Chapter

14

Robotic Assisted Pelvic and Para-aortic Lymph Node Dissection

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Pelvic and para-aortic lymph node dissection is a major component of surgery for several gynaecological malignancies. The role of the pelvic and para-aortic lymph node dissection for patients diagnosed with a gynaecological malignancy has evolved since the 1990s.

1. As part of staging procedure
2. Assessment of lymph node status has a prognostic significance
3. To decide upon adjuvant therapy
4. Can even be therapeutic in some scenarios

The surgical and oncologic goals of the lymph node dissection are to determine the extent of disease, stage it and, thereby, to guide further treatment.[1]

Lymphadenectomy may also have a therapeutic role in conditions in which removing nodes harbouring metastatic disease improves symptoms and survival.

Endometrial Cancer

Lymph node dissection is a fundamental part of surgery for carcinoma endometrium although the extent of dissection varies based on various risk factors. Previously, a full standard lymphadenectomy (i.e. dissection and assessment of both pelvic and para-aortic nodes) was recommended for all patients; however, to decrease side effects, a more selective and tailored nodal evaluation approach that includes the SLN algorithm is recommended by the NCCN Panel. (NCCN)

Pelvic and para-aortic lymph nodes involvement greatly impacts the 5-year survival in endometrial cancer women. Survival is 94% if negative lymph nodes, 75% if positive pelvic nodes, and 38% if positive para-aortic nodes.[2,3]

Tumor size of greater than 2 cm is another strong predictor of lymph node metastasis in those patients.[3]

If pelvic lymph nodes are positive, then there is 50% risk of para-aortic lymph node metastasis and isolated positive aortic lymph nodes occur in 2–3% women.[4] Para-aortic

lymph node dissection is recommended in patients with high risk factors like positive pelvic nodes, high grade, serous or clear cell histology (Table 14.1).[3,5]

Robotic surgery has been increasingly used in the surgical staging of endometrial carcinoma due to its potential advantages over laparotomy, especially for patients with higher BMI. Studies suggest that robotic approaches perform similarly to laparoscopy and result in comparable or improved perioperative outcomes, less frequent conversion to laparotomy and also give a comparable nodal yield, even in obese patients.[6–8] Oncologic outcomes appear to be comparable to other surgical approaches, although longer-term outcomes are still being investigated.[9]

Existing literature reports different approaches for endometrial cancer management strategy (Table 14.2).

Endometrial Cancer: Sentinel Lymph Node Mapping

Sentinel lymph node (SLN) is based on the concept that if the first lymph node group receiving lymphatic drainage from a primary tumor is negative, then it is anticipated that the rest of lymph nodes are also negative and vice versa.[12]

Table 14.1: Incidence of pelvic and aortic lymph node metastasis by tumor grade

Grades	*Pelvic lymph node metastasis*	*Aortic lymph node metastasis*
Low-grade	3.8–15.2%	0.8–9.4%
Intermediate-grade	7.3–17.1%	5.3–20.5%
High-grade tumors	6.9–35.3%	0–25%

Table 14.2: Comparison of different studies utilising various approaches to radical hysterectomy for endometrial cancer

Article	*Approach*	*Patients*	*Nodal yield*	*Operative time (min)*	*Blood loss (ml)*	*Hospital stay (days)*
Bernardini et al.[7]	Open-RH*	41	14	165	300	4
	RALRH**	45	18	270	200	2
Eklind et al.[8]	RALRH	40	13	127	76	1.8
	Open-RH	48	13	179	317	4.8
Pulman et al.[10]	Open-RH	69	14	210	300	4
	LRH***	44	17	240	150	1
	RALRH	63	18	240	150	1
Corrado et al.[11]	RSS-RH****	125	13	122	50	2
Backes et al.[9]	Open-RH	93	18	NA	300	4
	RALRH	89	15	NA*****	75	1

**RH, Radical hysterectomy*
***RALRH, Robotic-assisted laparoscopic radical hysterectomy*
**** LRH, laparoscopic radical hysterectomy*
***** RSS, robotic single site surgery*
******NA, not available*

- Sentinel lymph node biopsy is advised rather than lymphadenectomy.
- Earlier SLN was done with a combination of 99-Tm and a visible dye (such as isosulfan blue dye) but now ICG (indocyanine green) is used which is as it is superior to blue dye in detecting *sentinel lymph node*.
- SLN is done by injecting the dye intracervically or in uterine stroma, which gets accumulated into the corresponding lymph nodes and which can be picked up by robotic camera.[13]
- The Fluorescence Imaging for Robotic Endometrial Sentinel (FIRES) lymph node biopsy trial is a prospective, multicenter, cohort study that aims to assess the value of ICG-SLN biopsy as an alternative to lymphadenectomy in 385 patients undergoing robotic surgery for stage I Endometrial Carcinoma. The authors reported that ICG-SLN biopsy can safely replace lymphadenectomy with a sensitivity of 97.2% and a NPV of 99.6%.[14]

Cervical Cancer

Historically, cervical cancer was staged based on clinical findings alone; however, in 2018, surgical and radiologic findings were added to the staging system, thereby making lymph node status crucial to staging and management of cervical cancer.[15]

Pelvic lymph node metastasis in early-stage cervical cancer IA2 tumors is 2% and in stage IB tumors is 14–36%.[16,17] and para-aortic lymph node metastasis in stage IB tumors is 2–5%.[15,18]

As lymph node status is an important prognostic indicator and determines the management protocol, bilateral pelvic lymph node dissection is an integral part during radical hysterectomy or radical trachelectomy for the management plan of early-stage cervical cancer.

