DISCUSSION

Dr Christian de Virgilio (Torrance, Calif). First off, I want to thank the Western Vascular Surgery Society for the opportunity to comment on Dr Ham and Weaver’s presentation. Dr Ham, for an excellent presentation. Dr Ham describes surgical repair of 24 kidneys with complex renal artery pathology in 23 consecutive patients over a 25-year period. Using evi vivo cold preservation techniques, complex renal artery lesions were repaired and reconstructed safely with low perioperative morbidity and no mortality, and an impressive 5-year primary patency rate of 94%. There was only one renal artery occlusion, and 94% of patients with pre-existing HTN were either cured or had statistically significant improvement in BP and antihypertensive medication requirements. A unique and important aspect of this paper, as compared to other smaller series, is the long-term follow-up, which was a mean of 44 months, as well as the careful documentation of not only creatinine, but also creatinine clearance, kidney length, and cortical thickness. I would challenge those who attempt these complex aneurysms via an endovascular approach to provide similar meticulous follow-up. The USC group should be commended for excellent outcomes. I had several questions:

1) You mentioned in the manuscript that you utilized routine intraoperative completion duplex scan to assess the adequacy of the repair. What criteria did you use? And, what was your approach to provide similar meticulous follow-up. The USC group should be commended for excellent outcomes. I had several questions:

2) Though it was only one case, would you use cephalic vein for RAAA. Can you comment on the laparoscopic approach to provide similar meticulous follow-up. The USC group should be commended for excellent outcomes. I had several questions:

3) Recently, there have been a few cases series utilizing laparoscopic nephrectomy with ex vivo repair and pelvic reimplantation for RAAA. Can you comment on the laparoscopic approach?
4) Given that the experience has spanned 25 years, how has your patient selection and operative technique evolved over that time, and if so, how?

5) It is unclear from the manuscript how many of the renal artery aneurysms were asymptomatic, and what size they were. What size criterion do you utilize to operate on an asymptomatic RAA? And, will that size cutoff change 15 minutes from now?

Dr Sung Wan Ham. Thank you, Dr de Virgilio, for your comments and kind words. To address your first question regarding the use of intraoperative duplex to assess the adequacy of repair, we look for velocity shifts and color-flow disturbances across the arterial anastomosis as well as inspecting flow in the renal vein. A decision to revise one or more anastomoses is dependent on all these factors. In general, anastomoses with velocity shifts of 3:1 or greater that are associated with a B mode defect and color-flow disturbance would be candidates for revision. The decision to reinstitute cold perfusion is made if revision is anticipated to exceed 30 minutes.

Regarding your second question, our experience with cephalic vein as renal artery conduit reminds us why the cardiac surgeons stopped using them for coronary artery bypasses. The profound intimal hyperplastic reaction we observed in a relatively short period of time was likely due to the high-flow rates that are seen in the aortorenal position. Therefore, in the future, we will likely use prosthetic over cephalic vein for aortorenal bypasses in patients with no suitable saphenous vein.

As to your third question, there have been a few case reports and small series successfully utilizing laparoscopic nephrectomy modeled after live-donor transplant techniques with back bench ex vivo reconstruction and heterotopic reimplantation in to the pelvis. Claimed advantages of this technique include smaller incisional morbidity and optimal surgical visualization at the back table allowing meticulous dissection and complex reconstruction of branch vessels. Other theoretic advantages include quicker recovery and technically easier access for duplex surveillance. However, compared to replacement of the kidney back into the renal fossa, the advantages of laparoscopic nephrectomy and pelvic autotransplantation must be traded for an additional anastomosis between the ureter and bladder and its associated complications of leak or stricture formation. Furthermore, although there is nothing inherently wrong with using the iliac vessels as arterial inflow, given the relatively young age of the patients in our cohort, who had a mean age of 45 years old, theoretical progression of atherosclerotic occlusive disease of the iliac vessels over the remainder of their lifetime may compromise the renal reconstruction. Since the major advantage of ex vivo reconstruction is the extended cold ischemia time, which allows for precise branch vessel reconstruction, we preferentially replace the kidney in its orthotopic position with use of standard aortic attachment sites.

Regarding the question about our patient selection and operative techniques over time, our patient selection has been rather constant over the years. Although more sophisticated catheter-based techniques are now available to address these lesions, we feel that open repair provides the best chance for renal preservation in the long term. That is why we have not extended the indication for repair to endovascular techniques in this highly select group of patients. Over the past 25 years, there have been no major modifications to our operative techniques. Our preference for replacement of the reconstructed kidney to its original position in the renal fossa over autotransplantation in to the pelvis was adopted early on in our experience and has not changed over time.

As to your last question, of the 24 renal arteries treated, 19 (79%) were aneurysmal. Of the 19 renal artery aneurysms, eight (42%) of them were asymptomatic. The average size of asymptomatic renal artery aneurysms was 1.9 cm and 2.9 cm for symptomatic aneurysms. All patients who had asymptomatic aneurysms were also hypertensive. Generally speaking, our indications for renal artery aneurysm repair are tailored to individual patient presentation, with surgical repair reserved for asymptomatic aneurysms $\geq$2 cm in size and those in women of child bearing age. That said, all patients in our series with asymptomatic aneurysms had a mean aneurysm size of only 1.9 cm but had another indication for surgery.