Da Vinci X Zero Ischemia Nephron Sparing Surgery for Complex PADUA Presentation – Case Report

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Abstract

Introduction and Objectives. Nephron sparing surgery (NSS) for highly complex renal tumors with zero ischemia (no clamping) is technically challenging and requires highly skilled teams for minimal invasive surgical approaches.

Materials and Methods. Zero ischemia nephron sparing robotic surgery is discussed on a case report, with tips and tricks for optimal tumor excision and renorrhaphy. The 63 years old male patient presented with a right renal tumoral mass with a PADUA score of 10 (right renal superior pole, dimensions of 71/53 mm). Da Vinci X NSS was performed using a transperitoneal approach with zero warm ischemia (not clamping the renal arterial supply).

Results. Tumor excision and renorrhaphy lasted 48 minutes. Blood loss was 470 ml and Clavien Dindo complication grade II (30 days) and the patient discharged after 5 days of hospitalization. The histopathology report showed a clear cell renal carcinoma pT3aNxL0V1Pn0R0. The patient presents with renal function within normal range and free of disease recurrence and metastases at the most recent follow-up (6 months) with no need for adjuvant treatment.

Conclusions. Performing NSS for highly complex renal tumors with zero ischemia (no clamping) is technically challenging, but feasible to achieve trifecta and with promising implications in pentafecta. Da Vinci X robot offers gentle tissue manipulation, on point dissection and coagulation, aiding tumor excision within oncologic safety and a watertight renorrhaphy without tissue trituration. Nevertheless, oncologic safety is primordial and dictates the surgical approach and the choice for NSS or radical nephrectomy surgery, optimal results being obtained by a tumor board management.

Key-words: nephron sparing surgery, zero ischemia, robotic surgery, renal carcinoma

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Introduction and Objectives

Warm ischemia time during nephron sparing surgery (NSS) impacts post operative renal function, especially in extremely endophytic tumors with high PADUA score [1]. As technology evolves (3D laparoscopy/ robotics, intra operative ultrasound/ fluoroscopy/ augmented reality), it becomes feasible to approach more complex tumors within oncologic safety [2]. Indocyanine Green (ICG) fluoroscopy can be used more ergonomic with the FireFly™ mode of the robot, if partial clamping is feasible due to anatomy particularity. For example, if the renal tumor is at the superior pole and the kidney presents multiple arterial sources, fluorescence navigation can aid to identify territorial vascularization and NSS with partial clamping. ICG is a valuable asset in solitary kidney or for patients with impaired renal function [3].

The use of diuretic agents such as Manitol in partial nephrectomy is still controversial [4,5]. Different surgical techniques have been developed to optimize warm ischemia time, minimize the affected area of renal parenchyma or even to perform the surgery with zero ischemia. A systematic review analyzed the implications of zero ischemia techniques: offclamp / clampless / unclamped technique, selective/ segmental arterial clamping; preoperative superselective transarterial tumor embolization technique; sequential/modified sequential preplaced suture renorrhaphy technique; radio frequency ablation-assisted technique, plus combination of the above. All of them avoid ischemic damage by avoiding hilar clamping and are becoming more and more reported in the literature with promising potential [6]. Another systematic review and meta-analysis for cT1 tumors treated with zero ischemia vs. warm ischemia partial nephrectomy showed a decrease in deterioration of the estimated glomerular filtration rate in favor of zero ischemia technique [10]. The concept of zero ischemia technique was successfully reported with open approach in pregnancy [7] but translated also to both laparoscopic and robot- assisted approaches in small datasets of patients [8,9].

The hereby paper reports a zero ischemia Da Vinci X NSS for a PADUA 10 tumor using a transperitoneal approach, discussing technical aspects for technique feasibility.

Materials and Methods

Zero ischemia Da Vinci X robot NSS is exemplified on a PADUA 10 case and technical tips and tricks are discussed to optimize trifecta. The case was managed by a tumor board.

