Laparoscopic radical nephrectomy in the presence of a duplicated inferior vena cava

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KEY WORDS

laparoscopic nephrectomy ◗ IVC duplication ◗ IVC anomalies

ABSTRACT

Inferior vena cava (IVC) anomalies are often asymptomatic but have considerable clinical implications during retroperitoneal surgery. While laparoscopic radical nephrectomy (LRN) has become standard of care, retroperitoneal vascular injury remains one of the more common complications. Thorough knowledge of vascular anomalies enables the surgeon to appropriately plan the operative strategy and minimize intraoperative complications. We present a case of a duplicated inferior vena cava diagnosed by computer tomography and our management of it during left sided LRN.

INTRODUCTION

Laparoscopic nephrectomy has become the standard of care for patients undergoing radical nephrectomy for malignancy. Despite increased experience with laparoscopy, vascular injury still remains a common intraoperative complication occurring in 2.3% of cases [1].

Congenital anomalies of the inferior vena cava (IVC), while infrequent, are extremely diverse in nature. Advancements and frequency of helical computed tomography (CT) imaging have led to increased detection of these IVC anomalies [7]. Identification of these anomalies before retroperitoneal surgery is extremely important to avoid vascular injury and conversion to open surgery. We describe a patient undergoing laparoscopic left radical nephrectomy for renal cell carcinoma with a duplicated IVC.

CASE REPORT

A fifty-four year old man with a past medical history significant for hypertension presented with new onset gross hematuria. There was no history of flank pain, weight loss, fever, lower urinary tract symptoms, or trauma. The patient underwent a multiphase helical CT scan of the abdomen and pelvis revealing a 5.3 x 5.4 cm upper pole solid enhancing mass with invasion into the collecting system. There was no lymphadenopathy or vein thrombus present. The right infrarenal and suprarenal IVC was normal in size and character. A second left-sided IVC was visualized receiving drainage from the left common iliac vein and terminating at the left renal vein, which had a normal pre-aortic trunk as it drained into the right IVC. The left-sided IVC had an equal size to the right infrarenal IVC indicating that this was a type I IVC duplication [2]. Figure 1 is a CT image which illustrates the aberrant anatomy found in our patient.

Laparoscopic left radical nephrectomy using the transperitoneal technique was undertaken using a standard 4 trocar placement with diamond configuration. Upon hilar dissection, the left IVC could be seen joining the left renal vein. The gonadal vein entered at the junction of the IVC and renal vein and the left adrenal vein emptied into the left renal vein proximal to the junction with the left IVC. The left gonadal vein was stapled using a 45 mm endovascular stapler (Ethicon™ endosurgery, Cincinnati, Ohio). The renal vein was then mobilized and retracted superiorly, exposing the renal artery, which was skeletonized. The renal artery was then divided on the aorta using a 45 mm endovascular stapler (Ethicon™ endosurgery, Cincinnati, Ohio). The venous anatomy was then dissected completely to identify the left renal vein, left IVC, and adrenal vein.

The 45 mm endovascular stapler (Ethicon™ endosurgery, Cincinnati, Ohio) was applied across the left renal vein ensuring that it was lateral to the left IVC, but medial to the left adrenal vein so as to include the adrenal in the specimen. No other vascular anomalies were noted at the time of surgery. The final pathology returned as renal cell carcinoma, conventional type, clear cell morphology, Fuhrman grade 2, 6.5 cm in diameter, Stage T1b, and negative margins.

DISCUSSION

Congenital anomalies of the IVC have been reported since the 18th century. The formation of the IVC occurs in the 6-8th week of gestation from 3-paired veins, which include the posterior cardinal, subcardinal, and supracardinal. These veins can regress and anastomose in a variety of configurations resulting in varied IVC anatomy [3, 4]. During normal development, the right-sided supracardinal vein becomes the infrarenal IVC. The left supracardinal vein helps to form the lumbar veins caudally before eventually regressing. Persistence of the left supracardinal vein can either lead to a left IVC if the right supracardinal vein regresses or to a duplicated IVC if the right supracardinal remains. Persistence of the left and right supracardinal veins can occur as a continuum with three known varieties of IVC duplication. Our case exemplified a normal caliber of both the left and right IVC, Type I as described by Natsis et al., but it is possible to have a narrowed left IVC with a normal right-sided caliber or bilaterally narrowed IVCs [2].