Robotic Pelvic Lymph Node Dissection in Cervical Cancer

Minimally invasive approaches are the better alternatives to open pelvic lymphadenectomy and have comparable surgical and oncological results.

Conflicting results exist regarding the value of nodal yield on the survival of women with lymph nodes negative status, a more extensive lymph node dissection theoretically improves the pathological accuracy of lymph node status because a large number of retrieved lymph nodes certainly increase the chance of detecting and resecting micro-metastasis.

Hence the number of pelvic lymph nodes obtained are the surrogate marker of the extent and quality of surgery.

Existing literature reports different approaches for endometrial cancer management strategy. The majority of authors reported a comparable nodal yield among different surgical approaches (16–36 for robotic, 14–27 for laparoscopic, 17–25 for open) (Table 14.3).

Cervical Cancer: Sentinel Lymph Node Mapping (SLNM)

As suggested by various studies using radiocolloid tracer (Technetium-99) either alone or in combination with blue dye, sentinel lymph node mapping to be considered as an *alternative to lymphadenectomy only in the women with early-stage cervical tumors* <2 cm.[25–27]

Table 14.3. Comparison of different studies utilising various approaches to radical hysterectomy for cervical cancer

Article	*Approach*	*Patients*	*Nodal yield*	*Operative time (min)*	*Blood loss (ml)*	*Hospital stay (days)*
Salvo et al.[19]	Open-RT	358	17	171	200	6
	MIS-RT	288	18	262	50	2
Gao et al.[20]	RSS-RH	32	21.37	223.56	217.25	7.5
	LESS-RH	35	20.71	248.61	294.74	7.17
Ding et al.[21]	2D-LRH	54	21.7	151.6	233.5	10.4
	3D-LRH	85	23	111.8	211.6	10.7
	RALRH	100	22.4	171.6	317.5	10.9
Ramirez et al.[22]	Open-RH	312	21	NA	NA	5
	MIS-RH	319	20	NA	NA	3
Pellegrino et al.[23]	RALRH	34	35.58	227.64	67.88	2.58
	LRH	18	24.23	242.87	203.33	3.27
Nie et al. {Citation}	RALRH	100	22.39	171.64	317.5	10.41
	LRH	833	22.51	192.1	322.51	11.5
Wallin et al.	Open-RH	155	28.9	197	596	6.3
	RALRH	149	22.7	206	80.9	2.4
Diver et al.[24]	MIS-RH	101	19.4	NA	50	1.9
	Open-RH	282	16	NA	500	4.9
Li et al.	3D-LRH	24	18.08	222	325	15.54
	RALRH	37	16.05	215.84	309.73	15.57
Corrado et al.	Open-RH	43	25	290	480	8
	LRH	41	20	220	250	6
	RALRH	41	23	180	150	4
Corrado et al.	Mini-LRH	30	17.5	180	50	2
	RALRH	30	20	185	60	3
Yim et al.	RALRH	60	18	200.5	100	11
	LRH	42	19.9	215.6	145	10
Vizza et al.	LRH	25	21	188	220	6
	RALRH	25	23	190	160	4
Tinelli et al.	LRH	76	27.1	255	95	4
	RALRH	23	24.7	323	157	3
Sert et al.	RALRH	35	19.5	263.8	82.8	3.8
	LRH	7	15.4	364.2	164.2	8.4
	Open-RH	26	26.1	163.4	595	9.2
Schreuder et al.	RALRH	13	29	434	300	4
	Open-RH	14	26	225	2000	9
Nam et al.	RALRH	32	20.2	218.8	220.9	11.6
	Open-RH	32	24.2	209.9	531.5	16.9

MIS, minimally invasive surgery; RH, radical hysterectomy; NA, not available; RT, radical trachelectomy; RSS, robotic single site surgery; LESS, laparoendoscopic single site surgery; LRH, laparoscopic radical hysterectomy; RALRH, robotic-assisted laparoscopic radical hysterectomy; 2D, two-dimensional; 3D, three-dimensional.

Indocyanine green (ICG) tracer has comparable bilateral detection rates to the standard dual blue dye/technetium-99 approach, while randomized phase III FILM trial reported that ICG tracer identified more SLNs (overall and bilateral) than blue dye.[29] (NCCN).

However, further supporting literature is needed to recommend the use of ICG guided SLNs as an alternative to lymphadenectomy in patients with cervical cancer.

Advantages of Robot

- Three-dimentional view, 10 times magnification, tremor filtration, endo-wrist instruments, ergonomics and autonomy of camera control for both surgeons and patients
- Shorter learning curve compared to laparoscopic approaches
- Better cosmosis
- Reduced hospital stay
- Less estimated blood loss and less post-operative pain

Steps for Surgery

Patient Position

Patients were placed in the dorsal lithotomy or semi-lithotomy position using the Allen stirrups (Allen Medical, Acton MA) with the arms loosely tucked to each side. Gel or Foam padding was used to protect both arms and legs and also underneath shoulders. Patient's shoulder and chest are strapped to prevent patient sliding while in steep Trendelenburg.[30] Uterine manipulator or a vaginal occluder can be used to assist with bladder dissection, identification of the vaginal fornices, and vaginal transection during hysterectomy.

The operating table was placed in steep Trendelenburg position after all trocars have been placed, until the small bowel and sigmoid were displaced out of the pelvis, and to a maximum of 30°.

