

# Robot-assisted inguinal lymphadenectomy: preliminary experience and perioperative outcomes from an Italian referral center

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## Abstract

**Background:** Inguinal lymphadenectomy remains the gold standard for the treatment of inguinal lymph node metastases from penile carcinoma, melanoma, Merkel cell carcinoma, and squamous cell carcinoma (SCC). This procedure is associated with significant complications. In order to reduce morbidity, minimally invasive approaches have been described. We report our preliminary experience with robot-assisted inguinal lymphadenectomies (RAIL).

**Methods:** RAIL was performed according to the Sotelo technique. When indicated, a robot-assisted pelvic lymphadenectomy (RAPLND) was performed. We recorded age, sex, comorbidities, baseline oncologic diagnosis, operative time, hospital stay, lymph node yield, complications, time to drain removal, and oncologic outcomes.

**Results:** From December 2016 to February 2019, 13 patients underwent RAIL. Median age was 65 years (range: 31–85 years). Primary malignancy was melanoma in five patients, Merkel cell carcinoma in four, dermal duct tumor in one, penile cancer in two, and SCC in one. RAIL was monolateral in 12 cases and bilateral in 1 case. A total of 10 monolateral RAPLNDs were performed; median operative time was 279 min (range: 169–320). Median lymph nodes yield was 11 (range: 2–24) for monolateral RAIL and 9 for monolateral RAPLND (range 2–24). Median hospital stay was 4 days (range: 2–5). No procedure was converted to open. Median follow up was 16 months (range: 5–31). Five Clavien-Dindo grade I complications were recorded. Median time to drain removal was 32.5 days (range 7–65). Three recurrences and two cancer-related deaths were recorded.

**Conclusions:** RAIL is feasible and associated with a short hospital stay, with little incidence of perioperative complications.

**Keywords:** complications, dermal ducts carcinoma, inguinal lymphadenectomy, melanoma, merkel cell carcinoma, penile cancer, robotics, squamous cell carcinoma

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## Introduction

According to the European Association of Urology guidelines for penile cancer, inguinal lymph node dissection (ILND) should be performed in cN0 patients with pT1b and T2–T4 tumors, as well as in all cN1/cN2 patients.<sup>1</sup> Furthermore, ILND is the indicated procedure in regional lymph node management for other kinds

cancer of the lower limb with positive nodes such as melanoma, Merkel cell carcinoma, and squamous cell carcinoma (SCC).<sup>2</sup>

Unfortunately, 10–46% of patients undergoing ILND are subject to complications, even in the most experienced hands. The most common complications reported are: wound dehiscence,

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cellulitis, skin necrosis, leg edema, and deep vein thrombosis.<sup>1</sup> Video endoscopic approaches have been proposed to try to reduce morbidity of ILND, but their spread is limited by problematic ergonomics and long learning curve. In order to overcome these limitations, robot-assisted approaches were introduced.<sup>3</sup> Indeed, robot assistance offers advantages when working in a confined space due to better ergonomics, superior view, and instrumentation.<sup>4</sup>

We report the perioperative and oncologic outcomes of our preliminary experience with robot-assisted inguinal lymphadenectomy (RAIL) for penile cancer, melanoma, Merkel cell carcinoma, and SCC.

### Material and methods

We reviewed the records of the patients who underwent ILND since the introduction of RAIL at our Institution in December 2016, and identified patients who underwent a robot-assisted procedure.

RAIL was performed using a DaVinci Xi Surgical System (Intuitive Surgical Inc., Sunnyvale, CA, USA) according to the technique described by Sotelo and colleagues.<sup>5</sup>

The main superficial landmarks are: the anterior superior iliac spine, the pubic tubercle, the sartorius muscle laterally, and the adductor longus muscle medially. The DaVinci Xi Surgical System is placed on the left side of the patient for both sides dissection. The camera trocar is placed 3 cm below the inferior aspect of the femoral triangle, 25 cm below the inguinal ligament. The Scarpa's fascia is identified and a subcutaneous space is gained by sweeping finger dissection. Two robotic ports are placed laterally and medially with finger-guided technique. The workspace is expanded with CO<sub>2</sub> insufflation at a pressure of 15 mmHg. A 10-mm assistant port is placed between the camera and the robotic port on the assistant side. Monopolar scissors and bipolar Maryland forceps are used. The anterior working space is developed to the inguinal ligament. The boundaries of the dissection extend from the inguinal ligament superiorly, the sartorius muscle laterally, and the adductor longus muscle medially. The small branches of the femoral artery and vein may be clipped and divided, while the saphenous vein is spared. The dissection continues superiorly, where the packet is dissected off the fascia lata.

