Clinical Reports

Detection of retroperitoneal hemorrhage by transesophageal echocardiography during cardiac surgery

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Purpose: To present a case of massive retroperitoneal hemorrhage during cardiopulmonary bypass (CPB) which was detected using transesophageal echocardiography (TEE).

Clinical feature: A 50-yr-old man suffering from severe mitral regurgitation (MR) was admitted for mitral valvuloplasty. After the beginning of CPB, the volume in the reservoir was noticed to be gradually decreasing. Although venous cannulation had been properly performed, TEE showed an echo free space around the liver, the spleen and in front of the abdominal aorta showed intraabdominal hemorrhage. After cardiac surgery, emergency laparotomy revealed about 5,000 ml of blood in the retroperitoneal space probably as a result of femoral artery cannulation prior to CPB. Hemostasis was achieved, and the patient made complete cardiac and neurological recovery. Retrospective review of the TEE imaging revealed that the kidneys were surrounded by blood bilaterally confirming the diagnosis of retroperitoneal hemorrhage.

Conclusion: Retroperitoneal hemorrhage during CPB is rare, but may be lethal. Transesophageal echocardiography is a useful monitor not only to evaluate cardiac performance, but also to detect unexpected intraabdominal bleeding during cardiac surgery.

Objectif : Présenter le cas d'une hémorragie rétropéritonéale massive pendant la circulation extracorporelle (CEC), détectée à l'aide de l'échocardiographie transoesophagienne (ETO).

Éléments cliniques : Un homme de 50 ans, souffrant de régurgitation mitrale sévère, a été admis pour une valvuloplastie mitrale. Après le début de la CEC, on a noté que le volume du réservoir baissait graduellement. Bien qu'on ait correctement réalisé la mise en place d'une canule veineuse, l'ETO a montré un espace libre d'écho autour du foie, de la rate et, en avant de l'aorte abdominale, indiquant la présence d'une hémorragie intra-abdominale. Après la cardiochirurgie, la laparotomie d'urgence a révélé la présence d'environ 5 000 ml de sang dans l'espace rétropéritonéal, le résultat probable de l'introduction d'une canule dans l'artère fémorale avant la CEC. L'hémostase a été rétablie et le patient a connu une récupération cardiaque et neurologique complète. L'étude rétrospective des images de l'ETO a révélé que les reins étaient bilatéralement entourés de sang, ce qui confirme le diagnostic d'hémorragie rétropéritonéale.

Conclusion : L'hémorragie rétropéritonéale est rare pendant la CEC, mais elle peut être fatale. L'échocardiographie transoesophagienne est un moniteur utile non seulement pour évaluer le rendement du coeur, mais aussi pour détecter des saignements intra-abdominaux inattendus pendant la cardiochirurgie.

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IN cardiac surgery, the femoral artery is punctured to apply intra-aortic balloon pumping (IABP), to facilitate emergency arterial cannulation for cardiopulmonary bypass (CPB) and to monitor the systemic arterial blood pressure during and after CPB. However, femoral artery cannulation is associated with many complications including vessel trauma and infection.^{1,2} Among such complications, retrograde aortic dissection is the most severe.³

We present a case of massive retroperitoneal hemorrhage during CPB caused by femoral artery cannulation prior to CPB and detected during CPB using transesophageal echocardiography (TEE).

Case Report

Mitral valvuloplasty was planned in a 50-yr-old man suffering from severe mitral regurgitation (MR) as a result of infective endocarditis. The patient received digoxin, ubidecarenone and famotidine prior to surgery, and the anesthetic drugs administered prior to initiation of cardiopulmonary bypass were 0.3 mg·kg⁻¹ diazepam, 40 µg·kg⁻¹ fentanyl and 0.2 mg·kg⁻¹ pancuronium. A catheter (Arterial line kit, ARGON, Texas, USA: steel needle; 19 gauge guide wire; 40 cm, catheter; 18 gauge; 15 cm) was inserted into the right femoral artery using the Seldinger technique, and the pressure was monitored. Prior to CPB, the patient was anticoagulated with 300 U·kg⁻¹ heparin. The ascending aorta, inferior vena cava (IVC) and superior vena cava (SVC) were cannulated as usual.

During cannulation, systemic arterial blood pressure gradually decreased from 130/66 to 70/45 mmHg, filling pressure decreased from 6 to 1 mmHg, heart rate increased from 50 to 80 bpm and TEE (SSH-160A, Toshiba, Tokyo, Japan) showed a reduced size of the left ventricle and atrium despite MR, indicating a decrease in intravascular volume. Hypotension was treated with transfusion of hydroxyethyl starch. Because the blood pressure recovered rapidly, we did not take the problem very seriously at the time.

After anesthetic induction, the patient's hematocrit was 38% but was lower (12%) than expected (17%) at the beginning of CPB. Later, the volume in the reservoir was noticed to be gradually decreasing and hypovolemia was treated with rapid transfusion of blood products to maintain the level reservoir level. The hematocrit was 13-22% during CPB in spite of 2500 ml transfusion of blood products.

Since vasodilator agents had not been used, a complication of venous cannulation was suspected, e.g. kinking, malposition, unintentional clamping, air locking, or retention of the blood in the surgical field including the intrathoracic cavity but none could be identified.

