Renal Protection Strategies When Aortic Aneurysm Repair Necessitates Renal Artery Re-Implantation: Review And A New Technique

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Abstract

Aortic aneurysm repair in the presence of renal artery ectopia may be challenging. A variety of techniques have been described to minimise intra-operative renal ischaemia. We report a case of abdominoiliac aneurysm where the single right kidney received its dominant arterial supply from the aneurysmal left common iliac artery. We harvested the patients varicose left long saphenous vein to use as a temporary intraoperative shunt between the right brachial artery and the right kidney, incurring a total renal ischemia of 12 (5+7) minutes. The patient recovered well with no interruption of renal function. We suggest this new technique may prove advantageous in selected cases.

INTRODUCTION

Anomalies of renal artery anatomy may complicate the repair of Abdominal Aortic Aneurysms (AAA) in rare cases. Multiple renal arteries, though common, involve the aneurysm sac infrequently and their division rarely compromises renal function. Congenital pelvic kidneys may take their main arterial supply from iliac arteries whilst transplanted kidneys invariably do so. Arterial anomalies associated with horseshoe kidneys (affecting 0.25% of the population) [1] are complex and variable but there is usually at least one major branch arising from the aorta in the normal position above the area likely to be affected by an aneurysm.

When the aortic repair does not include the renal artery ostium (as with transplanted kidney), ischaemic times of 30-45 minutes can be achieved and renal function is usually preserved [2]. When the operation is certain to necessitate separate aortic and renal artery re-anastomosis the duration of ischaemia may be unpredictable. This dilemma is particularly taxing when there is a solitary kidney with evidence of impaired function. Available protective strategies then include temporary intra operative shunting, extra-anatomic bypass grafting [3,4,5,6,7] or perfusion cooling of the affected kidney to mitigate the effects of ischaemia.

CASE REPORT

A 71 year-old man was referred for assessment of an asymptomatic aortic aneurysm, detected at the time of renal ultrasound for the investigation of chronic hypertension. Renal function was impaired (Creatinine 197 umol/L). He also had a history of coronary artery bypass 10 years earlier. Physical examination revealed a large palpable AAA and normal lower limb pulses. An incidental finding was a varicose long saphenous vein in the left leg.

CT scan of the aorta showed a 6.4cm (AP) x 7.6cm (transverse) AAA extending into the Common Iliac Arteries (CIA) bilaterally. The left kidney was atrophic with no detectable arterial supply. The right kidney appeared normal but an anomalous right renal artery was noticed to be perfusing more than 90 percent of the renal cortex, which on further scanning was shown to arise from the aneurysmal left CIA. (Fig a,b)

Figure 1

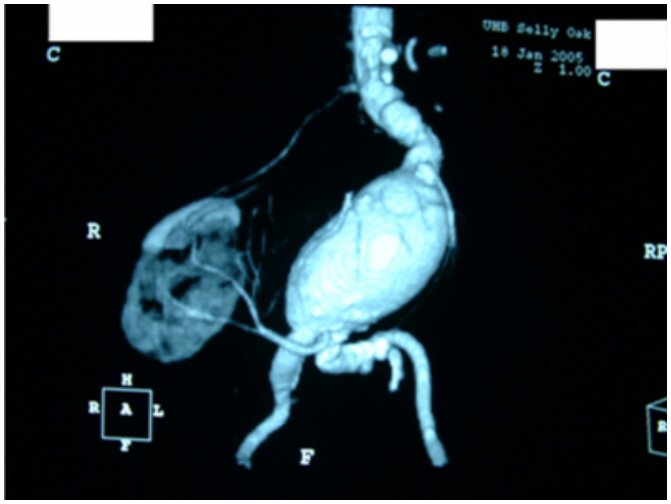
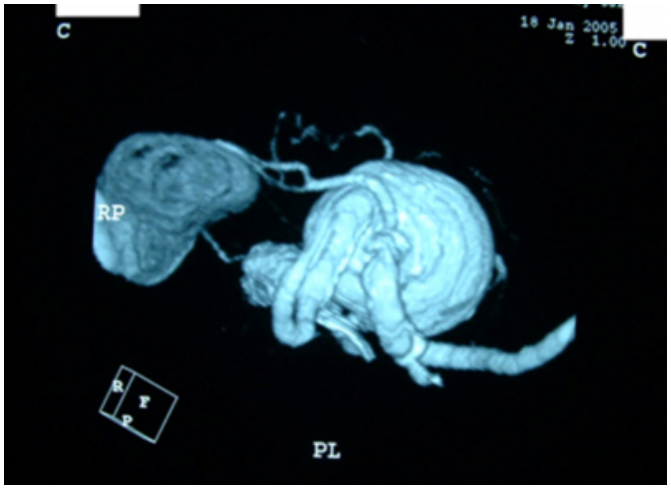


