

Myocardial rupture associated with bolus injection of contrast medium during computed tomographic study in a patient with acute myocardial infarction: a rare but lethal complication

Vincent Lai 黎永信
KC Hau 侯佳禎
HY Lau 劉顯宇
WC Chan 陳允芝

Well-documented potential cardiovascular complications associated with the use of contrast media include bradycardia, hypotension, arrhythmia, and conduction disturbances. Rupture of the myocardium after acute myocardial infarction is a known cause of death, but has yet to be recognised as a potential complication of the use of a bolus injection of contrast medium. On the contrary, contrast-enhanced computed tomographic studies have been performed widely for the diagnosis and evaluation of myocardial infarction. We report a case of complicated myocardial rupture after a single bolus injection of contrast medium during a computed tomographic study in an elderly woman with acute myocardial infarction, which led to cardiac tamponade and rapid death. Although rare, this should alert us to the need for cautious use of contrast medium in patients with acute myocardial infarction.

Introduction

Contrast-enhanced computed tomographic (CT) scans are being performed daily for many reasons. They are especially useful for the evaluation of patients with acute chest symptoms because myocardial infarction, pulmonary embolism, and aortic dissection have overlapping clinical presentations. Indeed, advances in technology and the introduction of multidetector CT scan have enabled better evaluation of the heart. Yet, the potential risks to the cardiovascular system of using a bolus injection of contrast medium, although rare, should not be ignored or underrated. Here, we report a rare case of complicated left ventricular free wall rupture after a single bolus injection of contrast medium during a CT study in an elderly woman with acute myocardial infarction. Such a case has not been reported in the literature to date. This should alert us to the potential, if rare, complications that use of a bolus injection of contrast medium may induce, and lead to more cautious use of contrast medium in the future.

Case report

An 85-year-old woman, with a history of good past health, was admitted to hospital for right lower abdominal pain. The abdominal pain was mild and she did not require any analgesia. On physical examination, she had a low-grade fever but was otherwise stable with normal vital signs. Her blood pressure remained within normal limits (systolic pressure: 130 mm Hg and diastolic pressure: 55 mm Hg). On abdominal palpation, mild tenderness was elicited in the right lower quadrant. Her initial blood tests (a full blood count, liver and renal function tests, and a serum amylase level) were unremarkable. A provisional diagnosis of diverticulitis or early appendicitis was made and she was treated with intravenous antibiotics. Two days later, her abdominal discomfort persisted despite resolution of her fever, so an urgent CT scan of the abdomen and pelvis was arranged to seek the underlying cause.

While awaiting the CT scan, a repeated blood screen was performed and revealed elevated cardiac enzymes, with a creatine kinase level of 211 U/L (reference range, 42-190 U/L) and lactate dehydrogenase level of 477 U/L (211-370 U/L). Her serum troponin I level was also elevated at 3.7 ng/mL (reference level, <0.060 ng/mL). An electrocardiogram was performed and showed ST segment elevation and T wave inversion in the anterolateral leads, confirming an acute myocardial infarction.

The patient was then sent for an urgent CT study. She remained well during the initial non-contrast scanning period but developed a sudden cardiac arrest immediately after an intravenous bolus injection of 80 mL non-ionic water-soluble contrast at a rate of 3 mL/sec during the contrast-scanning phase. Resuscitation commenced at once. A review of the

Key words

Contrast media; Heart rupture, post-infarction; Injections, intra-arterial; Tomography, X-ray computed

Hong Kong Med J 2009;15:285-7

Tuen Mun Hospital, Tuen Mun, Hong Kong;
Department of Radiology
V Lai, MB, ChB, FRCR
HY Lau, MB, ChB
WC Chan, MB, ChB
Department of Medicine and Geriatrics
KC Hau, MB, ChB, MRCP

Correspondence to: Dr V Lai
E-mail: vincentlai@hkcr.org

為急性心肌梗塞病人進行電腦掃描時與團注造影劑有關的心肌破裂：一種罕見但會引致死亡的併發症

造影劑可能引發的心血管併發症，包括心博過緩、低血壓、心律失常，以及傳導受阻問題，文獻中早有記載。目前已知急性心肌梗塞可引發心肌破裂致死，可是使用團注造影劑而有可能引致心肌破裂這種潛在的併發，則鮮為人知。另一方面，增強掃描被廣泛用作診斷及評估心肌梗塞。本文報告為一名急性心肌梗塞的年長女病人進行電腦掃描時，因團注造影劑引致心肌破裂，最後病人因心臟壓塞而快速死亡的病例。此病例雖然罕見，卻提醒我們對急性心肌梗塞病人使用造影劑時要格外小心。



FIG 1. Non-contrast computed tomographic scan showing normal-looking heart and pericardium

images showed that caecal diverticulitis accounted for the patient's symptoms. The major concern, however, was the normal-looking myocardium and pericardium seen during the non-contrast phase (Fig 1) complicated by rupture of the left ventricular free wall with active contrast extravasation (Fig 2a) and haemopericardium (Fig 2b) during the contrast phase. Such dramatically different findings indicated that the bolus contrast injection induced myocardial rupture. Because the patient had developed cardiac tamponade, an urgent ultrasound-guided pericardiocentesis was performed and fresh blood was drained out. She did not respond to resuscitation, however, and finally died 1 hour afterward.

