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REVIEW

An Emergency Visceral Hybrid Procedure for Ruptured Thoraco-Abdominal Aortic Aneurysms

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Abstract Rupture of a thoraco-abdominal aortic aneurysm (TAAA) is usually lethal. Patients with contained ruptures, who reach the hospital, have traditionally been subjected to open reconstructive surgery. However, especially in older patients, open surgery has a high mortality and morbidity rate. Visceral hybrid procedures (VHPs) can provide an alternative in this high-risk patient group. We present a literature review of VHPs with a focus on acute TAAAs.

A thoraco-abdominal aortic aneurysm (TAAA) is potentially lethal. An estimated incidence of 5–10/100 000 is reported.[1,2] A prospectively included cohort of 721 patients showed a 5-year survival rate of patients with untreated aneurysms larger than 6 cm to be approximately 56%, with a yearly rupture, dissection or death rate of at least 14.1%.[3] However, elective open surgery is associated with high mortality (10% in expert centres and up to 20% in other centres) and high morbidity rates as well.[2,3] Advanced age, a Crawford type II TAAA, preoperative renal impairment, cardiac disease, cerebral vascular occlusive disease and obstructive pulmonary disease are associated with poor outcomes.[4,5] Elective surgical repair is generally considered when elective operative mortality rate is less than the yearly rupture rate of the TAAA. A Swedish registry study revealed an overall out-of-hospital mortality rate of 59% (65 patients with a ruptured TAAA). Of the remaining 41% of the patients that reached the hospital alive, only two were operated.[2] Other publications report mortality rates in the range of 26–72% after emergency repair of TAAAs.[1,5,6] After the introduction of endovascular techniques in aortic aneurysm repair, the treatment options of TAAAs have changed. Visceral hybrid procedures (VHPs) have been described since 1999.[7] This technique combines open renal and visceral bypass surgery with endovascular exclusion of the aneurysm. This avoids thoraco-phrenico-laparotomy and aortic cross clamping. Importantly, visceral and renal ischaemia times can be minimised. Although described only in small non-randomised series and a high-level evidence is lacking, this technique shows encouraging results with

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a trend towards less mortality and morbidity in elective and urgent cases.[5,8–11] We present a literature review of VHPs which a focus on acute TAAAs in order to illustrate the potential of this treatment option, especially in high-risk patients who may not be eligible for open surgery.

Literature Review

A search of the literature published between September 1999 (initial report of VHP by Quiñones[7]) and December 2008 was performed using PubMed. Search strategies using the keywords 'thoraco-abdominal aneurysm', 'endovascular' and 'hybrid' were deployed. Relevant publications were identified by reading the abstracts and an additional search through the reference list of the relevant articles was carried out. Publications were included if (1) a hybrid procedure was performed combining re-vascularisation of visceral arteries with endovascular exclusion of the TAAA; (2) follow-up longer than 30 days was reported; (3) a statement was made on mortality and morbidity following the procedure; (4) in case of heterogeneous groups, the follow-up of the VHP group had to be clear and (5) data had not been published earlier. Selection of articles and data was done by two independent reviewers. Disagreements on inclusion were solved by discussion.

