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ORIGINAL RESEARCH

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Intraoperative complications, treatments and outcomes of lymph node dissection for gynecological malignancies

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Abstract

Background: Lymph node dissection (LND) is crucial in gynecological malignancies for accurate staging, adjuvant therapy and curative intent. Intraoperative vascular injuries, nerve injuries, and ureter injuries may be observed. The aim of our study is to evaluate intraoperative vascular, nerve, and ureteral injuries associated with the LND procedure, along with their treatments and outcomes. **Methods**: This retrospective study included patients who underwent pelvic ± para-aortic LND due to gynecological malignancies (cervical, endometrial and ovarian) at the Gynecological Oncology Surgery Clinic between 2015 and 2024. **Results**: Two thousand four hundred ninety-three cases were reviewed. Major intraoperative complications associated with lymph node dissection (LND) occurred in 59 cases (2.3%). In 39 patients (1.5%), small (<1 cm) lacerations of the inferior vena cava (IVC) were observed and were repaired with primary suturing (6.0 Prolene). There were 3 (0.1%) cases of vascular injury requiring repair with a vascular graft. No complications were observed in any patients during postoperative follow-up after grafting. There were eight (0.3%) patients with obturator nerve injury. Ureteral injury occurred in 9 (0.3%) patients. **Conclusions**: Retroperitoneal lymph node dissection associated with gynecological malignancies, while rare, can lead to complications that may result in serious morbidity or mortality. Follow-ups of intraoperatively diagnosed and repaired complications (such as inferior vena cava injury, vascular injuries requiring graft repair, obturator nerve injury and ureteral injury) generally did not lead to morbidity. Intraoperative diagnosis and appropriate treatment are usually associated with low morbidity and improved quality of life.

Keywords

Gynecological malignancy; Lymph node; Obturator nerve; Ureteral injury

1. Introduction

Lymph node dissection (LND) is crucial in gynecological malignancies for accurate staging, adjuvant therapy and curative intent [1–3]. Systematic LND is the procedure used to describe retroperitoneal pelvic and para-aortic LND. In cases of early-stage endometrial and cervical cancer, pelvic LND is considered an acceptable procedure. Recently, sentinel LND has been applied, especially in early-stage low-risk endometrial and cervical cancer (stage IA2) [2, 3]. Sentinel lymph node biopsy does not show any difference in survival compared to systematic LND, especially in early stage endometrial cancer [4, 5]. Sentinel lymph node biopsy offers dramatically lower intraoperative and postoperative complication rates [4, 5]. Bulky lymph nodes positively influence progression-free survival in ovarian cancer [1]. Advances in industrial tools have made it possible to perform endometrial cancer surgeries using minimally invasive techniques. Intraoperative and postoperative complications related to the LND procedure can occur. Intraoperative vascular injuries (0.8–3.3%), nerve injuries (0.3%), and ureter (0.6–0.8%) and bowel (0.3%) injuries may be observed [6, 7]. It was determined that the rate of intraoperative complications in minimally invasive surgery is no different from that in laparotomy [7]. During the postoperative period, complications such as lymphedema, lymphocysts and chylous ascites are the most commonly observed complications [6]. Patients may receive adjuvant therapy during the postoperative period. The timing of the initiation of adjuvant therapy postoperatively is important. Therefore, the morbidity caused by intraoperative complications and the management of patients may have negative effects based on the recovery process. The most common nerve injury is obturator nerve injury [8]. The aim of our study is to evaluate intraoperative vascular, nerve and ureteral injuries associated with the LND procedure, along with their treatments and outcomes.

2. Methods

This retrospective study included patients who underwent pelvic ± para-aortic LND due to gynecological malignancies (cervical, endometrial and ovarian) at the Gynecological Oncology Surgery Clinic between 2015 and 2024. Patients who had fertility preservation procedures, did not require lymph node dissection, or underwent sentinel LND were excluded. Since this study involved a retrospective review of a database, participant consent was deemed unnecessary. Institutional Ethics Committee approval was obtained from our local headquarters (Decision number: 0188/2024). All procedures were performed in accordance with the ethical standards of institutional and/or national research committees, the 1964 Helsinki Declaration and its later amendments, or comparable ethical guidelines.