Discussion

Myocardial rupture is commonly divided into three



FIG 2. Post-contrast computed tomographic scans (a) revealing ruptured left ventricular free wall with active contrast extravasation, and (b) showing contrast collection in the pericardium with cardiac tamponade

major subgroups: rupture of the papillary muscle, the interventricular septum, and the free wall. Acute rupture of the free wall is the most common type of rupture, comprising more than 50% of all ruptures,¹ and accounts for 10% of in-hospital deaths following acute myocardial infarction.² Rupture of the papillary muscle and interventricular septum are less frequent, accounting for 8% and 16% respectively. Being female, having hypertension, diabetes, angina, and previous myocardial infarction are all risk factors for ruptured myocardial death, with prolonged and recurrent chest pain being the most frequent and consistent clinical characteristic.¹

Myocardial rupture usually occurs between 3 and 6 days or within 2 weeks after the infarction,³ typically

involving the anterior or lateral wall, in the terminal region of the left anterior descending coronary artery distribution.² Rupture of the left ventricular free wall usually leads to haemopericardium and death from cardiac tamponade, which can be acute (acute tear leading to immediate death) or subacute (slow and incomplete tear leading to late rupture). Non-ionic water-soluble iodinated contrast is the agent of choice for performing contrast CT studies. Iodinated contrast medium can cause a wide range of complications. Well-documented potential cardiovascular complications include hypotension, bradycardia, arrhythmias and conduction disturbances, probably via vasovagal reactions, a direct negative inotropic effect on the myocardium and peripheral vasodilatation.

Our case has demonstrated that a single bolus injection of contrast medium can induce myocardial rupture in patients with acute myocardial infarction, which, to the best of our knowledge, has not been reported in the literature to date. It is difficult to be certain of the pathogenesis, especially when there have been a significant number of past studies using CT to evaluate acute myocardial infarction or ruptured myocardium using contrast-enhanced CT scans,⁴ and contrast is routinely used during cardiac catheterization for patients suffering from myocardial infarction. We postulate that the large volume of contrast injected at a rapid rate via the mechanical power injector may have generated a pressure with each stroke volume that was too high for the infarcted myocardial tissue to withstand, leading to

perforation. Previous studies in experimental animals have shown that cardiac output elevation occurs as early as 3 seconds after the injection of a volume load.⁵ A similar phenomenon can be observed in humans when intravenous iohexol is injected, resulting in a statistically significant increase in the left ventricular systolic pressure and left ventricular diastolic diameter as early as 15 seconds after injection.⁶ This phenomenon would be exaggerated in myocardial infarction as left ventricular stiffness increases after infarction.⁷ Therefore, a single bolus injection of contrast can increase left ventricular pressure to a degree theoretically able to rupture infarcted myocardium. This single report raises the possibility of this rare complication of use of contrast-medium injection during a CT study and should warn us to use it cautiously in patients with acute myocardial infarction.

Although successful surgical intervention using rapid pericardiocentesis, volume expansion and immediate surgery using cardiopulmonary bypass has been reported,⁸⁻¹⁰ treatment should be directed towards prevention of rupture due to its lethal nature. Therefore, the potential risks of intravascular administration of contrast medium must be weighed against the potential benefits and thoroughly discussed with the patient beforehand. It is important to identify individuals for whom there is an increased risk of such an adverse event and to search for an alternative investigative modality where necessary.

References

- Dellborg M, Held P, Swedberg K, Vedin A. Rupture of the myocardium. Occurrence and risk factors. *Br Heart J* 1985;54:11-6.
- Trindade ML, Tsutsui JM, Rodrigues AC, Caldas MA, Ramires JA, Mathias Junior W. Left ventricular free wall impeding rupture in post-myocardial infarction period diagnosed by myocardial contrast echocardiography: case report. *Cardiovasc Ultrasound* 2006;4:7.
- Lewis AJ, Burchell HB, Titus JL. Clinical and pathologic features of postinfarction cardiac rupture. *Am J Cardiol* 1969;23:43-53.
- Gosalia A, Haramati LB, Sheth MP, Spindola-Franco H. CT detection of acute myocardial infarction. *AJR Am J Roentgenol* 2004;182:1563-6.
- Karliner JS, Boucharard RJ, Gault JH. Haemodynamic effects of angiographic contrast material in man. A beat-by-beat analysis. *Br Heart J* 1972;34:347-55.
- Higgins CB, Gerber KH, Mattrey RF, Slutsky RA. Evaluation of the hemodynamic effects of intravenous administration of ionic and nonionic contrast materials. Implications for deriving physiologic measurements from computed tomography and digital cardiovascular imaging. *Radiology* 1982;142:681-6.
- Popovic AD. Old and new paradigms on diastolic function in acute myocardial infarction. *Am Heart J* 1999;138:S84-8.
- Bashour T, Kabbani SS, Ellertson DG, Crew J, Hanna ES. Surgical salvage of heart rupture: report of two cases and review of the literature. *Ann Thorac Surg* 1983;36:209-13.
- Lillehei CW, Lande AJ, Rassman WR, Tanaka S, Bloch JH. Surgical management of myocardial infarction. *Circulation* 1969;39(Suppl IV):315S-333S.
- Cobbs BW Jr, Hatcher CR Jr, Robinson PH. Cardiac rupture. Three operations with two long-term survivals. *JAMA* 1973;223:532-5.