CASE REPORT

Role of transoesophageal echocardiography in renal cell carcinoma: a brief review

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SUMMARY

Transoesophageal echocardiography (TOE) is regularly used in cardiac and also increasingly in non-cardiac surgeries. It has a leading role in the perioperative management of renal cell carcinoma with tumour extension into inferior vena cava. We report two cases in which TOE was of immense help for patient management. This report highlights the two cases where intraoperative TOE was of immense help to establish diagnosis, to modify surgical plan, to guide the surgeon during clamp placement, to monitor cardiac function, to rule out tumour embolism and to confirm the complete removal of tumour thrombus.

BACKGROUND

Renal cell carcinoma (RCC) could present as a renal mass with tumour thrombus extending into inferior vena cava (IVC) or right atrium. The surgical procedure may vary depending on the tumour extension, which would significantly affect the patient outcome.^{1–3} The transoesophageal echocardiography (TOE) plays a crucial role in perioperative management of these patients.⁴ This report enumerates and emphasises the perioperative use of TOE in these patients.

CASE PRESENTATION

Case 1

Fifty-seven-year-old woman complained of decreased flow of urine with intermittent burning micturition for 6 months for which she consulted the urologist. The patient did not have history of fever, pus, blood or stone in urine. Also, there was no history loss of appetite, loss of weight or

vomiting. On clinical examination, abdomen was soft with no organomegaly. The patient was known to have hypertension and diabetes on regular treatment.

INVESTIGATIONS

Case 1

Her preoperative blood investigations were normal. Ultrasound and CT abdomen showed a right renal mass extending into IVC. Positron emission tomography scan revealed a metabolically active mass lesion arising from the anterolateral cortex of the midpole of the right kidney with tumour extending into the right renal vein, the IVC and along the suprahepatic segment of the IVC up to the right atrium. The patient was staged to have T₄N₀M₀ disease. The routine preoperative transthoracic echocardiography (TTE) did not reveal any evidence of tumour extension into the right atrium.

TREATMENT

Case 1

The team of urologists, cardiac surgeons and anaesthesiologists decided to perform intraoperative TOE and proceed for surgery based on TOE findings. Cardiopulmonary bypass (CPB) machine and the cardiac team were ready in case of haemodynamic instability because of tumour embolism. Anaesthesia was induced with fentanyl, thiopentone and vecuronium. The trachea was intubated, and the lungs were ventilated with isoflurane in 40% oxygen. Anaesthesiologist inserted the TOE probe and examined the proximal extension of the tumour. The midesophageal (MO) four-chamber view of TOE revealed the tumour, which was protruding into the right atrium (see online Supplementary file 1). Hence, the surgical plan was to perform both laparotomy and partial sternotomy under CPB for right radical nephrectomy along with tumour thrombus excision. Surgery commenced with laparotomy by urology team through a midline incision. Right kidney was mobilised, and renal artery and ureter were ligated and cut. Both renal veins and IVC were defined. Through partial sternotomy, pericardium was opened. On systemic heparinisation, aorta, superior vena cava and infrarenal IVC were cannulated. After the initiation of CPB, right atrium was opened. Unusually, there was increased venous return to right atrium. Hence, the renal vein was clamped for 18 min and portal vein for 20 min to facilitate surgical access. Core cooling was done

Figure 1 This figure shows the excised surgical specimen (case 1) of renal cell carcinoma of right kidney (solid arrow) along with tumour thrombus (hollow arrow).

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Figure 2 This figure shows the role of TOE in renal cell carcinoma with tumour thrombus. TOE, transoesophageal echocardiography.

up to 18°C. On opening the RA, tumour thrombus was found. Tumour thrombus was pushed inside the IVC, and RA–IVC junction was clamped. IVC was opened adjacent to right renal vein, and tumour along with extension was retrieved (figure 1). After the IVC was approximated, rewarming was started. Haemostasis was secured in the abdomen and thorax. Residual tumour extension into the IVC and right atrium was ruled out by TOE once the patient was off CPB (see online supplementary file 2). Remaining intraoperative period was uneventful.

OUTCOME AND FOLLOW-UP

Case 1

At the end of surgery, patient was shifted to intensive care unit (ICU) for elective ventilation. Patient was extubated on first postoperative day and subsequently discharged. Histopathology of the specimen revealed clear cell renal carcinoma. Presently, the patient is on regular follow-up with no evidence of any metastatic spread.

CASE PRESENTATION

Case 2

A twenty-one year-old male presented with right flank pain for 7 days, high-grade fever and vomiting for 1 day. The patient did not have history of fever, pus, blood or stone in urine. Also, there was no history loss of appetite and loss of weight. He did not give any history of trauma. The clinical examination was unremarkable. Based on the signs and symptoms, urinary tract infection with pyelonephritis was suspected.

INVESTIGATIONS

Case 2

Routine urinary tests did not show any pus cells, and culture was sterile. On evaluation, CT abdomen revealed that the tumour was extending from suprahepatic IVC to bilateral femoral vein. The patient was staged to have T₃N₀M₀ disease. Based on the prior experience, it was decided to perform TOE preoperatively. The lower oesophageal hepatic venous view of TOE also confirmed the proximal extent of tumour thrombus (see online Supplementary file 3).