With increasing experience, laparoscopic radical nephrectomy (LRN) has become the standard of care for T1-T2 renal tumors. Despite increasing experience, significant complications and risks still exist. Vascular injury, occurring in 2% of cases continues to be one of the most common and troublesome intraoperative complications during LRN. Aberrant vasculature can increase this risk, especially in laparoscopy where the magnified view decreases peripheral vision. In addition, a small amount of venous oozing can also impair vision. In both type II and type III IVC duplication the left IVC is decreased in size compared to the normal caliber and this small caliber vessel can be mistaken for a lumbar vein or a gonadal vein. On CT scan it may also be confused as a retroperitoneal lymph

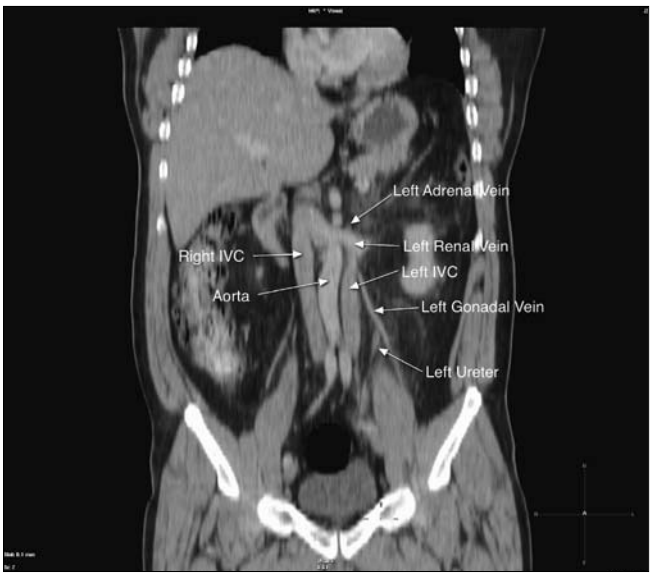

Fig. 1. CT reconstruction demonstrating dual IVC and left renal vein with tributaries. Note the left ureter running from medial to lateral crossed by the gonadal vein on the left. The left renal vein can be seen crossing anterior to the aorta to join the IVC on the right side. The left renal vein is joined by the left sided IVC, adrenal and gonadal veins. Lumbar veins were present but are not visible in this image.

node. Since the left IVC is the direct recipient of the left sided iliac venous return, inadvertent ligation would lead to significant venous congestion and complications. Furthermore, when a venous anomaly is encountered, the surgeon must be suspicious of other possible anomalies. Multiple renal veins, bridging veins, gonadal vein anomalies, and retrocaval ureters have been reported in cases of duplicated IVC [5, 6].

Preoperative planning with careful review of available radiographic imaging is important in all cases of LRN. When vascular anomalies are suspected, 3D reconstruction and digital subtraction imaging are essential for preoperative planning.

Aberrant anatomy also requires a modification of surgical technique. Extensive dissection is required to identify all vascular structures prior to ligation. We feel these cases should be approached like left laparoscopic donor nephrectomy where the renal vasculature is dissected medially to the aorta. The left renal artery should be traced to its origin from the aorta to prevent inadvertent ligation of the superior mesenteric artery. The left renal vein should be mobilized medially to the level of the aorta as well. The adrenal vein should also be identified to allow sparing of the adrenal if possible. In this case there was insufficient distance between the adrenal vein and renal hilum to allow sparing of the adrenal gland. The gonadal vein must be ligated to allow the renal vein to be reflected superiorly and anteriorly to allow identification of the artery. Care must be taken not to injure the lumbar vein complex, which usually drains into the posterolateral aspect of the left renal vein. These lumbar veins may need to be ligated either with a stapling device or between intracorporeal ties. We do not recommend titanium or plastic locking clips on the renal vein side as they may interfere with endovascular staplers, usually with disastrous consequences.

In summary, laparoscopic renal surgery is technically feasible in the presence of a duplicated IVC. However, careful preoperative planning and meticulous surgical technique with medial vascular dissection is essential.

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