Thereafter, the IVC cannula was examined using TEE because the IVC obstruction or liver damage might occur after the IVC cannulation. We found that the IVC venous cannula was properly positioned and that the liver and the spleen were not damaged. In some views, TEE revealed a hypo echoic space around the liver and the spleen (Figure 1). At this point, we noticed serious bleeding occurred into the intraperitoneal space. Fluid balance during CPB revealed 2,000 ml fluid deficit. Since the patient had a history of duodenal ulcer, we attributed the intraperitoneal hemorrhage to perforation of the duodenum. Immediately after the reversal of the anticoagulant effect of heparin with protamine, we performed fibregastroduodenoscopy, but did not find any hemorrhage in the upper gastrointestinal tract.

After ruling out duodenal bleeding, the following facts became clear. Firstly, TEE showed a small hypo echoic mass in front of the abdominal aorta, and secondly, one surgeon recalled a problem during femoral artery cannulation because blood had not been obtained after removal of a guide wire but some blood did return after the catheter was slightly withdrawn. We suspected that the hypo echoic space around the spleen was not from intraperitoneal bleeding but instead from retroperitoneal bleeding, and we assumed that either the right femoral or external iliac artery might have been penetrated by a steel needle, and subsequent systemic heparinization may have accelerated a retroperitoneal hemorrhage from a tear in the damaged artery. Based on this, laparotomy was performed to obtain hemostasis.

At the end of the cardiac surgery, the abdominal wall was distended and hard. Fluid balance during CPB revealed 5,000 ml fluid deficit. Laparotomy revealed 5,000 ml blood in the retroperitoneal space and a small amount of blood in the peritoneal space. Because we found a large amount of coagulation on the right external iliac artery, we speculated that the external iliac artery was injured. Although the bleeding site could not be clearly identified, hemostasis was achieved. The patient thereafter made a full cardiac and neurological recovery.

Retrospective review of the TEE images revealed the kidneys surrounded by blood to confirm the diagnosis.

Discussion

Among the many complications associated with femoral artery cannulation, retrograde arterial dissection is the most serious, and occurs in 0.2-0.9% of the patients.³⁻⁶ Retrograde arterial dissection may lead to retroperitoneal hemorrhage or retrograde extension to the aortic root.⁷ However, retroperitoneal hemor-

FIGURE 1 The spleen and liver floating in the hypo echoic space (blood).

FIGURE 2 Kidneys surrounded by hyper echoic mass (coagulated blood).

rhage may be difficult to diagnose after induction of systemic heparinization for CPB and can be potentially lethal because the clinical signs do not appear until massive bleeding occurs.

In this case, the clinical signs of hemorrhage were hypotension and the reduced size of both left ventricle and atrium detected by TEE. Retroperitoneal hemorrhage may occur spontaneously or as a result of anticoagulation, bleeding diathesis, tumor, or during placement of arterial or venous catheters.⁸ Computed-tomography (CT) is more sensitive than abdominal ultrasound in finding retroperitoneal bleeding and evaluating the extent of hemorrhage.⁸ However, neither CT nor angiography can be performed in the operating room or just after a cardiac operation due to the hemodynamic instability.

The usefulness of TEE during cardiac surgery has been established. Cardiac valve physiology and pathology, wall motion, atheromatous ulcers and calcification of the aorta, and aortic dissection⁹ can be estimated by TEE.¹⁰ During CPB, TEE has been used to detect the appropriate positions of arterial and venous cannula and aortic dissection. In this case, when we tried to check the position of the venous cannula in the IVC, there was, in some views, an echo free space under the liver. However, the ultrasound examinations including transabdominal or transesophageal can not distinguish between intraperitoneal and retroperitoneal hemorrhage. The ultrasound findings of retroperitoneal hemorrhage are nonspecific, and a negative ultrasound examination does not rule out the presence of even large retroperitoneal bleeding.⁸

Retrospectively, we reviewed the TEE images on videotape and found a high and low density echo area at the lateral and dorsal site of the kidneys (Figure 2), evidence of retroperitoneal hemorrhage. It has been reported that kidneys can be seen with TEE.¹¹ Moreover, we could easily visualize the kidneys and spleen with TEE because of the movement of all the abdominal structures upwards due to the massive retroperitoneal bleed. Therefore, we suggest that retroperitoneal hemorrhage may be detectable by TEE during CPB. The minimum amount of blood that should be present in the retroperitoneal cavity for the diagnosis may be about 1000 ml because we could easily detect the intraabdominal bleeding at 2000 ml blood loss.

To detect retroperitoneal hemorrhage using TEE the short axis view of the left ventricle was first obtained and then the transducer was moved down and slightly to the left side. This showed the spleen floating in an echo-free space. A small hypo echoic space behind the right lobe of the liver was found when the transducer was moved to the right. After the transducer was moved downwards, hyper echoic (coagulated blood) and hypo echoic (blood) masses were detected at the lateral and dorsal sites of the kidneys bilaterally. Based on these findings, retroperitoneal hemorrhage was diagnosed.

Our case suggests that such hemorrhage can be difficult to control after induction of systemic heparinization for CPB and that retroperitoneal hemorrhage may be lethal. When an unexpected decrease in the reservoir volume occurs during CPB, we usually con-

sider trouble in the venous cannula, an inadequate venous return, retention of blood with the surgical field, or vasodilatation.¹² Our case clearly shows that, in these circumstances, possible hemorrhage into the retroperitoneal and/or the intraperitoneal space should be sought by TEE examination. Further, potentially lethal hemorrhage into the retroperitoneal space can occur after a troublesome puncture of the femoral artery followed by systemic heparinization.

In conclusion, retroperitoneal hemorrhage during CPB is rare, and such complications can become lethal in cardiac operations, especially during CPB. Transesophageal echocardiography appears to be a useful monitor not only to evaluate cardiac performance but also to detect unexpected intraabdominal bleeding during cardiac surgery.

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