TREATMENT

Case 2

It was decided by the team of urologists, cardiac surgeons and anaesthesiologists to go ahead with surgery without CPB, with intraoperative TOE monitoring. General anaesthesia with endotracheal tube along with invasive monitoring was planned. After induction of anaesthesia, the anaesthesiologist inserted the TOE probe. Postinduction, TOE (lower oesophageal hepatic venous view) ruled out the intracardiac extension (see online Supplementary file 3). The lower oesophageal hepatic venous view is obtained at the angle of 20°, while the TOE probe is rotated

towards right.⁵ Surgery commenced with laparotomy, and the urologist mobilised the right kidney. The cardiac surgeon had applied the suprahepatic IVC clamp under real-time TOE guidance. After suprahepatic IVC clamping and liver mobilisation, right radical nephrectomy was done. Distal extension of thrombus was retrieved through infrarenal cavotomy with bilateral common iliac and femoral venotomy. The suprahepatic IVC clamp was applied for 22 min. Postclamp release, patient had bradycardia and hypotension. This was managed by vasopressors, atropine and infusion of volumes. Simultaneously, we had ruled out the presence of pulmonary embolism by TOE. Later, the presence of any residual tumour in IVC was also ruled out by TOE monitoring. (Supplementary file 4)

OUTCOME AND FOLLOW-UP

Case 2

Postoperatively, patient was shifted to ICU, electively ventilated and was extubated on first postoperative day. Histopathology revealed leiomyosarcoma. The patient was put on adjuvant chemotherapy. He developed lung metastasis and is currently on follow-up.

DISCUSSION

Tumour thrombus in RCC is classified depending on the level of the thrombus such as extension into renal vein (level I), infrahepatic IVC extension (level II), retrohepatic IVC extension (level III) and into right atrium (level IV). Level III is subclassified into thrombus extending below major hepatic veins (IIIa), reaching the ostia of major hepatic veins (IIIb), above the hepatic veins but below diaphragm (IIIc) and supra hepatic, supra diaphragmatic (IIId). The importance of TOE in the management of RCC with levels III and IV tumour extension is well established (figure 2).^{6,7} The first and foremost role is to define the extent of tumour thereby helping to decide the surgical plan. Even though the cardiologist could have performed the TOE preoperatively, it was not done in the first case, as the cardiologist was convinced with the findings of TTE. Hence, it was decided to modify the surgical plan based on intraoperative TOE findings. The tumour extension into right atrium diagnosed by intraoperative TOE necessitated the surgery under CPB. We postulate two reasons for the non-detection of tumour thrombus in the right atrium by preoperative TTE. One cause could be the time gap between the performance of TTE and the surgical procedure. As these tumours are notorious for rapid growth, it is possible for the tumour to have extended into the right atrium in the 2-week time period between TTE and surgery. Also, TOE is superior to TTE in detecting right atrial mass.⁸ Erdemli *et al*⁹ also encountered a similar incident where the TOE detected right atrial extension of tumour thrombus which was not diagnosed by TTE 2 days prior to surgery. Based on the experience from the first case, preoperative TOE was performed in the second case. This confirmed that the tumour was not extending into the right atrium and hence decision was taken to perform surgery without CPB.

The second important role is during application of suprahepatic clamp, which is guided by real-time TOE monitoring. Inadvertently applying the clamp to a portion of IVC with thrombus can result in embolisation. In these patients, sudden hypotension following IVC clamp could be due to reasons like tumour embolism or decreased venous return that can be well differentiated by TOE. Tumour embolism is recognised by disappearance of tumour head in the IVC, appearance of thrombus in pulmonary arteries and right atrial and right ventricular dilatation. Decreased venous return results in decreased left

Learning points

- ▶ Transoesophageal echocardiography (TOE) should always be performed preoperatively in patients of renal cell carcinoma with inferior vena cava (IVC) extension.
- ▶ This will detect intracardiac extension of thrombus helping to decide surgical plan.
- ▶ TOE helps in troubleshooting the cause of haemodynamic instability in this major surgery.
- ▶ This will guide the surgeon to choose the clamp site avoiding the thrombus.
- ▶ TOE also rules out residual IVC thrombus.

ventricular preload, which is recognised by small left ventricular size with kissing walls. The pulmonary artery can be viewed by TOE in the MO ascending aorta short-axis and long-axis views.

Lastly, towards the end of surgery, TOE helps to rule out the presence of any residual tumour thrombus in IVC. Oikawa *et al*¹⁰ used TOE to guide the placement of Fogarty catheter proximal to IVC thrombus. Burbano *et al*¹¹ used TOE to diagnose the residual IVC thrombus.

There are several views suggested for TOE monitoring. The initial assessment of tumour extension is done in MO two-chamber view, four-chamber view or lower oesophageal (LO) hepatic venous view. For monitoring the tumour embolism, the LO hepatic venous views or four-chamber view may be preferred. Guiding the application of IVC clamp is done by LO hepatic venous view.

To conclude, TOE is a valuable tool to know the extent of tumour thrombus, to decide the surgical plan, to guide the surgeon during clamp placement, to monitor tumour embolism, to diagnose embolism by disappearance of tumour head and appearance of thrombus in pulmonary arteries with signs of right heart dysfunction and to rule out residual tumour thrombus.

Contributors All authors were involved in the case management and writing the manuscript. CRT had written the manuscript. RM and SCBV had edited and modified the surgical details. CRT was the anaesthesiologist. RM was the urologist. SCBV was the cardiovascular surgeon. All authors have read the manuscript and accepted for submission.

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