, right renal vein, right hepatic vein and intense enhancement of the dependent right hepatic lobe. At the same time, it showed opacification of the left cardiac chambers and of the aorta. This is best explained by the fact that the patient maintained a perceptible blood pressure during the examination and started to drop few minutes later before the complete loss of pulse. So, a cardiac activity was still present when the CT-scan was performed allowing mixture of blood and contrast in the heart chambers, as explained before.

Conclusion

Cardiac arrest during or shortly after CT examination is not a common finding but tends to occur more frequently nowadays with the widespread of CT-scans in critically-ill patients. Imaging characteristics of an impending cardiac arrest are well known with constant findings of pooling of the contrast agent in the inferior vena cava, and the dependent veins and organs. It is important for the radiologists – but also for the technicians – to be familiar with these features to take the resuscitative measures within the appropriate time frame.

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Statement of Ethics

Informed consent was obtained from the parents of the patient involved in the study.

Disclosure Statement

The authors have no conflict of interest to declare.

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Author Contributions

L. Menassa-Moussa conceived the presented idea and did the review of literature along with P. Audi. T. Smayra and N. Aoun verified the work and supervised the findings of this work. All authors discussed and contributed to the final manuscript.

References

- 1 Singh AK, Gervais D, Mueller P, Shirkhoda A, Sagar P, Mccarroll K. Cardiac arrest: abdominal CT imaging features. *Abdom Imaging*. 2004 Mar-Apr;29(2):177–9.
- 2 Hong SH, Kang EY, Huh S, Yong HS, Kim YK, Woo OH, et al. Emergent CT findings of impending cardiac arrest: a report of 4 cases. *Am J Emerg Med*. 2013 Mar;31(3):637.e3–6.
- 3 Millán S, Gallardo X, Martín-Loeches I. Contrast-enhanced signs of cardiac arrest during CT. *Med Intensiva*. 2015 May;39(4):261.
- 4 Clark TJ, Suby-Long T. Computed tomography of acute heart failure: A novel case and literature review. *Radiol Case Rep*. 2015 Dec;10(1):1065.
- 5 Jana M, Gamanagatti SR, Kumar A. Case series: CT scan in cardiac arrest and imminent cardiogenic shock. *Indian J Radiol Imaging*. 2010 May;20(2):150–3.
- 6 Garg P, Mittal MK, Rathi N, Grover SB. Computed Tomography (CT) Findings in Imminent Cardiac Failure. *Int J Contemp Med Surg Radiol*. 2018 Jul;3(2):B89–91.
- 7 Shiotani S, Kohno M, Ohashi N, Yamazaki K, Itai Y. Postmortem intravascular high-density fluid level (hypostasis): CT findings. *J Comput Assist Tomogr*. 2002 Nov-Dec;26(6):892–3.
- 8 Tsai PP, Chen JH, Huang JL, Shen WC. Dependent pooling: a contrast-enhanced sign of cardiac arrest during CT. *AJR Am J Roentgenol*. 2002 May;178(5):1095–9.

Fig. 1. The non-enhanced head CT-scan on admission revealed bilateral acute to subacute temporo-parieto-occipital subdural hematomas following head trauma (a) and a 7 mm left midline shift (b).

Fig. 2. The abdominal CT angiogram on the arterial phase revealed striking opacification of the inferior vena cava (arrow) (a) and left hepatic vein (elbow arrow) (b). c Note the opacification of the aorta and opacification of the left cardiac chambers (star).

Fig. 3. Enhancement of the most dependent right hepatic lobe (arrow) (a) and opacification of the right renal vein (curved arrow) on the arterial phase (at 40 s post-contrast injection) (b). Note the biliary stent (star). c The sagittal view showed on the portal phase a filiform opacification of the celiac trunk and superior mesenteric artery showing circumferential wall thickening (probably due to post-radiation changes) (star). Note the lack of enhancement of the visceral organs at both arterial and portal phases.