Patient history

A 63 years olds male patient presented to our department with an incidental finding (routine abdominal ultrasound) of a right renal tumoral mass with a PADUA score of 10 (right renal superior pole, dimensions of 71/53 mm). The patient was known with:

Medical history: essential hypertension, dyslipidemia, left renal cysts, left adrenal adenoma, T12 hemangioma

Surgical history: perianal fistula – operated in September 2021

Medication: Aspirin Cardio (stopped one week before surgery), Noliprel (ACE inhibitor + thiazide diuretic), Bisoprolol (Betablocker), Lipantil and Atorvastatin (Lipid lowering)

Denied allergies / alcohol consumption

Laboratory examinations showed values within normal range: Hemoglobin level (13.8 g/dl), Neutrophilia (5260/µL), platelet level (175000/µL), Ca (9.4 mg/dl), K (3.71 mmol/L), Na (141 mmol/L), Creatinine (0.8 mg/dl), Urea (38.2 mg/dl). Urine analysis presented no pathological findings and urine culture was negative. Karnofsky Performance status of 90 points.

Imaging findings (Computed Tomography) in Figure 1.

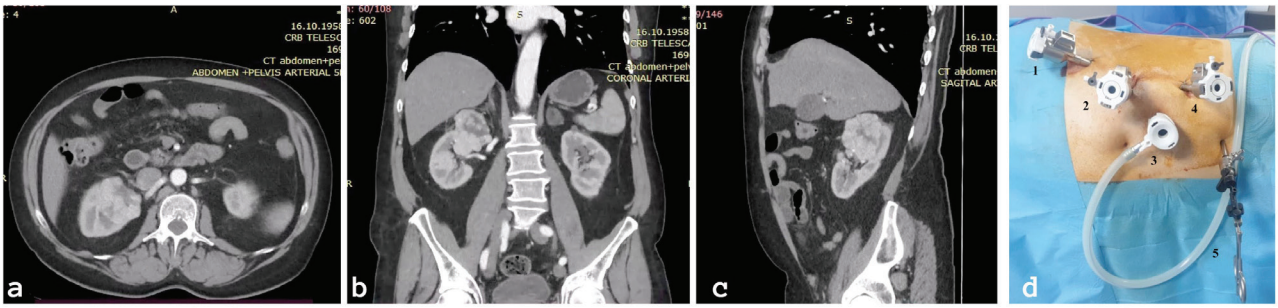

Figure 1 - contrast enhanced Thorax / Abdomen / Pelvis Computed Tomography (a- axial, b- coronal, c- sagittal): right renal solid tumor (71/53 mm, anterior hemivalve presentation with renal pelvis involvement) exceeding the renal cortex being in contact with the renal fascia without invading it. The tumoral mass presented central necrosis, fast accumulation of arterial contrast agent with venous and parenchyma washout. Simple cortical cysts on the left kidney and left adrenal adenoma of 27 mm were noted. No lymph node or distant metastases. Figure 1d - trocar placement for Da Vinci X transperitoneal approach: 1,2,4 - robotic trocars of 8 mm each, 2 - optic trocar; 3 - single use transparent laparoscopic trocar of 12 mm (table assistant), 5 - laparoscopic grasper (liver lifting)