Port Placement

A 8 mm supra umbilical trocar specific for the da Vinci robotic system was introduced using the open technique approximately 23 to 25 cm cephalad to the symphysis pubis. 30° da Vinci angled scope was inserted through this port and ancillary trocars were placed in the supine position as follows: (1) 8 mm robotic port (first arm) was placed on the patient's right side, 8 to 10 cm lateral and 1 to 2 cm inferior to the camera port; (2) 8 mm robotic port (second arm) was placed on the patient's left side, 8 to 10 cm lateral and 1 to 2 cm inferior to the camera port; (3) 8 mm robotic port (third arm) was placed 8 to 10 cm lateral, 1 to 2 cm inferior to the second arm; and (4) 12 mm assistant trocar was placed on the anterior axillary line 6–8 cm lateral to 1st arm on the right, used by assistant at patient cart (Figs 14.1 and 14.2).

The assistant, sitting to the left of the patient, at shoulder level, performs important tasks using 12 mm trocar: Sealing and division of vascular structures using a vessel sealing device, suction and irrigation, procurement of peritoneal cytology, removal of biopsy specimens, tissue retraction, and introduction and retrieval of sutures for vaginal cuff closure.

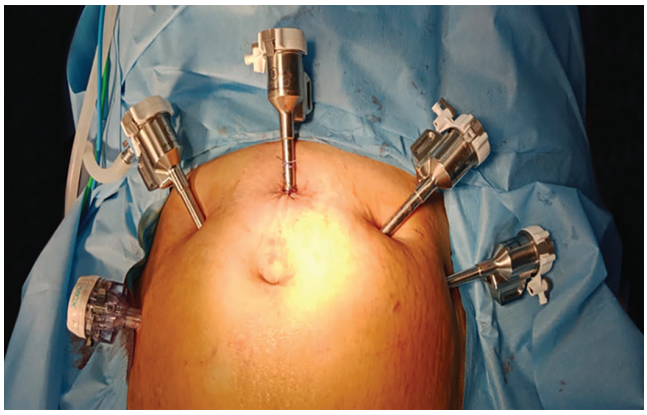

Fig. 14.1: Port placement

Fig. 14.2: Vision cart is placed next to patient's head end on the left

Docking: Side docking is used when the surgeon needs better access to external patient anatomy. The user angles the patient cart so the laser line intersects the initial endoscope port and the stirrup mounting-clamp on the OR table (not the target anatomy, as is normally done) at a 45° angle. This change in cart position allows for enhanced beside access to the anatomy such as the perineal area for using a uterine manipulator (Figs 14.3 and 14.4).

Monopolar scissors (endowrist instrument; intuitive surgical) was introduced through the first arm (right trocar), bipolar grasper (fenestrated or force bipolar forceps, endowrist instrument; intuitive surgical, Sunnyvale, CA, USA) was introduced on the second arm and in the third arm (left lateral trocar), Prograsp forceps (intuitive surgical) was used.

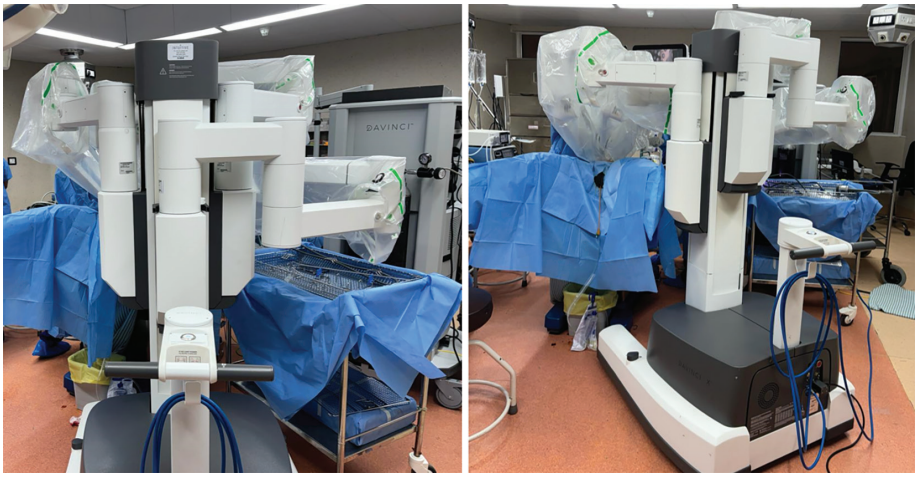

Fig. 14.3: Side docking

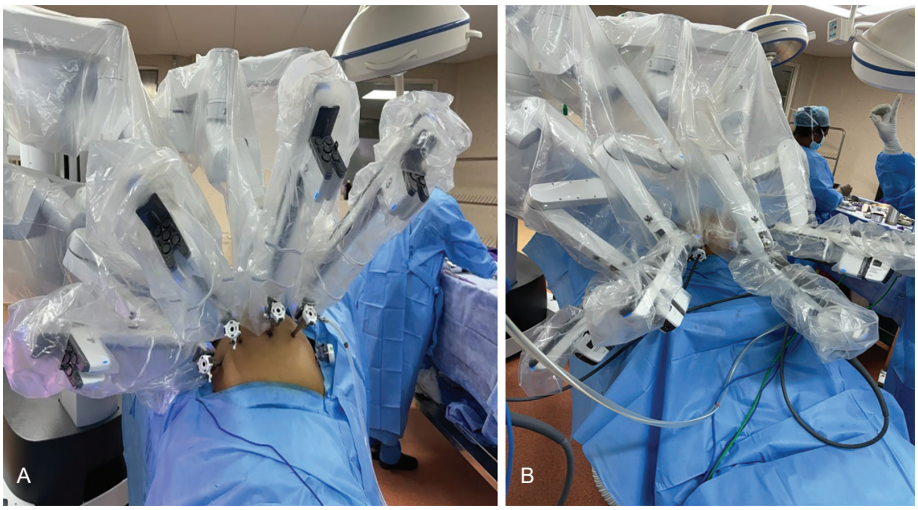

Fig. 14.4. After docking (A) insertion and placement of instruments (B)

Pelvic Lymph Node Dissection

Pelvic Lymph Nodes Mainly Include

- External iliac, internal iliac, and obturator lymph nodes, which are below the bifurcation of the common iliac artery. The lymphatic tissues lay on the external iliac vessels anteriorly and medially, over the internal iliac vessels, at the interiliac junction, and over the obturator nerve; these lymph nodes should be removed in order to achieve a complete (systematic) pelvic lymphadenectomy.[31]

Borders of the Pelvic Lymph Nodes

- Genitofemoral nerve laterally, bifurcation of the common iliac artery cranially, the deep circumflex iliac vein caudally, the obturator nerve inferiorly, and the obliterated umbilical artery medially (Fig. 14.5).