After encountering the fossa ovalis, the packet is dissected away at its superolateral and superomedial limits. The superficial and deep planes of dissection join, and separate the package from the inguinal ligament. The nodal packet is dissected circumferentially to the saphenous arch. The specimen is removed in an impermeable sac, and extracted after extending the camera trocar incision.

When indicated, a robot-assisted pelvic lymph nodes dissection (RAPLND) was performed at the same time, redocking the robot for a transperitoneal approach.<sup>4</sup> The patient is placed in steep Trendelenburg position. The robot is turned cranially. The standard six ports are placed (camera port just above umbilicus, three robotic ports, and two assistant ports). Boundaries of pelvic lymphadenectomy are genitofemoral nerve laterally, bladder wall medially, node of Cloquet distally, and proximally until the bifurcation of the common iliac artery.

For every patient, we recorded age, sex, comorbidities, baseline oncologic diagnosis, operative time, hospital stay, lymph nodes yield, and complications according to Clavien-Dindo classification.<sup>6</sup>

### Results

From December 2016 to February 2019, 13 patients underwent RAIL (8 men and 5 women). Median age was 65 years (range: 31–85 years). Two patients had a history of type II diabetes and one patient had cardiac disease. Primary malignancy was melanoma in five patients, Merkel cell carcinoma in four, dermal duct tumor in one, penile cancer in two, and SCC in one.

In 12 cases, a monolateral RAIL was performed, while in one case the procedure was bilateral. In 10 cases, a monolateral RAPLND was performed at the same time. Median overall operative time was 279 min (range: 169–320); median operative time was 204 min (range 122–300) and 72 min (range 69–87) for RAIL and RAPLND, respectively. Operative times for RAIL were significantly longer than for open inguinal lymphadenectomy in our Institution (median operative time: 67 min; range: 62–87).

Median lymph nodes yield was 11 (range: 2–24) for monolateral RAIL and 9 for monolateral RAPLND (range 2–24); bilateral RAIL yielded 19 nodes. The patient in which only two inguinal

and two pelvic nodes were retrieved underwent a neoadjuvant treatment with vemurafenib and cobimetinib for melanoma extended to the inguinal nodes, with partial response. Six patients had positive nodes at RAIL, while two patients had positive nodes at RAPLND. Median hospital stay was 4 days (range: 2–5). No procedure was converted to open.

Median follow-up was 16 months (range: 5–31). No intraoperative complications were reported. Five patients (38.4%) experienced a postoperative grade I complication: one hematoma; two skin necrosis, treated conservatively; and two seromas, evacuated with a large intravenous catheter.

Median time to drain removal was 32.5 days (range 7–65). Three patients developed locoregional relapse and two patients died of disease during follow up (Table 1). Among the patients who had locoregional relapse, the first had monolateral RAIL for penile cancer with 9 negative nodes removed, the second had bilateral RAIL for penile cancer with 1 positive node out of 19, and the third had monolateral RAIL for melanoma with extranodal invasion in 1 out of 10 nodes; this patient later died of disease following systemic spread. One patient underwent monolateral RAIL and RAPLND for Merkel cell carcinoma: 16 inguinal and 7 negative pelvic lymph nodes were retrieved; this patient passed away following systemic spread of the disease. According to our experience, local relapses and distant metastases did not appear to be related with the surgical approach.

## Discussion

Open ILND has been the recognized gold standard for the treatment of inguinal lymphadenopathy for decades. Large incisions, combined with removal of subcutaneous tissues rich in blood supply to the skin, posed the risk of devascularization of the skin flap, with consequent wound infection.<sup>7</sup> Modified techniques, limiting the area of dissection to superior-medial to the saphenofemoral junction, without performing a sartorius flap, aimed to mitigate wound complications. However, over 50% of these patients still experience complications, with more than one-third of such complications being major.<sup>8</sup>

To reduce postoperative morbidity, minimally invasive approaches have been introduced: in

2003, the first video endoscopic inguinal lymphadenectomy (VEIL) was described, while the first RAIL was reported in 2009.<sup>9</sup> Since then, this latter procedure has been reported in small series of patients. A systematic review published in 2019 reported data from a total of 51 patients.<sup>9</sup> RAIL was confirmed as feasible, with minimal postoperative complications such as lymphocele, lymphedema, skin necrosis, cellulitis and seroma; only a few significant complications (wound breakdown, sepsis) were reported.