Figure 2



The patient was well hydrated prior to surgery and Furosemide infusion was used perioperatively to maintain good urine output. At laprotomy the right renal artery was found stretched anteriorly across the aneurysm sac arising from the aneurysmal left CIA. Following preliminary dissection of the neck of the aneurysm and the iliac bifurcations, the varicose left long saphenous vein was harvested from groin to knee and an end to side anastomosis was then made between this vein and the right brachial artery, creating a valve-free pulsatile conduit of 40-50 cm length. The right renal artery was then clamped and divided in front of the aneurysm its divided end was anastomosed to the end of the vein conduit (with a clamp time of 5 minutes), restoring pulsatile blood flow to the kidney. The vein graft passing between the right arm and the right kidney was covered with moist sterile towels and protected from compression and kinking. The aneurysm was then repaired with a polyester bifurcated aortic graft with distal anastomoses to the iliac bifurcations, which required local endarterectomy. Finally the saphenous vein shunt was divided 5cms from the renal artery and re-implanted onto the right limb of the aortic graft incurring a further 7 minutes of clamp time. The urinary flow remained unchanged throughout the procedure. The redundant portion of the vein was then ligated close to the brachial artery and all wounds were closed routinely.

The patient's postoperative course was essentially unremarkable. Furosemide infusion was stopped next day and a satisfactory urine output was maintained throughout. Creatinine peaked on day-2 at 215 umol/L and came down to 176 umol/L on day-6 of the operation. There were no complications relating to the right arm or left leg.

DISCUSSION

Congenital anomalies of the genitourinary system are common and include developmental variations in the number and anatomical origin of the renal arteries. Multiple and ectopic renal arteries may pose a challenge when contemplating AAA repair. The finding of a renal artery crossing the midline has only previously been reported in the context of crossed renal ectopia [8].

There is a high incidence of early postoperative dialysis in patients with established renal impairment who undergo AAA repair and this may be associated with a poor outcome. [1]

The techniques described in the literature to avoid renal ischaemic injury when repairing AAA in the presence of pelvic or transplanted kidney fall into three main categories.

NO PROTECTION

Harris et al. published a case series [2] where prolonged ischaemia to a transplanted kidney was achieved (range 35-40 minutes) with no patient requiring postoperative dialysis after aortic surgery. This was earlier described by Lacombe in 1986[9],who used double proximal aortic clamping to allow division of the AAA neck without opening the aneurysm sac, thus maintaining some renal perfusion through lumbar and iliac collaterals. In all these cases the arterial supply to the transplanted kidney did not arise from the aneurysmal sac. A separate anastomosis was therefore not required.

COLD RENAL PERFUSION

Renal perfusion with cold electrolyte solutions (i.e. Ringer's

lactate, PBS, Citrate solutions) has been employed to limit ischaemic injury, alone or in combination with the double clamping technique described by Lacombe. Renal auto-transplantation, with or without re-implantation of the ureter has also been described [10] and is particularly useful when ex-vivo bench surgery is required, either to correct arterial pathology or to resect tumour. However ureteric re-plantation is best avoided in the context of prosthetic aortic grafting.

Problems with all these techniques include complexity, unpredictable efficacy and the risk of circulatory overload, though this can be avoided by venting the renal veins. In general satisfactory results are reported.

SHUNTS

A variety of shunting procedures, both temporary and permanent have been described. These included permanent axillo-bifemoral graft [3], aorto iliac Gott shunt [4], axillo-femoral Gott shunt [5], temporary axillofemoral graft [6], combination of double clamping then temporary perfusion using a Javid shunt [7]. These techniques have the disadvantages of complexity or of incurring significant period of renal ischaemia.

None of these series (with the exception of O'Hara et al. [1]) reported pre-existing renal impairment.

As far as we are aware, this is the first report of a case of an autologous vein graft being used as a temporary brachio-renal shunt during the repair of a complex AAA. Of the previously reported techniques, none could have permitted the short periods of ischaemia we were able to achieve. We were also able to avoid the potential risk of circulatory overload with in-situ cold perfusion in a patient with limited cardiac reserve.

CONCLUSION

Careful assessment of renal artery anatomy is a prerequisite of elective AAA repair. When one or more dominant renal arteries arise within or distal to the aneurysm sac, there will inevitably be some degree of interruption of blood flow during aneurysm repair. Selecting an operative strategy that minimises the time of renal ischaemia requires detailed pre-operative evaluation and a readiness to select from the wide variety of approaches that have been described.

The technique reported here, utilising temporary intra-operative brachio-renal shunting using an autologous long saphenous vein (that was conveniently large and incompetent) proved highly appropriate for our patient. We suggest that this approach represents a useful and innovative alternative to existing options, particularly in the presence of pre-existing renal impairment.

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