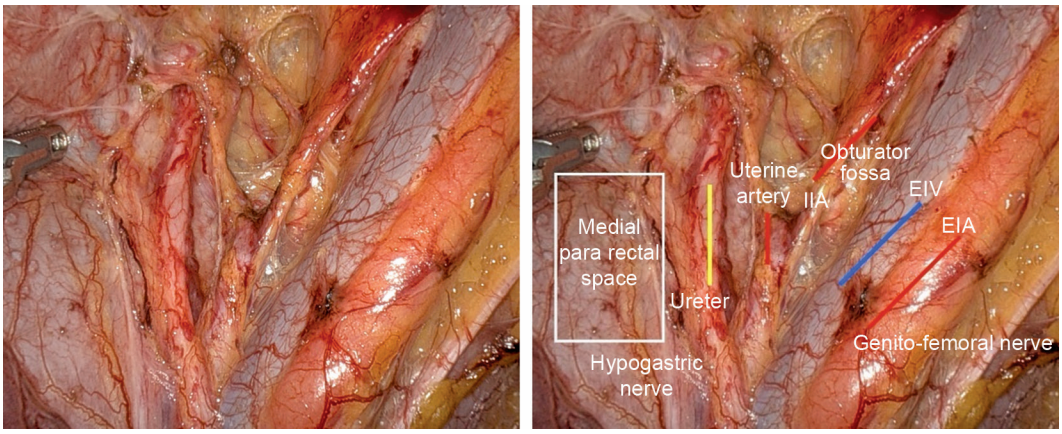

Fig. 14.5: Internal iliac artery (IIA); External iliac artery (EIA); External iliac vein (EIV)

Sacral lymph nodes are generally not encountered in the pelvic lymph node group and its dissection is not a routine part of pelvic lymphadenectomy. Sentinel lymph node mapping studies also showed that sentinel lymph nodes are rarely detected in the presacral area; however, if there is a bulky lymph node, it should be dissected.

Surgical Technique

In order to achieve a successful pelvic lymphadenectomy

- Firstly, a good anatomic exposure should be maintained to visualize the entire surgical field (Fig. 14.5).
- Secondly, lymph nodes over the external and internal iliac vessels are dissected and then the obturator lymph nodes are removed.
- After exploring the abdomino-pelvic cavity, the uterus is drawn over to the contralateral pelvic side wall, caudo-medially.
- The lateral parietal peritoneum is incised between the round ligament and the infundibulopelvic ligament, so the retroperitoneal space is accessed (transection of the round ligament to access the retroperitoneal area is optional).
- The incision is enlarged and the peritoneum is cut parallel to the infundibulopelvic ligament.
- The ureter is identified at the base of the posterior sheet of the broad ligament. The pararectal space is developed between the internal iliac artery (lateral) and ureter (medial). The paravesical space is developed between the bladder (medial) and pelvic side wall (lateral); the obliterated umbilical artery divides the paravesical space into two parts and the lateral part indicates the obturator fossa. The peritoneal tissue of the round ligament where it enters the inguinal canal under the inguinal ligament is pulled upward. The ureter is retracted medially, and the pelvic lymphadenectomy starts over the external iliac artery, below the bifurcation of common iliac artery.
- The fibroadipose lymphatic tissue over the external iliac artery and vein is gently elevated off the vessel, dissected and excised until the level of deep circumflex iliac vein, which is the caudal border. Therefore, internal iliac lymph nodes are also removed over the anterior part of internal iliac artery. The dissection of obturator lymph nodes is done after retraction of external iliac vessels laterally to the psoas

muscle and maintaining a medial retraction on the paravesical space, which retracts the obliterated umbilical artery medially. All the lymphatic tissue over the obturator nerve lateral to the obliterated umbilical artery is stripped from the attachments and finally the lymphatic tissue is removed. If there is a bulky lymph node at the obturator fossa and lying under the obturator nerve, care should be taken during stripping the attachments under the obturator nerve. There is an extensive venous vascular bed and collateral circulation of internal iliac vein, which makes the control of bleeding difficult.

Para-aortic Lymph Node Dissection

It has been recommended to perform PALND to the level of the left renal vein to high risk endometrial cancer patients. Apart from the lymphatic metastasis routes between the uterus and the external iliac, obturator basins, a direct pathway may exist from the uterus to the aortic-node basins. It is considered to occur through lymphatics adjacent to the gonadal vessels within the infundibulo-pelvic ligament.[32]

Although robotic surgery facilitates minimally invasive oncological procedures, the current robotic system prohibits operating both in the pelvis and upper abdomen because of the limitations in arm mobility.[33] Several methods such as patient rotation or relocation of the robotic column have been suggested to overcome these limitations.