Matin and colleagues conducted a phase I prospective study in order to verify the oncologic adequacy of dissection during RAPLND. This verification was performed by an independent surgeon *via* a separate open incision at the conclusion of the robot-assisted procedure. The latter authors concluded that RAIL allowed adequate staging of disease in the inguinal region among patients with penile cancer at risk for inguinal metastases.<sup>10</sup> However, oncologic results of RAIL can only be evaluated comprehensively with longer follow up and larger series.<sup>9</sup>

Singh and colleagues compared open ILND and RAIL in terms of perioperative and postoperative outcomes, including complications, pathological parameters on the final histopathological report and disease recurrence at follow up<sup>3</sup>: 51 patients who underwent RAIL were compared with 100 treated with open ILND. Patients who underwent RAIL had a significantly shorter median hospital stay (3 *versus* 4 days,  $p=0.0008$ ) and number of days requiring drains to remain *in situ* (median 12 *versus* 15 days,  $p<0.0001$ ). A median yield of 13 nodes per inguinal basin was observed for RAIL: the yield was comparable with that of open ILND, which confirms the oncologic adequacy of dissection. Follow up ranged from 10 to 70 months, and a comparable number of patients received adjuvant chemoradiation in the two groups. Patients treated with RAIL experienced significantly lower incidence of major complications (2% *versus* 17%,  $p=0.0067$ ), edge necrosis (9.8% *versus* 23%,  $p=0.048$ ), flap necrosis (2% *versus* 13%,  $p=0.035$ ), and severe limb edema (0% *versus* 9%,  $p=0.029$ ). The two groups experienced a similar incidence of lymphocele, surgical site infection, cellulitis, and early and late limb edema. At this Institution, sentinel lymph node biopsy (SLNB) was not performed; however, Kumar and colleagues showed lower complications for VEIL *versus* open ILND even when the SLNB protocol is followed.<sup>11</sup>

**Table 1.** Characteristics of the included population, perioperative outcomes, and complications.

Total patients	13
Male	8 (61.5%)
Female	5 (38.5%)
Median age (range)	65years (31–85years)
Significant comorbidities:	3 (23.1%)
Type II diabetes	2 (15.4%)
Cardiac disease	1 (7.7%)
Primary tumor	
Dermal duct tumor	1 (7.7%)
Melanoma	5 (38.4%)
Merkel cell carcinoma	4 (30.8%)
Penile carcinoma	2 (15.4%)
SSC	1 (7.7%)
RAIL	13
Monolateral	12 (92.3%)
Bilateral	1 (7.7%)
Concurrent RAPLND	10 (76.9%)
Open conversions	0
Median operative time (range)	
Overall	261 min (169–320 min)
Inguinal lymphadenectomy	279 min (169–320 min)
Pelvic lymphadenectomy	72 min (69–87 min)
Median lymph node yield (range)	11 (2–24)
Median hospital stay (range)	4 days (2–5 days)
Median follow-up (range)	16 months (range: 5–31 months)
Median time to drain removal (range)	32.5 days (7–65 days)
Complications:	5 (38.4%)
Hematoma (grade I)	1 (7.7%)
Seroma (grade I)	2 (15.4%)
Skin necrosis (grade I)	2 (15.4%)
Locoregional relapses	3 (23.1%)
Cancer-related deaths	2 (15.4%)
RAIL, robot-assisted inguinal lymphadenectomies; RAPLND, robot-assisted pelvic lymphadenectomy; SSC, squamous cell carcinoma.	

In our series, median lymph node yield was adequate, since around 12–20 nodes can be usually found in this region.<sup>4</sup> Hospital stay was comparable with the other available series,<sup>3,10</sup> and sometimes we decided to prolong observation because of novelty of the surgical approach and the age of our patients (6 out of 13 patients were more than 70 years old). Median operative times reported were longer than reported in the literature, probably reflecting the learning curve. A total of 38.4% of patients experienced Clavien-Dindo grade I complications; no major complication occurred.

In conclusion, according to our experience and to the available evidence, RAIL provides adequate oncologic outcomes in terms of lymph node yield, and is associated with a short hospital stay and low incidence of significant complications. The only relevant disadvantage of RAIL seems to be the high cost of the procedure,<sup>3,9</sup> which may be mitigated by the lower rate of complications as compared with open ILND.<sup>3</sup>

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### Conflict of interest statement

The authors declare that there is no conflict of interest.

### Ethical statement

Our study did not require an ethical board approval because it did not contain human or animal trials.

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