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Case report

A survival after cardiac arrest during CT scan: The critical imaging findings ☆☆☆

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ABSTRACT

It obtains infrequently hemodynamic images of patients undergoing impending cardiac arrest. Heart pump failure causes blood stasis in the venous system and organs, which is demonstrated on imaging by the deposition and layering of contrast in the veins. We present a case of a multi-trauma patient undergoing imminent cardiac arrest during computed tomography scan under sedation. Signs of early cardiac arrest were immediately found during the examination, including contrast pooling in the inferior vena cava and hepatic veins, poor opacification of the left heart chambers and the aorta. Fortunately, the patient was quickly resuscitated, and his heart pump returned to normal. Although cardiac arrest on computed tomography scan is extremely rare, detecting imaging signs of this situation helps patients receive timely resuscitation and better survival.

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Introduction

Because the imaging features of cardiac arrest on computed tomography (CT) are rare, early recognition of these signs is critical to improving the patient's outcome [1–5]. Moreover, with the increasing use of contrast-enhanced CT, imaging

features of cardiac arrest may become more common nowadays. That is the reason why both technicians and radiologists should notice these signs. Nevertheless, there are few publications describing these characteristics. This article presents a young patient presenting imminent cardiac arrest signs on CT who was successfully resuscitated.

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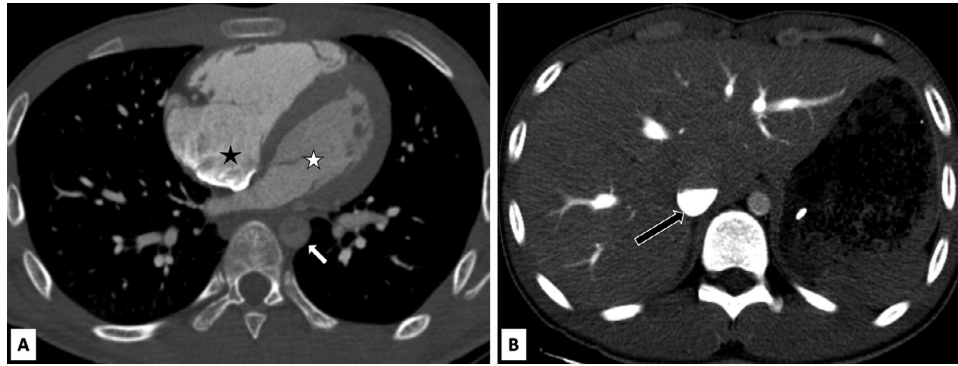


Fig. 1 – A 15 year-male with impending cardiac arrest. (A) Axial contrast-enhanced CT demonstrates accumulation of contrast agents in the right atrium and ventricle (black star). In addition, there is a small amount of contrast material in the left heart chambers (white star) and descending aorta (white arrow) compared with the right chambers. (B) The axial arterial phase shows an accumulation of contrast material in the hepatic veins and layering in the inferior vena cava (black arrow).

Case report

A 15-year-old boy with unremarkable medical history was transferred to our institution due to multiple injuries after a motorbike accident. On admission, the patient was intubated, agitated with the Glasgow Coma Scale of 11, stable hemodynamically, respiratory rate of 22 breaths per minute, and oxygen saturation of 97% on room air. He had severe head-maxillofacial trauma and left tibia-fibula fracture. On abdominal echography, we suspected an abdominal trauma with hemoperitoneum at Morrison's pouch. A contrast-enhanced abdominal CT was then indicated to looking for abdominal organ injuries. Five milligram of midazolam was used for sedative purposes before an abdominal CT scan due to the lack of coordination from the patients. In the arterial phase of the CT scan, intense contrast opacification of the heart's right chambers, the inferior vena cava (IVC), and the hepatic veins were found. In contrast, the left heart chambers and descending aorta were poorly opacified (Fig. 1).

Due to these signs, the CT examination was stopped immediately. After a very rapid clinical evaluation, cardiopulmonary resuscitation was performed. The patient had a spontaneous circulation after 3 minutes, and he was shifted back to the intensive care unit to have a better resuscitation. The abdominal CT scan was then retaken after 30 minutes. On the second abdominal CT, a regular functional blood pump comes along with a liver trauma grade II according to AAST 2018 were shown (Fig. 2). The patient had recovered well and was discharged from the hospital on day-15.