Various studies have reported that for removal of the infrarenal aortic nodes adjacent to the left renal vessels, the robotic column can be repositioned at the patient's head for a transperitoneal midline approach,[33] at the patient's right for an extraperitoneal approach,[34] and at the patient's left for a transperitoneal left lateral approach,[35] with additional trocar placement for each one of these approaches. In addition, "hybrid" procedure which performs conventional laparoscopy as an adjunct can be another option. Operating both in pelvis and high para-aortic region with the same port placement is also a feasible option. All robotic ports and one assistant port were located above the level of umbilicus to access both high para-aortic lymph node and pelvis.

With all the methods mentioned above, total operation time may be elongated and could be a technical challenge to the surgeon and anaesthesia team.

Additional measures in PALND-mechanical bowel preparation may be considered to improve visibility in the pelvis and displacement of the bowel for aortic lymphadenectomy especially in obese individuals. It is helpful to ask the anaesthetist to adjust the ventilator with reduced tidal volumes and increased rate (to maintain minute-ventilation) during the infra-renal portion of the aortic lymphadenectomy, when exposure is most difficult.

Standard patient position and OR table inclination is placed, same as for hysterectomy and pelvic lymph node dissection. Port placement depends on which approach is chosen for PALND (Fig. 14.6A and B).

1. Using same ports for PLND and PALND—an additional assistant trocar for traction of the small bowel (duodenum) maybe placed 1 cm inferior to the subcostal margin on the right mid-clavicular line.

Para-aortic lymph nodes in the gynecologic oncologic field are subgrouped into b1 and b2 lymph nodes; b1 lymph nodes are located between the lower margin of the left renal vein and the upper margin of the inferior mesenteric artery (IMA), whereas b2 lymph nodes are located between the upper margin of the IMA and the bifurcation of the abdominal aorta.

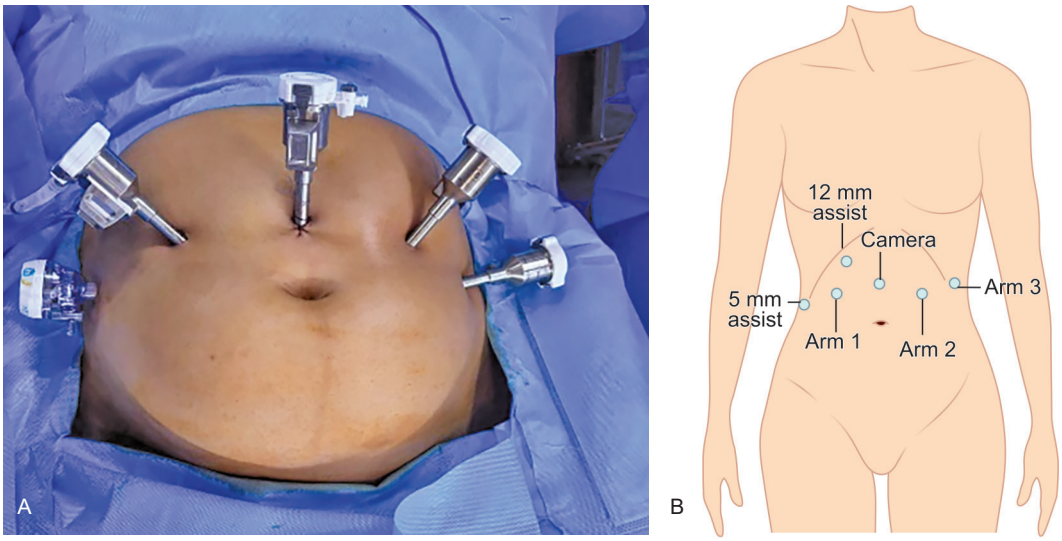

Fig. 14.6A and B: (A) Standard ports for hysterectomy and PLND; (B) Additional assistant port in right mid-clavicular line for retraction of duodenum in PALND; Modified placement of a slightly cephalad third arm trocar (left) allows using Prograsp forceps as an effective retractor in PALND

The procedure of para-aortic lymphadenectomy is divided into two types: Right-sided and left-sided para-aortic lymphadenectomy with respect to the center of the aorta. Right-sided para-aortic lymphadenectomy is performed by dissecting the lymph nodes of the precaval and paracaval area up to the level of the origin of the right ovarian vein in the inferior vena cava (IVC) or the right renal vein. Conversely, left-sided para-aortic lymphadenectomy is performed by dissecting the lymph nodes on the aorta from the level of bifurcation to the left renal vein.

The abdominal aorta has important branch vessels, such as the renal artery, ovarian artery, IMA, lumbar artery, and median sacral artery. The anatomy of the infrarenal portion of the IVC is divided into three portions: Level 1 is the area of the bifurcation of the vena cava, Level 2 is the area between the bifurcation and the IMA, and Level 3 is the area between the IMA and the right ovarian vein.

The most important requirements of lymphadenectomy are the maintenance of a clear surgical field and precise anatomy of vessels in case of an accidental injury. In case of a vessel injury, compression by a gauze to decrease the bleeding, hemostatic agents, quick conversion to laparotomy and use of vascular clamps may be helpful and injury of a larger vessel may require suture repair with monofilament and nonabsorbable sutures. Removal of positive lymph nodes has to be performed taking care not to cause any injury to the main vessels, especially the IVC, due to affluent artery and vein to lymph nodes.

In case of right PALND, it is crucial for the assistant to tract duodenum to the direction of patient's head in order to optimize the surgical view and tract right ureter lateral side by Prograsp near the common iliac artery area. During the left PALND, it is critical to use Prograsp and retract the peritoneum near inferior mesenteric artery (IMA). Traction of small bowel through assistant arm in the case of left high PALND is also important as the right side.