Results

After the initial search was performed, 53 articles (representing 297 cases of VHPs) were identified. After exclusion of the ineligible articles, 38 remained, representing 222 cases (Fig. 1). The selected articles are summarised in Table 1. The mean age of 211 patients (no data available on 11 patients) was 65.9 years (range: 17–85 years). In 143 men and 67 women (gender was not reported in 12 cases), 186 elective, 35 symptomatic and 19 acute VHPs were performed. Of the 222 patients, 124 (56%) had undergone a central vascular procedure earlier. In most cases it was explicitly stated that the patients were deemed unfit for conventional operative repair due to congestive heart failure, ischaemic heart disease and chronic obstructive pulmonary disease. The average diameter of the aneurysm was 7.2 cm (range: 2.6–12 cm). The distribution of aneurysm type is listed in Table 2. A total of 699 bypasses were constructed. The inflow source predominantly was an iliac artery or an (previously inserted) aortic graft. The number of grafts depended on the individual anatomy and extent of the aneurysm, functionality of the kidneys and previous visceral/renal bypass surgery. After re-vascularisation of the renal arteries (304/444; 68%), the superior mesenteric artery (188/222; 85%) and the celiac trunk or its major branches (173/222; 78%), the aneurysm was excluded. The procedure was done in a single session in 73%, the remainder in two sessions. During the procedure, three patients in the one-stage group turned out to be anatomically unfit for the VHP; two of these received other treatments; the other patient died 10 days after the exploratory laparotomy due to aneurysm rupture. In nine patients of the two-stage group, the procedure was not completed. One patient refused endovascular treatment, one turned out to be anatomically unfit, the remaining seven (9%) died (four of aneurysm rupture) before the final stage could be attempted. Spinal drainage was used in 37% (69/185) of the patients; no data regarding this were available in 37 patients.

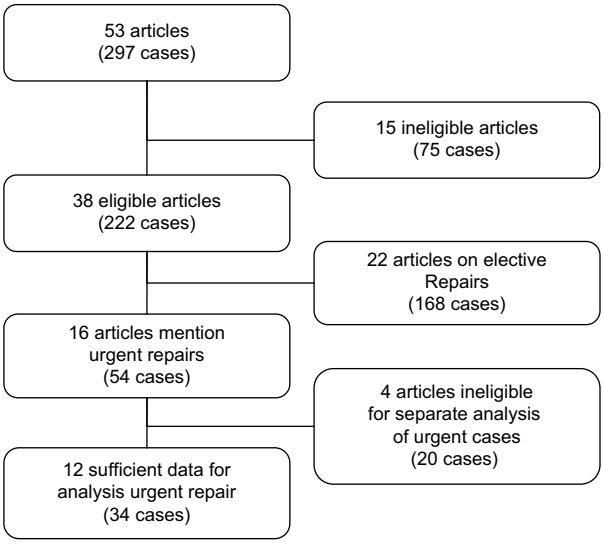

Figure 1 Diagram showing article selection process.

The 30-day or hospital mortality rate was 16% (35/222). Early deaths were mostly due to haemorrhage (12 cases), visceral ischaemia (six cases), multi-organ failure (five cases) and myocardial infarction (four cases). Conditions such as (ischaemic) pancreatitis, respiratory failure, peri-operative death (unspecified), sepsis, pulmonary embolism and sub-arachnoidal haemorrhage accounted for the other early deaths.

Postoperative complications are shown in Table 3. Only three patients needed a redo-operation for graft occlusion. In the early phase (<30days) 18 type I endoleaks (10 treated by an additional stent, one by ligation of an iliac artery and seven untreated), 16 type II endoleaks (only two needed to be coiled) and two type III endoleaks (untreated) occurred. The mean follow-up time was 13.0 months (range: 1–78 months). During this follow-up period another 18 patients died (10.4 months; range: 2–36 months). These late deaths were due to cardiac conditions ($N = 4$), ruptured recurrent aneurysm ($N = 3$), respiratory failure ($N = 3$), kidney failure ($N = 1$) and pancreatitis ($N = 1$). In six cases, the cause of death was not specified. The overall cumulative survival of the 222 patients treated with a VHP was 76% after this 13-month follow-up period.

During follow-up, there were two additional cases of type I endoleaks; one of which was treated with an additional endovascular graft. Three previously noted persistent type I endoleaks were left untreated. Of the two cases of type III endoleaks, one was treated with a stent and the two late type II endoleaks were left untreated. The follow-up data on graft patency were given in 641 out of the 699 grafts. Out of these 641, 622 grafts were patent at the last follow-up (97%).

Symptomatic and ruptured TAAAs treated with VHP

In addition, we tried to gain more insight in the results of the acutely treated patients. Therefore, we identified all reported ruptured (signs of rupture on CT scan) and symptomatic (painful aneurysm, but no signs of rupture on CT