Ventricular pulling sign on computed tomography in mediastinitis—a predictor for right ventricular rupture at surgery

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Abstract

Mediastinitis is an unusual but potentially life-threatening complication of cardiac surgery. Open drainage is one of the standard therapies, but there could sometimes be potential complications. We had a patient who underwent open drainage surgery for postoperative mediastinitis, and right ventricular rupture occurred subsequently to extubation in an operation room. Retrospectively reviewed, computed tomography showed strong adhesions between the right ventricle and the posterior margin of sternum, pulling his right ventricle to the right side of his sternum. We should have noticed the risk of leaving the sternum open and performed adhesiolysis of the right ventricle and the posterior margin of sternum to prevent the devastating complication. This case illustrates the importance of recognizing the rare computed tomography sign of ventricular pulling—a predictor for right ventricular rupture after open drainage for mediastinitis.

Keywords Mediastinal infection · Reoperation · Complications · Right ventricular rupture

Introduction

There are some reports of complications after open drainage for mediastinitis. A right ventricular (RV) rupture is one of the complications, which is rare but fatal [1, 2]. We experienced a patient who developed the RV rupture after an open-drainage surgery for mediastinitis in an operating room. There was a hazardous computed tomography (CT) sign, which we should have noticed, to predict the devastating complication.

Case report

A 55-year-old man underwent an emergency surgery for an acute aortic dissection in our hospital. His weight was 100 kg, and his urine culture tested positive for methicillin-resistant *Staphylococcus aureus*. His ascending aorta and

brachiocephalic artery were replaced with a 28-mm graft [J Graft SHIELD NEO (Japan Lifeline®, Tokyo, Japan)]. The upper half of the pericardium was closed. The surgery was uneventful but required 12 days of intubation because of respiratory dysfunction caused by a preoperative history of long-term smoking. He was given a combination of cefazolin and vancomycin for 1 week, but his temperature remained above 38 °C. We obtained a computed tomography scan to investigate the cause of his fever 8 days after the surgery. The CT scan showed bilateral basal atelectasis with slight pneumonitis, a partially separated sternum without fluid collection, and a small amount of pericardial effusion (Fig. 1).

Twelve days after the surgery, his respiratory condition improved, and he was extubated.

Fifteen days after the surgery, his temperature was still above 38 °C, and we repeated a CT scan, which showed subcutaneous fluid collection, a pericardial effusion, and complete separation of his sternum (Fig. 2). We suspected mediastinitis and performed an urgent surgery of open irrigation and drainage.

Intraoperatively, when we opened his skin, we found subcutaneous fluid, and his sternum was separated over its entire length. All six sternal wires used during the first surgery were removed. There were strong adhesions noted, and we irrigated the mediastinum and chose open drainage using a commercially available system (Vacuum Assisted Closure V.A.C.®

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Fig. 1 Eight days after the surgery, the CT showed bilateral basal atelectasis with slight pneumonitis, a partially separated sternum without fluid collection, and a small amount of pericardial effusion. The right ventricle was not pulled to the right side of the sternum yet

Therapy System, Kinetic Concepts, Inc., TX, USA) with a negative pressure of 50 mmHg. The soft foam was placed between the separated sternum, and the V.A.C. dressing foam was placed over the sternum. Therefore, the sternum, subcutaneous tissue, and skin were left open.

During the surgery, his vital signs were noted to be stable. Just as the anesthesiologist was aspirating the tracheal tube to clear the sputum and getting the patient ready for extubation, the patient happened to cough vigorously. Suddenly, a massive blood flooded out from the V.A.C. foam, and he developed cardiorespiratory arrest within a few seconds. We performed sternal compression but it only worsened his bleeding. He was again immediately anesthetized and readied for an

Fig. 2 Fifteen days after the surgery, the CT showed an increased subcutaneous and pericardial fluid and dehiscence of the sternum indicated mediastinitis. Retrosternal soft tissue thickening was seen with the anterior wall of right ventricle pulled towards it—the “ventricular pulling sign” (white arrow) suggesting adhesions between the anterior wall of right ventricle and sternum, a predictor for ventricular rupture at surgery

extracorporeal membrane oxygenation (ECMO). However, we could not get an adequate blood pressure level and were able to start the ECMO 10 min later. We noted a 4-cm laceration on the anterior wall of his RV (Fig. 3). We closed the laceration with a 3–0 monofilament suture but could not get a spontaneous heartbeat.

We reviewed this case retrospectively, and the last CT scan before open-drainage surgery showed a thickened retrosternal soft tissue with the anterior wall of RV pulled towards it (Fig. 2). This ventricular pulling sign suggested adhesions between the anterior wall of RV and sternum. We presumed that his RV was torn by his separated sternum, which due to leaving his skin and subcutaneous tissue open increased the mobility of his sternum on both lateral sides. The ventricular pulling sign was a predictor for ventricular rupture at surgery, we should have noticed.

Microbiological cultures of his soft tissues and mediastinal fluid were positive for methicillin-resistant *Staphylococcus epidermidis*.

Discussion

Mediastinitis is defined as a deep wound infection associated with sternal osteomyelitis with or without an infected retrosternal space, with an incidence of 1–4% [3]. Post-sternotomy mediastinitis is a serious and lethal complication of cardiac surgery. Perrault and colleagues previously reported readmission rates, and mortality were five times higher in patients with mediastinal infection than in patients without mediastinal infection [4]. Medical therapy alone is not generally enough to achieve complete recovery, and we usually require surgical procedures that include removal of sternal wires, open debridement, bedside irrigation, and frequent dressing change, followed by reconstruction with muscle flaps or omental transposition when the wound appears clean or the result of microbiological culture becomes negative [3]. Recently, various negative pressure wound therapy

Fig. 3 A laceration of the anterior wall of the right ventricle (white arrow), which was sewn and repaired (black arrow)

techniques, viz., V.A.C.® treatment, have been introduced to treat mediastinitis with favorable results reported [3, 5, 6].

Several authors suggest that initial surgical debridement should include an extensive slitting up of the sternum to free the RV from any chest wall adhesions and to decrease the pulling tension during chest wall movements [1, 2]. Where mediastinal adhesions are strongly suspected and excessive bilateral shear stress after releasing the skin, subcutaneous tissue, and sternum is likely, judging from a CT scan, in a case like this one, it is suggested that we be prepared to free the heart from adhesions to the posterior margin of sternum. The pulling sign of the RV to both lateral sides of the divided sternum is a strong predictor of RV rupture after open drainage and leaving sternum separated.

In conclusion, we should be especially wary of this sequence of events in a patient who undergoes open drainage surgery for mediastinitis and must interpret the preoperative CT cautiously. If there are indications of strong adhesions, the ventricular pulling sign of CT scan like this case, we should consider not only doing an open-drainage surgery but performing adhesiolysis of the RV to the posterior margin of sternum to prevent the RV rupture.

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