CASE REPORT

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Thoracoabdominal aneurysm rupture: a modification of the visceral perfusion circuit

Aneurisma toracoabdominal roto: modificação do circuito de perfusão visceral

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Abstract

A patient with ruptured type IV thoracoabdominal aortic aneurysm (TAAA), underwent surgical treatment utilizing visceral perfusion assisted by a centrifugal pump and neonatal membrane oxygenator. This circuit allows visceral perfusion with oxygenated blood during the ischemic period and the fast infusion of intravenous volume after clamp removal.

Descriptors: **Aortic aneurysm, thoracic, surgery. Aortic aneurysm, abdominal, surgery Perfusion. Infusion pumps.**

Resumo

Paciente portador de aneurisma toracoabdominal (ATA) tipo IV, roto, submetido a tratamento cirúrgico utilizando perfusão visceral assistida por bomba centrífuga e oxigenador de membrana neonatal. Este circuito permite a perfusão visceral com sangue oxigenado, durante o período de isquemia, e infusão de volume rápido via venosa após a retirada da pinça.

Descritores: **Aneurisma da aorta torácica, cirurgia. Aneurisma da aorta abdominal, cirurgia. Perfusão. Bombas de infusão.**

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INTRODUCTION

Since the report on surgery of thoracoabdominal aneurysms published by Etheridge et al. in 1954 and the improvement of the surgical technique by Crawford in 1965, technical advances have contributed to the amelioration of the surgical results. Although intra- and postoperative therapy has progressed considerably in elective surgeries, prognosis after the surgical repair of ruptured thoracoabdominal aneurysms remains unclear [1-3].

In thoracoabdominal aneurysms, different techniques both with and without perfusion of the distal arteries during clamping can be utilized [1,3-8]. These include the following techniques: 'clamp and go', which involves aortic clamping without distal perfusion; perfusion of the renal ostia using cooled crystalloid solution; aorto-distal shunt, with selective visceral and passive perfusion; axillo-visceral shunt, with passive perfusion; femoral vein–femoral artery or femoro-visceral shunt, utilizing an oxygenator and pump for the infusion; atrio-femoral shunt, with selective visceral perfusion and active infusion using a pump; a shunt between left pulmonary vein and femoral artery or visceral arteries; cardiopulmonary bypass (CBP) using deep hypothermia and circulatory arrest.

In methods using passive perfusion it is impossible to achieve adequate control of the perfusion pressure or the infused volume in the visceral arteries.

In respect to active perfusion methods, with or without the use of an oxygenator, a reduction in the risk of paraplegia and visceral ischemia has been demonstrated. However its use is not routine for type III or IV aneurysms, where the time of clamping is short and so it is mainly used for special cases [1,6-8]. We chose visceral perfusion, with a shunt between the femoral vein and the visceral arteries using a modified system where the shunt enables the use of a fast venous infusion pump in the partial CBP circuit.

CASE REPORT

A 57-year-old man underwent tomographic examination that showed an aneurysm of the abdominal aorta (involving the superior mesenteric and the renal arteries), which measured 7.5 cm in its greatest diameter with a posterior hematoma.

Conduct

The operation performed by thoracophrenolaparotomy in the eighth intercostal space on the left, approached the retroperitoneum with visualization of the thoracic aorta up to its bifurcation, identifying its visceral branches.

There was a retroperitoneal hematoma and an aneurysm of approximately 8 cm at its greatest diameter, from the superior mesenteric artery to the bifurcation of the aorta. The left femoral vein was dissected and systemic heparinization using 200 units/kg was made. A 20 Fr venous catheter (Tecnobio Ind. Com. Repr. Ltda.) was introduced to the inferior cava vein and connected to the modified partial CBP circuit. Proximal and distal clamping of the aneurysm was made and it was opened along all its length. The visceral ostia were identified and perfusion was started with normothermic oxygenated blood, through Pruitt 9 Fr catheters, in the renal arteries, superior mesenteric artery and the celiac branch. The pressure of the visceral perfusion was maintained at 60 mmHg with a flow of 300 mL/min (Figure 1).

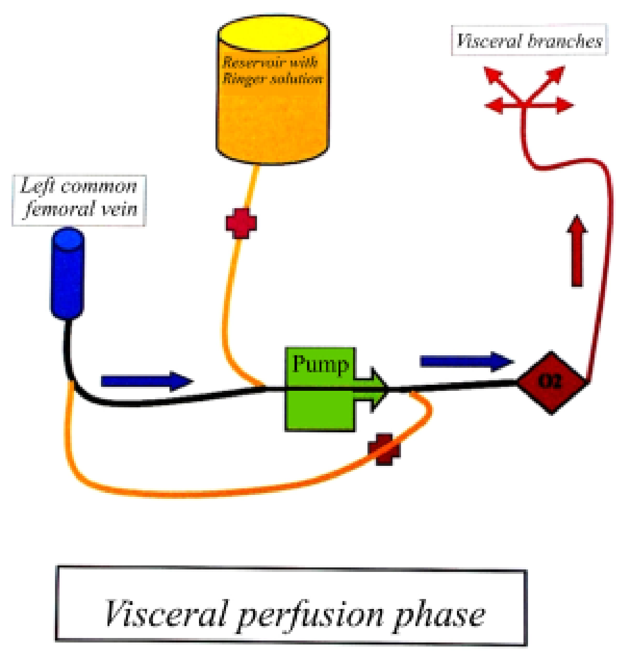

Fig. 1 – In yellow is the cardiotomy reservoir and the connection line of the circuit. In this phase, these lines are clamped (red cross). In blue is the venous catheter inserted in the left femoral vein, which in this phase is used for venous drainage. The blue arrows indicate the direction of the venous blood flow and the red arrow indicates the direction of the oxygenated blood. In green is the centrifuge pump. In red is the oxygenator with lines for the visceral branches.

