# A new surgical approach for nephroblastoma with a tumor thrombus in the lower vena cava reaching the right atrium

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#### Dear editor:

Malignant renal tumors account for 6% of all pediatric tumors, with Wilms' tumor (WT) being the most prevalent<sup>1</sup>. Tumor emboli (TE) invade the inferior vena cava (IVC) and reach the right atrium in 5-10% of patients<sup>2</sup>. IVC thrombectomy is a complex procedure with a surgical complication rate of 16.2–  $20.3\%^3$ . Preoperative chemotherapy can reduce tumor and thrombi volumes and improve patient survival. Preoperative chemotherapy and delayed surgery are usually recommended to reduce the size/extent of the TE and minimize surgical complications<sup>4</sup>; nevertheless, TE adhesion to the vascular wall (VW) is common and can result in fracturing of thrombi and difficulty in removing emboli. The right atrium and IVC are opened and TE are removed during cardiopulmonary bypass (CPB) and deep hypothermic circulation arrest (DHCA) <sup>5, 6</sup>. Invasion of the VW by tumor thrombi may necessitate partial resection and repair. However, this can increase intraoperative blood loss and transfusion rate and carries a risk of disseminating intravascular coagulation and tumor spread<sup>7</sup>. Small movable thrombi can be removed through a buttonhole in the vessel, while larger thrombi may require more extensive cavotomies, and adherent thrombi require partial resection/reconstruction. However, the use of bioartificial blood vessels or vascular patch materials carries a risk of thrombosis and infection, and autologous vascular transplantation can cause damage<sup>8</sup>. As children grow, they require patch materials with growth potential. Falciform ligament (FL) is useful for repairing the IVC during liver surgery. FL is easy to obtain and adjust in size/shape. Compared to polyester/polytetrafluoroethylene, vascular repair with FL is associated with a lower risk of thrombosis and graft infection, and no risk of rejection or need for therapeutic anticoagulation<sup>9, 10</sup>.

There are currently no reports on tumor thrombus (TT) removal from the IVC and right atrium without CPB and CHCA. Here, we report a novel pediatric surgical technique wherein the right atrium was incised before thrombectomy was performed without CPB and DHCA, and FL was used to repair the IVC.

A 5-year-old girl was diagnosed with WT with an IVC TT. Tumor size was reduced after four cycles of the CCCG-WT-2016 chemotherapy regimen (from  $11.3 \times 8.5 \times 12.2$  cm to  $3.8 \times 5.0 \times 6.2$  cm). The patient then underwent right radical nephrectomy and thrombectomy without CPB and DHAC. An intraoperative ultrasound showed that the TT had invaded the IVC and entered the pericardium over the second hepatic hilum, moving 1.5 cm into the right atrium. (Fig. 1). The left renal vein and IVC were cut longitudinally, and the thrombi in the left renal vein, IVC, and right atrium were removed. The TT adhered to the blood vessel wall and into the surrounding branches showing drill-like growth, which was fully removed. The longest vascular occlusion time was 33 min. Continuous sutures with 4-0 silk were used to repair the blood vessels. Complete resection of the right renal tumor, perirenal fat sac, and ureter was achieved. Stenosis of the IVC blocked blood flow, and the liver was enlarged. Therefore, blood flow could not be returned to the abdominal cavity, and the patient's blood pressure decreased to 40/30 mmHg. The diaphragm was reopened and the suture

was removed from the right anterior stenosis of the IVC. The right vessel wall of the IVC was found to have been eroded by the tumor and was not amenable to suturing. A 3-cm long and 1-cm wide section of the FL of the liver was resected and used to suture the forearm of the IVC continuously with 5-0 silk to repair the VW. Upon release of the clamp the IVC filled, the blood supply was restored, and the swelling/congestion of the liver was relieved. The patient made a full recovery and was discharged 10 days later without complications. Over the next 3 years of follow-up, the patient developed normally into a healthy school-age child.

Blocking the right atrium below the level of the coronary artery, below the sinoatrial node, can thus be used to open the right atrium and remove TTs without CPB or DHCA, which offers a viable new surgical protocol. Fibrosis of blood vessels and TTs caused by multiple courses of chemotherapy in the IVC, and adhesion of these TTs, can lead to thickening and brittleness of the blood vessel walls and stenosis of the lumen. This can necessitate TT removal and suturing of the VW after a longitudinal split, which can in turn lead to further stenosis of the lumen, resulting in reflux disturbance of the hepatic venous system and systemic circulatory system below the second porta hepatis. The body adapts slowly and establishes systemic collateral circulation in the process of tumor growth; therefore, the enlargement and reconstruction of the vascular segment of the IVC at the diaphragm level can solve the problem of blood return obstruction. In contrast to more rigid materials, the FL is a strong double-sided peritoneum with excellent tension resistance and smooth surfaces suitable for facing blood vessels. It is easy to obtain, its removal has no deleterious effects, and it is, therefore, an ideal material for repairing the IVC. This case demonstrates that this surgical technique is safe and effective.



Figure 1. Intraoperative ultrasound images. (A-D) The TT in the IVC; the lowest 2 cm below the level of renal vein confluence, the upper boundary reaches the right atrium, close to the posterior wall of the right atrium, approximately 1 cm long. (E-G) TT in the right renal vein fills the lumen; TT can be seen in the trunk of the left renal vein and left adrenal vein. The TT in the left adrenal vein was approximately 1 cm long, but no TT was found in the renal vein at the left renal hilum.

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#### **Conflicts of interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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