Dissection can be carried out from caudal to cephalad direction. Only disadvantage of this method being pooling of lymphatic fluid in the surgical field, which can be circumvented by using gauze and suction. It is possible to use tagging traction suture and put away the small bowel from operation site by fixing the peritoneum on abdominal wall. In this case, the mobility of the surgical instruments through assistant port and robot ports become limited.

Current robotic system has a limitation that it cannot access the whole abdomino-pelvic cavity. Several methods such as patient rotation or relocation of the robotic column have been introduced but these methods are time-consuming and technologically complicated which requires highly skilled surgeon and anaesthesia team.

Steps of PALND

The peritoneum along the right common iliac artery is opened, the ureter and ovarian vessels are identified and retracted laterally by the bedside assistant with a laparoscopic suction cannula. Common iliac lymph nodes are dissected free, taking care to avoid injury to the vein and genitofemoral nerve running below the artery along the psoas muscle. Maximum exposure to the aortic recess below the duodenum is created with a laparoscopic bedside assistant grasper on the small bowel peritoneum that effectively 'tents' away the small bowel, along with the Prograsp in the 'third' arm reflecting the duodenum. Duodenum can also be retracted using a 10 mm fan bowel retractor introduced through the assistant port. Caution must be exercised to avoid vascular injury by identifying the insertion of the right gonadal artery, gonadal vein and inferior mesenteric artery (IMA). Minor vena caval bleeding can be easily managed with pressure and hemostatic agents. Care must be taken to avoid lifting the nodal bundle off the vena cava, sheering the anterior perforating fellow veins and instead dissecting around the veins using bipolar and monopolar cautery carefully.

The right aortic nodes over the vena cava and aorta were excised first, as well as the interaortic nodes if a separating space existed between these 2 vessels. The dissection was extended cranially until no nodal tissue was present, usually at or above the level of the insertion of the right ovarian vein to the vena cava.

The third arm is then moved to the left, retracting the duodenum above the left renal vein and exposing the left gonadal vein. Lymph nodes from the left renal vein to the IMA are dissected free of the descending colon mesentery and aorta with blunt dissection and short bursts of monopolar cautery. The aortic lymphadenectomy is completed by dissecting below the IMA retracting the ureter laterally down to the external iliac artery. To access the inframesenteric left aortic nodes, the peritoneal incision is extended from the aortic bifurcation caudally and over the left common iliac artery for approximately 4 to 5 cm. The sigmoid mesentery was retracted laterally by the assistant surgeon, exposing the psoas muscle and the left ureter.

It is not necessary to sacrifice the IMA and major lymphatic trunks should be bipolar cauterized or clipped when identified to minimize the risk of lymphoceles or chylous ascites.

The left ovarian vein and the cranial border of the left renal vein were the lateral and upper limits of left aortic dissection, respectively.

Extra Peritoneal Approach

Obesity, in particular the truncal and mesenteric types, short intestinal mesentery, distended bowel, intestinal adhesions, previous aortic lymphadenectomy, and

intolerance to Trendelenburg are limiting factors for the performance of transperitoneal laparoscopic or robotic aortic lymphadenectomy to renal vessels. To overcome some of the limitations of the transperitoneal route and in an attempt to reduce the formation of postoperative intestinal adhesions, an extraperitoneal approach to aortic lymphadenectomy was developed and has been reported by numerous authors.[1–6] This new technique provided a similar number of aortic nodes as with the transperitoneal laparoscopic approach. The robotic column is situated perpendicular to the torso or with about 15° of angulation to the torso in a caudal direction (Fig. 14.7).

The morbidity associated with PLND and PALND is more pronounced in open approach. The incidence of surgical complications is much lesser in robotic approach[36]

- Bleeding
- Vessel injury: External iliac vessels, internal iliac vessels, obturator vessels, or pubic vein or artery (corona mortis);
- Nerve injury
  - Genitofemoral nerve (neuropathic groin pain or over medial aspect of thigh)
  - Obturator nerve (adductor weakness, neuropathic pain, sensory deficits over medial aspect of thigh): Obturator nerve injuries are rare; however, end-to-end anastomosis can be performed or nerve grafts may be applied.
- Ureter injury: Ureter injuries are managed according to the region of injury; double-J-stents or end-to-end anastomosis are the options
- Lymphorrhea
- Lymphocyst/Lymphocele: The lymphatic-filled cystic lesions are called lymphocele. The peak occurrence is <1% and usually found at 3–8 weeks or 1 year after surgery. Majority of occurrence is seen in PALND women.
- Small asymptomatic uninfected lymphoceles usually regress spontaneously but larger ones require treatment. Lymphoceles presents with pelvic pain, infection,

Fig. 14.7: Extra peritoneal approach—Trocar sites placement. The caudal most medial mark was the site used for the initial incision and development of the extraperitoneal space with an inflatable balloon. The cranial top site was used for the monopolar spatula. The most lateral mark (lowest in the picture) was the site for the optical trocar and laparoscope. The mark over the iliac crest was for the assistant trocar, but once the robotic trocars were in place a more preferable site was used located cranially, along the same line, to immediately below the left costal margin, and equidistant from the optical trocar and the cranial robotic trocar

lower urinary tract symptoms, leg edema, deep vein thrombosis and other symptoms related to compression of adjacent structures

- Lymphedema—incidence is more among women who had received radiotherapy.

The number of serious complications like vessel injury is expected to be higher at the beginning of the learning curve.