Anastomosis of visceral ostia to a 30 cm 24 mm Dacron tubular prosthesis was performed.

After completing the distal anastomosis the visceral perfusion was ceased and fast venous infusion of Lactate Ringer solution was performed (Figure 2).

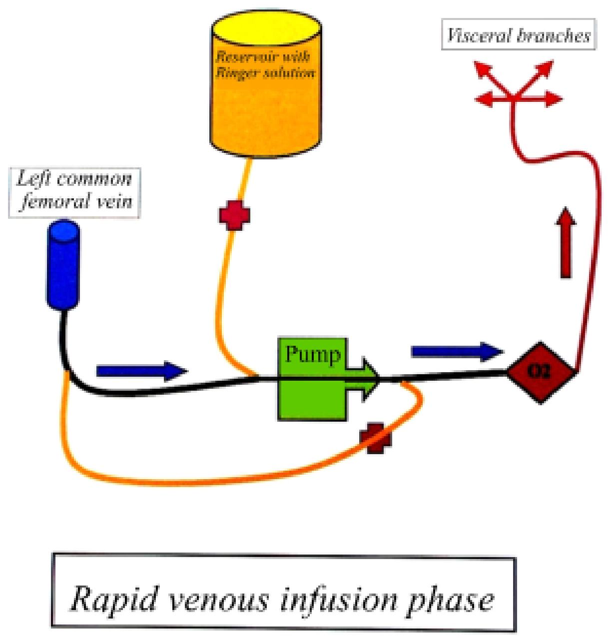

Fig. 2 – In yellow is the cardiotomy reservoir and the connection line containing Lactate Ringer solution. The yellow arrows show the direction of flow. In blue is the venous catheter inserted in the left femoral vein, with the line connected to the centrifuge pump (green) and the oxygenator (red). Note that in this phase the suction line of the femoral vein is clamped and so is the pump-oxygenator line (red crosses).

After completing the proximal anastomosis, a new fast infusion of Lactate Ringer solution was made before distal declamping (Figure 2). With hemodynamic stabilization, the catheter of the femoral vein was removed, followed by reversal of the heparin using protamine sulfate (half the calculated dose) and the cavities were closed.

Operative data: The operation time was 5½ hours, with bleeding estimated at 4 liters. Blood derivatives were transfused and 800 mL of blood was recovered with a Cell Saver. The Time of visceral clamping was 30 minutes and the total clamping time was 55 minutes. The intraoperative diuresis was adequate and the total volume of Lactate Ringer solution infused by the fast venous pump was 1900 mL. The patient was extubated in the immediate postoperative period.

The modified partial cardiopulmonary bypass consisted of a centrifuge pump (International Biophyscs Corporation – Austin /Texas/ USA), a neonatal membrane oxygenator and an adult cardiotomy reservoir (Braile Biomédica Ind. e Com. Ltda). Priming was by Lactate Ringer solution.

COMMENTS

In type III and IV thoracoabdominal aneurysms, many authors use the 'clamp and go' technique. They normally justify this because the aortic clamping time is relatively short, with a lower risk of medullar ischemia [3-5,8].

In the cases of reoperations or ruptures, in which the clamping time can be prolonged, the utilization of visceral perfusion can improve the preservation of renal and hepatic function, reducing the deleterious effects caused by intestinal ischemia and reducing the risk of acute renal insufficiency, coagulation disorders or other alterations with hemodynamic repercussions [1,6].

In this case we opted for visceral perfusion during the supra-diaphragmatic aorta clamping with a circuit that associates 'partial' cardiopulmonary bypass with a fast venous infusion pump.

The cardiotomy reservoir was utilized for the venous infusion of crystalloid solution. A neonatal membrane oxygenator was utilized with the aim of decreasing the dose of heparin necessary in this circuit (desired ACT = 300 seconds). The necessary flow for visceral perfusion is approximately 60 mL/min per arterial branch and the neonatal oxygenator has a capacity of oxygenating up to 1000 mL/min [6,8].

The advantage of the circuit is the fast venous infusion using the centrifuge pump with a shunt connected to the circuit. This volume infused by the pump coincides exactly with the termination of the proximal and distal anastomoses, when an additional volume is necessary due to the hypertension caused by declamping the aortic.

Even in elective type III and IV thoracoabdominal aneurysm surgery, this perfusion circuit would be interesting. Associating a fast venous infusion pump guarantees venous access by the inferior vein and increases the time allowed to safely perform the anastomoses. There is still the possibility of associating cold blood perfusion in renal arteries and to add a heat exchange unit in the venous infusion to heat the patient if necessary.

The aforementioned traditional circuits could be utilized in this case. However, this would not solve our problem of the fast infusion pump. These circuits require greater doses of heparin (cardiopulmonary bypass circuits) or do not have control of the visceral perfusion flow (passive perfusion).

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