Discussion

Several authors have described CT findings of cardiac arrest, including reflux and pooling of the contrast agents in right

heart chambers, inferior vena cava, and concern veins such as hepatic veins, kidney veins [3–9]. Other signs of this situation are the dependent contrast layering and contrast-fluid level of venous reflux [3–9]. These specific images for acute cardiac failure and hemodynamic changes were found in our case.

It is essential to mention that besides cardiac arrest, the contrast-fluid level or "IVC level sign" could be present in patients with low cardiac output without having cardiac arrest or shock state such as tricuspid regurgitation and right ventricular dysfunction [5,10]. However, like our case, with well-state history patients, there is no differential diagnosis with these images.

In this case, there is no accumulation of contrast in the hepatic parenchyma, which are pretty common signs described by several authors [3,6–9,11]. This difference could be explained by rapid interruption of the CT scan process before the contrast having enough time to accumulate in the parenchyma.

In our case, although there were contrast materials in the lung veins, left chambers of the heart, and aorta, it was significantly lower opacified in comparison with the remaining side of the heart and central veins. This feature is also found in some other cases [8,9]. It can be explained that in these cases, the heart was still able to pump blood, even though cardiac output was meager [6]. Therefore, this can be considered as a sign of impending cardiac arrest and suggesting a better prognosis.

Although an adverse reaction to contrast material or brain injuries could also cause cardiogenic shock, a more likely cause in this patient would be an unwanted effect of midazolam. Midazolam is the sedative of choice for radiographic studies because of its rapid onset of action and short elimination half-life [12]. However, this sedative could be the reason for cardiac arrest in a small proportion of cases [13].

We strongly believe that early recognition of impending cardiac arrest of CT leads to rapid response, and especially the prompt CPR played crucial roles in such a good overall clinical outcome.

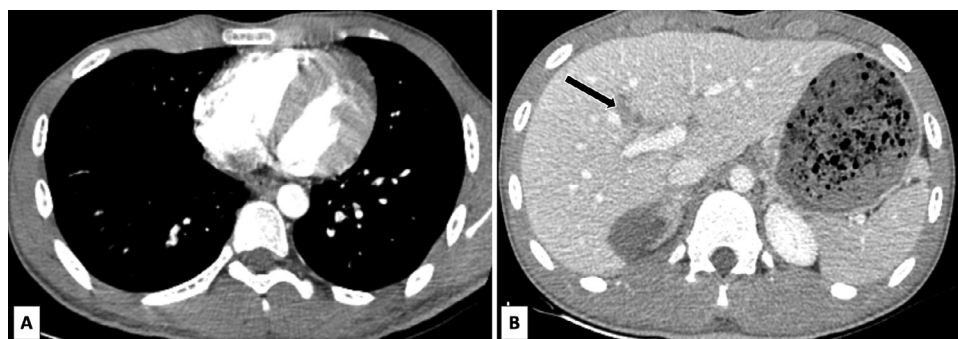


Fig. 2 – (A) Arterial phase of CT scan shows that the 2 ventricles and the aorta are equally enhanced. (B) Portal venous phase shows poor-enhanced and irregular areas of the liver, compatible with lacerations (black arrow).

Conclusion

The use of sedation improves image quality and thus the diagnostic performance of radiographic studies in agitated patients, but the risks of anesthetic toxicity should also be weighed. Cardiac arrest is a life-threatening condition and is rare during or shortly after a CT scan but tends to be increasingly common due to the widespread use of CT. Contrast accumulation in the inferior vena cava and associated veins and organs is considered a cardiac arrest imaging feature. Therefore, technologists and radiologists need to be aware of these findings in order to propose prompt resuscitation.

Ethics approval

For this type of study formal consent is not required. Owing to design of case report, institutional review board approval was waived.

Patient consent

Consent for publication was obtained for individual person's data included in the study during the post-withdrawal visit, noted in the patient's paper medical record.

Authors' contributions

LTD and TVS contributed equally to this article. LTD, TVS and NTHA prepared, drafted, and revised manuscript critically for important intellectual content. Each author gave the final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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