Sutureless Videoendoscopic Thoracic Aorta to Iliac Artery Bypass: The Easiest Approach to Occlusive Aorto-iliac Diseases

P. Tozzi,* A. F. Corno, B. Marty and L. K. von Segesser

Department of Cardio-Vascular Surgery, Centre Hospitalier Universitaire Vaudois (CHUV), Rue du Bugnon, 46, 1011 Lausanne, Switzerland

Objective. We designed an animal study to determine the feasibility of videoendoscopic thoracic aorta to iliac artery bypass using a sutureless anastomotic device for proximal anastomosis construction.

Methods. In 12 pigs the descending thoracic aorta was exposed using the thoracoscopic technique. A 4 mm PTFE thin wall graft was used as conduit. The proximal anastomosis was constructed using a mechanical device for sutureless anastomosis inserted through the camera port incision. The prosthesis was passed through the diaphragm in the retroperitoneal space and the distal anastomosis was done with running suture.

Results. The operation was successfully completed in 11 animals. One animal died due to hemorrhage during anastomosis construction. Mean graft flow was 144 ml/min (range 88–167 mmHg). The angiogram showed no graft kinking or stenosis. Total operative time was 58 min (range 47–68 min).

Conclusions. This approach allows quick and excellent exposure of the entire descending thoracic aorta. The use of the sutureless device to perform the proximal anastomosis dramatically reduces the technical demands of this procedure and could avoid an aortic clamp.

Key Words: Occlusive aortic disease; Sutureless vascular anastomosis; Videoendoscopy.

Introduction

There are several surgical options to treat occlusive aorto-iliac disease. If we exclude the endovascular approach1,2 and the axillo-bifemoral bypass3 which have limited indications, the gold standard is the transabdominal or retroperitoneal exposure of the abdominal aorta. Recent reports describe the performance of laparoscopic aorto-iliac or aorto-femoral bypass, but the enthusiasm for this procedures has been limited by a number of technical difficulties like bowel retraction and maintaining pneumoperitoneum.4,5 Many of these technical limitations may be avoided if the aortofemoral bypass originates from the descending thoracic aorta.6,7 The thoracoscopic approach to the aorta has the advantage of easy aortic dissection,8 but the need of an aortic clamp and the fact that constructing a vascular anastomosis with the endoscopic technique is a highly demanding procedure makes it a challenging technique. The introduction of sutureless anastomotic technology could overcome some of these problems and this experimental study has been designed to verify this hypothesis.

Materials and Methods

Symmetry aortic connector (St Jude Medical Inc., USA). This is a metal memory alloy ring that has seven pins on which the synthetic graft is inserted and, on the other side, two series of fins that squeeze the aortic wall guaranteeing the aorta-device connection. It is 4–4.5 mm and the connector is mounted onto a delivery system. Aortotomy is performed with an aortic punch delivered with the connector.

Study design. In 12 pigs (50–55 kg) two 5 mm dissecting ports were inserted in the fourth and 10th left intercostal spaces and a 10 mm camera port was placed in the eighth intercostal space (Fig. 1). Lung retraction was obtained insufflating CO2 into the left chest. A 4 mm PTFE thin wall graft was used as conduit. The graft was mounted onto the connector.
and inserted into a delivery system. A 4 mm aortotomy was performed with the aortic punch inserted through the camera port incision. The punch was switched with the delivery system. The anastomosis was completed in a few seconds, without clamping the aorta (Fig. 2). The prosthesis was passed via a retroperitoneal tunnel and anastomosed to the left iliac artery with the standard technique. The bypass was controlled with angiography. Iliac artery flow was assessed with a 4 mm flowmeter probe (Medistim, Inc.) after its proximal occlusion.

All animals received human care in compliance with the European Convention on Animal Care and the study has been approved by our ethics committee. Values were expressed as median and range.

Results

The operation was successfully completed in 11 out of 12 animals. One animal died because of a massive hemorrhage during the proximal anastomosis construction: we were not able to insert the delivery system into the aortic hole. No leaks at the anastomotic site were detected. CO₂ insufflating pressure was 10 mmHg (range 7–12 mmHg). The mean aortic diameter was 2.6 mm (range 2.5–2.8 mm) and the mean graft flow was 144 ml/min (range 88–167 mmHg). An angiogram showed no graft kinking or stenosis. Total operative time was 58 min (range 47–68 min).

Discussion

The construction of any vascular anastomosis using the endoscopic technique is very technically demanding due to the endoscopic instruments having limited degrees of freedom causing long operative duration.
and occasionally significant blood loss. In this study we introduced a new concept that could potentially improve the surgical technique: the use of the aortic connector for the proximal anastomosis. Connectors have been developed for coronary surgery to facilitate the realization of proximal and distal anastomoses. Most of the devices are based on memory shape alloy technology and manufactured using nanotechnology. In this study we used the Symmetry aortic connector, and the anastomosis was performed in a few seconds. Even though this device has been developed for vein graft, we were able to use a PTFE thin wall graft since the nitinol was strong enough to pierce the material providing an adequate anastomotic sealing. Severe calcified aorta and an aortic wall thicker than 4 mm contraindicate the use of this connector. Aortic cross-clamps or side-clamps are not mandatory if the surgeon is skilled enough to quickly switch the aortic puncher with the delivery system.

The duration of a surgical procedure is not of primary importance, but a mean operative time of less than 1 h to treat the abdominal aorta occlusive disease could represent an important step forward in the development of fast track procedures. However, this technique has some limitations. The surgeon has to quickly switch the aortic punch with the delivery system to avoid massive bleeding. New devices seem to overcome this limitation since the aortic punch is provided with a valve that seals the aortotomy minimizing the risk of bleeding. Another limitation is in the diameter of the connector: 4 mm is too small to guarantee an adequate perfusion of an human adult lower limb. In the future, connectors up to 10 mm in diameter should be available. This procedure has to be coupled with a cross-over bypass (i.e. femoro-femoral bypass) to provide the complete revascularization of both lower limbs.

Moreover, there is still no evidence of the long-term effectiveness of the sutureless anastomosis device and few cases of early graft occlusion have been reported.

Conclusions

Videoodendoscopic descending thoracic aorta-to-iliac artery bypass using a sutureless device for proximal anastomosis is a technically feasible operation in the pig model. The use of the sutureless device to perform the proximal anastomosis dramatically reduces the technical demand of this procedure and could avoid the aortic clamp. The need of cross-over bypass and the absence of the long-term effectiveness of sutureless anastomotic devices represent some of the drawbacks of this technique.

References


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