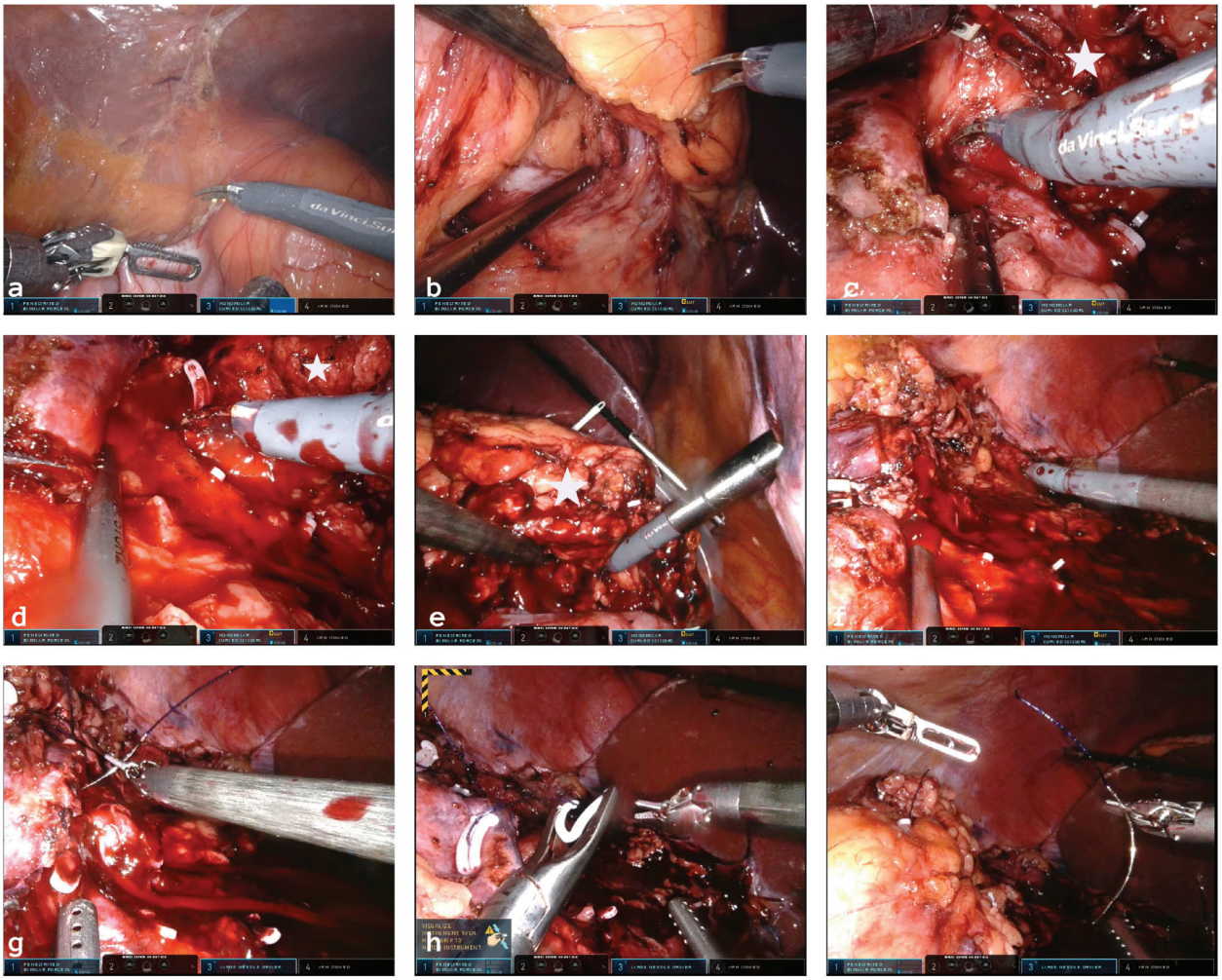

Figure 2 – intra operative collage - (a) the colon is mobilized, accessing the retroperitoneal space, (b) renal pedicle is prepared, (c, d, e) - tumor excision using Da Vinci X monopolar scissors en bloc with ipsilateral adrenal, (f) specimen is placed in Endobag™, (g, h, i) - renorrhaphy using Quill filament (size 0, 36 mm needle, 30 cm length) and Hem-o-lok clips. The tumor is marked with a white star.

Da Vinci X nephron sparing surgery- transperitoneal (Figure 2)

The patient was placed in lateral decubitus and trocars were placed for the transperitoneal approach as shown in Figure 1d, respecting triangulation principle. 500 ml of Manitol 20% were i.v. administered when surgery trocar placement started.

The surgery started with a pneumoperitoneaum of 14 mmHg. The ascending colon was identified and mobilized towards the midline to access retroperitoneal space. The right ureter was identified and the dissection continued cranial to the identification of the renal pedicle that was prepared for arterial clamping if required. A laparoscopic grasper was used to move the liver board cranial and expose the superior pole. The exophytic mass was observed and the excision trajectory was marked with monopolar device on the surface of the renal parenchyma. Under CT cognitive guidance, tumor excision was performed with cold robotic scissors without clamping the renal artery, en bloc with ipsilateral adrenal gland. Table assistant performed aspiration during bleeding from the resection bed to offer visibility for the main operator and pneumoperitoneum was raised to 20 mmHg. On point coagulation was performed with bipolar fenestrated device when arterial sources were identified in the resection bed. When completely excised, the specimen was placed in an Endobag™. The renorrhaphy was performed in a double layered suture (1 filament- running suture). The first one for the depth of the excision bed and the second one- external suture using Hem-o-lok clips to not triturate the tissue when making it watertight (excursion of pressure). The specimen was exteriorized in the Endobag™, hemostasis checked, and a lumbar drainage tube was placed after the gas was evacuated. Entry points were sutured.

