thrombus. Therefore, our results might not be equally reproducible everywhere. We encourage further multicenter studies with larger patient pool on this topic.

CONCLUSION

In a subset of patients with RCC and tumor thrombus, IVC ligation is required to achieve negative surgical margins. This retrospective case control study compared IVC ligation without reconstruction with IVC thrombectomy. Although patients undergoing IVC ligation may experience a more complicated immediate and short-term postoperative course, they have similar long-term outcomes in terms of kidney function, pulmonary embolism, lower extremity edema and survival.

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EDITORIAL COMMENTS

This paper raises 2 important questions that merit further discussion.

What options exist for IVC reconstruction?

a) Suture cavoplasty. To remove IVC thrombus, a cavotomy must be made and repaired. Running suture repair with polypropylene is all that is typically required.

b) Patch cavoplasty. If the IVC is narrowed greater than 30% to 50% a patch cavoplasty is necessary to avoid IVC stenosis, which leads to lymphedema and thromboembolism. This is done using autologous (if on bypass) or bovine pericardium, though other options exist (eg expanded PTFE).

c) IVC replacement grafting. If IVC damage is extensive (e.g. >75% circumference or long), replacement should be considered. Ringed PTFE grafts are used and as the authors point out are prone to thrombosis. Recently, we have used cadaveric aortic grafts and outcomes appear better in the short-term.

When should the IVC be ligated/resected instead of reconstructed?

a) Extensive infrarenal bland thrombus. If the infrarenal IVC is thrombosed with benign clot, IVC ligation is reasonable to prevent massive thromboembolism (fig. 1C,E). Suture ligation or vascular stapling are options. A completely obstructed IVC usually has mature collateral venous outflow paths that prevent lymphedema.

b) IVC wall invasion. IVC wall invasion should be suspected when a “fat cava” (IVC diameter greater than 3.5 cm) is present or the IVC wall signal is lost on magnetic resonance imaging. If invasion is limited, patch cavoplasty is usually possible. If extensive invasion and a right sided renal tumor, IVC resection is often the safest approach since the left renal vein can be safely ligated (fig. 1F). Left sided renal masses are more complex because the solitary right kidney needs venous drainage. If

the infrarenal IVC is devoid of thrombus, then suprarenal IVC resection is possible (fig. 1D). If the infrarenal IVC is thrombosed, IVC reconstruction is required.

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In this retrospective, single institutional, case-controlled study, the authors matched 26 patients with renal cell carcinoma who underwent inferior vena cava ligation with 52 RCC patients who underwent IVC thrombectomy based on preoperative renal function, tumor stage and intraoperative thrombus level. The authors reported no difference in overall and major complications at 1 month, no difference in mean renal function decline at 18 months and no difference in cancer-specific and all-cause mortality between groups. The Mayo clinic has previously reported on the feasibility of IVC ligation and/or resection in appropriately selected RCC patients with extensive bland thrombus with immediate risk of pulmonary embolism, IVC tumor wall invasion or extensive tumor thrombus (reference 7 in article). Although renal insufficiency and lower extremity edema are the most common postoperative complications due to impaired venous drainage of the remaining kidney and/or lower extremities,[1] the present study reported similar rates of these complications compared to traditional IVC thrombectomy. This is likely secondary to the presence of sufficient and adequate collateral circulation for venous drainage due to chronic IVC occlusion. Therefore, accurate and precise preoperative imaging to assess the degree of venous obstruction within the IVC and to help with differentiation between bland and tumor thrombus is crucial to achieving a surgical outcome with minimal morbidity and adequate oncological control.[1] Use of immunotherapy with checkpoint inhibition may potentially play a role in the future in reducing tumor thrombus size before surgery to preserve IVC length.[2]

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