Sentinel Lymph Node Dissection

Superficial (1–3 mm) and optional deep (1–2 cm) cervical injection leads to dye delivery to the main layers of lymphatic channel origins in the cervix and corpus, namely the superficial subserosal, intermediate stromal, and deep submucosal lymphatic sites of origin. Injection into the uterine cervix provides excellent dye penetration to the uterine vessels and main uterine lymphatic trunks that condense in the parametria and appear in the broad ligament leading to pelvic and occasionally paraaortic sentinel nodes. The uterine body lymphatic trunks commonly cross over the obliterated umbilical artery with the most common location of pelvic SLN being medial to the external iliac, ventral to the hypogastric, or in the superior part of the obturator region. A less common location is usually seen when the lymphatic trunks do not cross over the obliterated umbilical and move cephalad following the mesoureter; in these cases, the SLN is usually seen in the common iliac and presacral region (Fig. 14.8).

The radiolabeled colloid most commonly injected into the cervix is technetium 99m (99mTc); colored dyes are available in a variety of forms (Isosulfan Blue 1%, Methylene Blue 1%, and Patent Blue 2.5% sodium). Indocyanine green (ICG) recently emerged as a useful imaging dye that requires a near-infrared camera or the in-built firefly mode on robotic system for localization, provides a very high SLN detection rate, and is commonly used in many practices at the present time.

SLN identification should always be done prior to hysterectomy, except in cases where a bulky uterus must be removed to allow access to iliac vessels and LNs.

Suspicious or grossly enlarged nodes should be removed regardless of SLN mapping results. For cases of failed SLN mapping, reinjection of the cervix may be considered. However, if SLN mapping fails, a reflex side-specific nodal dissection should be performed and any suspicious or grossly enlarged nodes should be removed regardless of mapping.

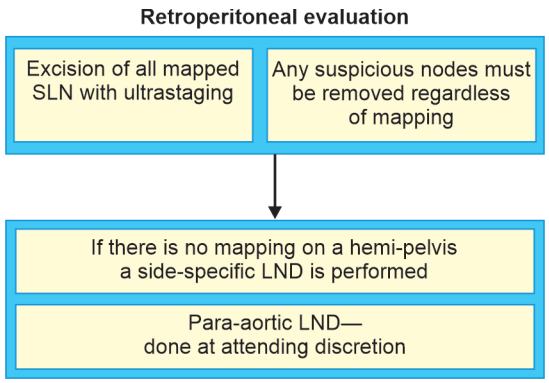

Fig. 14.8: SLND algorithm

Technique of dye injection consists of two or four-point injection into the cervix (or peritumoural) using a 23 to 25 G spinal needle, where half the volume is injected deep into the stroma, (1–2 cm) and other half is injected submucosally (1–3 mm). Total volume of 4 ml if ICG (0.5 mg/ml dilution of freshly reconstituted dye) is injected, 1 ml at each site and depth. Alternatively, total volume of 4 ml of blue dye or 0.1–0.5 mCi of radiolabelled filtered Tc-99m can be used. ICG and blue dye are injected just at the start of the surgery whereas Tc-99m is injected one day prior or on the morning of surgery (Figs 14.9 to 14.14).

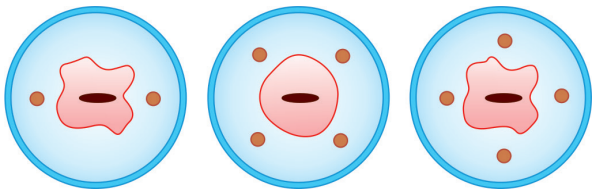

Fig. 14.9: Sites of dye injection on the cervix

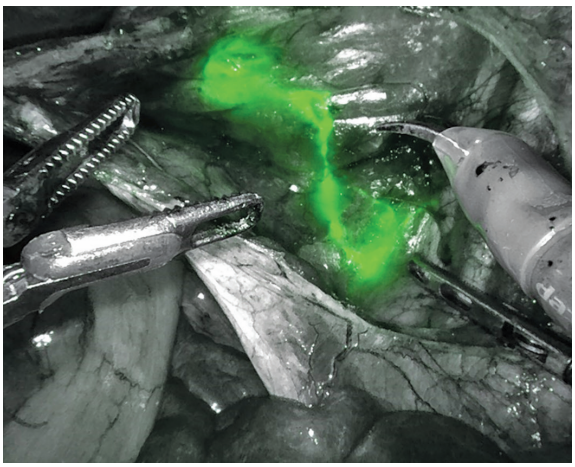

Fig. 14.10: Right pelvic SLN using ICG-lymphatic vessel leading up to right external iliac lymph node

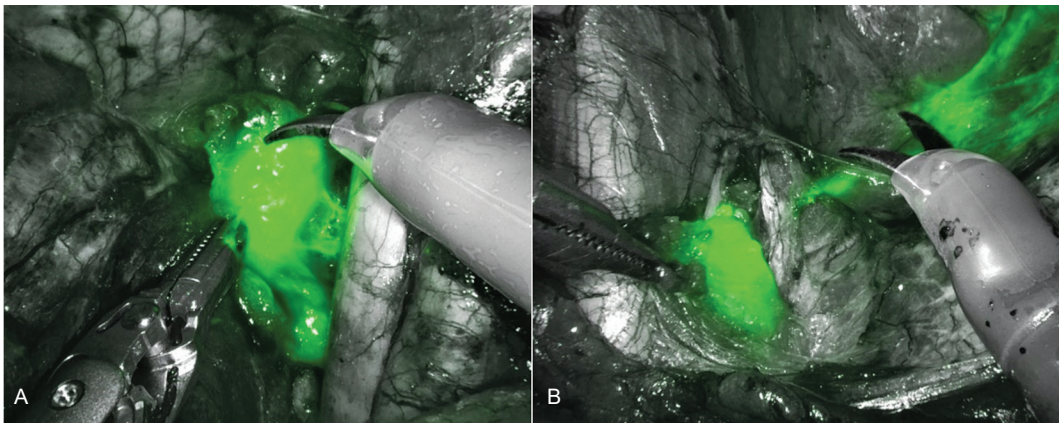

Fig. 14.11: SLND using ICG (A) Right external iliac lymph node and (B) Left external iliac lymph node