Results

The surgery lasted 124 minutes (exision – 34 minutes, renorrhaphy- 14 minutes), with blood loss of 470 ml and grade II Clavien Dindo complications (30 days), patient receiving 1 unit of blood, the same group and Rh during surgery. The drainage tube was removed after 48 hours and the patient was hospitalized for 5 days and discharged with preserved normal Creatinine level (0.9 mg/dl). The histopathologic report showed a 190/110 mm excision piece with a tumoral lesion of 5/6.8/4 cm, represented by a clear cell renal carcinoma pT3aNxL0V1Pn0R0, WHO/ISUP G2 and right adrenal gland (40/30 mm) presenting no pathology. The recent follow-up (6 months post operative, thorax / abdomen / pelvis CT evaluation) showed no signs of disease recurrence or metastases, with no adjuvant treatment needed. The patient continues periodical urologic, oncologic and imagistic, endocrinologic follow-up every 6 months.

Discussions

The difficulties of this case consisted not only in the tumor presentation (superior pole/ harder for excision, reaching the renal pelvis, nearness to the renal pedicle), but in the fact that is was performed with ZERO warm ischemia. After the renal pedicle was prepared (dissected for easy access), the tumor excision and renorrhaphy were performed without clamping the renal artery.

During the tumor excision, the Da Vinci robot offered on point coagulation and precise dissection, but a very good communication and experienced tandem training of the surgical team is required, as the table assistant performs suction, helping the main surgeon to optimally perform NSS in safe oncologic conditions. As it has been previously reported by Canadian colleagues, selective suction and pressure on bigger arterial sources in the resection bed along with bipolar fenestrated device cautery offers control of dissection plane during tumor excision [9].

The penumoperinoneum is recommended to be modified during tumor excision (can be risen to 18/20 mmHg, depending on the anesthesiology team for a proper pulmonary ventilation) as the pressure allows a certain degree of hemostasis. Nevertheless, renorrhaphy may impose difficulty as the kidney is full of blood and it may be more fragile to trituration, requiring the aid of Hem-o-lok clips (tension distributed on the surface of the clip) when the rims of the excision bed are brought together to make the suture watertight. Even more, the self-retaining barbed suture facilitated renorrhaphy with safety profile [11].

Complete endophytic tumors raise difficulties, especially in case of performing NSS with CT cognitive guidance - intra-operative US examination may aid tumor localization/ delimitation from healthy tissue. Also, they impose a depth of incision for tumor removal, that implies opening bigger vessels and needing a tight renorrhaphy but with minimal ischemic impact on the remnant healthy parenchyma. Superior pole presentation may impose en bloc excision with adrenal gland for oncologic safety, especially if they present necrosis (risk at manipulation) or capsular imaging invasion. Right renal polar tumors also represent a more technical challenging position due to the liver and how it dictates the dissection space. A laparoscopic grasper can be used to lift the liver board cranial and obtain a better exposure of the surgical field.

The transperitoneal approach offers the advantage of a bigger working space, without impairing impact on the pressure when performing tumor excision/ suturing (due to suction / especially in zero ischemia cases) and it is ideal for ventral or voluminous tumors. Even for other tumor localizations, it allows the flipping (moving) of the kidney for optimal approach. Compared to the laparoscopic approach, the robotic approach offers better surgical access to tumor independent of its position, due to the wrist articulation (cutting / excision angle, needle vs. tissue, excision rim vs. instruments) and the tissue manipulation is gentler. The robotic precision in dissection was an advantage in the hereby case also because of the vicinity of the tumor with the renal pedicle.

There are situations in which the technical difficulty of minimal invasive tumor excision may prolong too much the warm ischemia time and make the surgeon decide in favor of an open partial nephrectomy or even a radical nephrectomy. In this case the blood loss was not exceeding 500 ml and offered the advantage of not working against the clock, as in the situation of arterial clamping. The price of a controllable blood loss may not be too high as every minute matters [12,13] for functional outcomes. It may even offer better excision control as the surgeon is not pressured to work against the clock; with the help of a good table assistant and robotic precision, complex tumors become approachable.

Conclusions

Minimal invasive nephron sparing surgery in zero ischemia for extremely endophytic tumors is technically challenging, but feasible, especially with the Da Vinci

robot that offers a broad and precise range of movements due to the wrist articulation. Several tips and tricks can be used to ease the technical aspect of tumor excision and renorrhaphy. Nevertheless, the oncologic outcome remains a non-debatable priority, therefore, an open partial nephrectomy or a radical nephrectomy is preferred to a partial nephrectomy that does not reach trifecta.

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