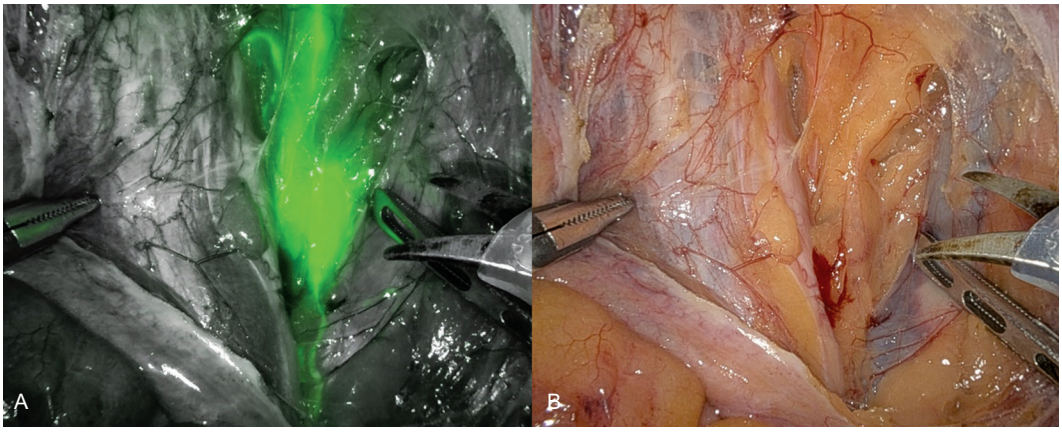

Fig. 14.12: Right obturator node: (A) With ICG and (B) without ICG

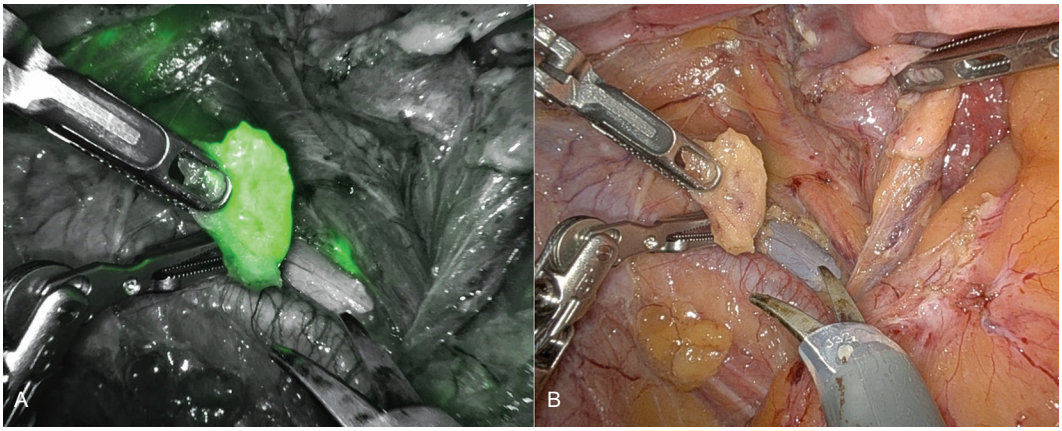

Fig. 14.13: Left obturator node: (A) With ICG and (B) without ICG

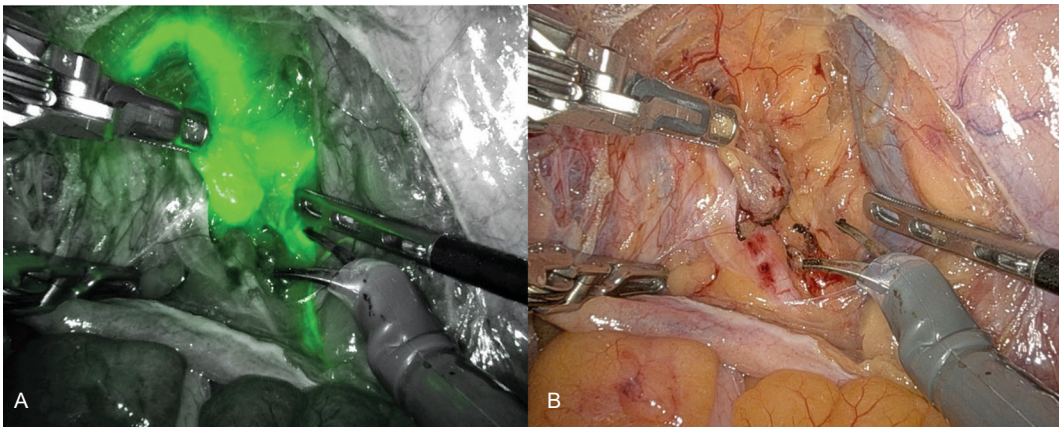

Fig. 14.14: Right obturator node and lymphatic channel: (A) With ICG and (B) without ICG

Disadvantages of Robotic Surgery

The major obstacle to the use of robotic surgery in the routine treatment of gynaecological malignancies is the cost of the system.

Role of minimally invasive surgery is still not well established in some malignancies like ovarian cancer.

Dissemination of tumor cells intra-peritoneally is a concern expressed by some researchers. However, measures like vaginal closure using endoscopic stapler or sutures to seal the vagina before colpotomy is an effective and feasible way to circumvent this concern and can improve oncological outcomes like rates of recurrence and survival.[37]

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