All surgeries were performed by experienced gynecological oncology surgeons. The diagnoses of cervical and endometrial cancer were determined by preoperative biopsies; ovarian cancer was diagnosed via frozen section. Surgical procedures were performed using either a Phanenstial incision, a vertical midline incision from below or above the umbilicus, or laparoscopy. During the initial exploration of the surgery, the following areas were examined: intestinal mesentery and serosa, liver capsule, stomach, paracolic areas, Douglas peritoneum, omentum and subdiaphragmatic peritoneum. Patients underwent hysterectomy and bilateral oophorectomy. Extrafascial hysterectomy (type 1) involved the complete excision of the uterus and cervix, with the parametrium and paravaginal tissues remaining intact. Radical hysterectomy (type 3) involved the removal of the cervix, proximal vagina, parametrial tissues and paracervical tissues. Omentectomy was performed when necessary. Management of endometrial cancer showed variation, particularly regarding the role of LND. While some patients with endometrial cancer underwent bilateral pelvic LND, others underwent both pelvic and para-aortic LND. The decision to perform lymph node dissection and its extent was individually selected by the operating surgeons. For cervical cancer patients, pelvic and para-aortic LND was usually performed up to the inferior mesenteric artery. In ovarian cancer patients, if the disease was not peritoneally widespread, pelvic and para-aortic lymph node sampling was performed up to the left renal vein. Gynecological pathologists conducted pathological evaluations. The number of lymph nodes excised was recorded. Pelvic LND included the removal of lymphatic tissue over the external and common iliac vessels and within the obturator fossa. Para-aortic LND was characterized by the excision of lymphatic tissue starting from the bifurcation of the inferior vena cava and aorta extending down to below the left renal vein. In some patients, the procedure was terminated below the inferior mesenteric artery, while in others, it extended to the level of the left renal vein. If bulky lymph nodes were not detected during pelvic LND, lymph nodes located distal to the deep circumflex iliac vein and beneath the obturator nerve were not excised. Absorbable sutures or hemoclips were used when necessary to secure the lymphatic vessels. They were also used in all cases to ligate the distal pelvic LND area. LND was generally performed using a unipolar cautery or Metzenbaum scissors. An abdominal drain was placed to monitor for any bleeding or leakage in the early postoperative period.

Only major intraoperative complications were examined in the study. Patients who could not be repaired with primary suture in vascular injuries and were repaired with prosthetic grafts were examined as a group. In addition, patients with approximately 1 cm or shorter inferior vena cava and repaired with primary suture were examined as a separate group. Patients who were completely cut or cauterized with ligasure were examined. Patients who were minimally cauterized with monopolar cautery without severing the obturator nerve could not be examined because they were not in the file records. Cases in which the ureter was completely divided into two pieces or the ureter was separated from the bladder inlet were reported in the study. Ureteral injuries that did not cause complete separation or only injured the vessel were not noted.

All participants received intravenous cefazolin as prophylaxis; extended surgeries ($>$3 hours) required additional doses. Patients also received thromboprophylaxis containing low molecular weight heparin. In our facility, this prophylaxis begins 12 hours before surgery and continues until the 28th postoperative day. In patients who had grafts placed due to vascular injury, thromboprophylaxis was extended up to 3 months. The dosage and duration were tailored based on the patient's body mass index and relevant risk factors such as history of embolism, atrial fibrillation, or cardiovascular disease. Compression stockings were recommended for all postoperative patients. Observations were recorded for up to 6 months postoperatively for this study. The timing of stent removal in patients with double J stents placed due to ureteral injury was evaluated based on postoperative follow-up at 3 and 6 months.

Numerical values are presented as means ± standard deviations. Categorical variables are shown as frequencies and percentages. Data recording and statistical analyses were performed using SPSS software (version 17, SPSS, Inc., Chicago, IL, USA). p values < 0.05 were considered statistically significant.

3. Results

Two thousand four hundred ninety-three cases were reviewed. Among these, 161 cases (6.5%) were diagnosed with cervical cancer, 1246 cases (49.9%) with endometrial cancer and 1086 cases (43.6%) with ovarian cancer. Major intraoperative complications associated with lymph node dissection (LND) occurred in 59 cases (2.3%). Among patients with cervical cancer, the incidence of injury to the inferior vena cava was 1 (0.6%), vascular injury requiring repair with a vascular graft was 1 (0.6%), obturator nerve injury occurred in 1 (0.6%), and ureteral injury occurred in 4 (2.5%) patients. In patients with endometrial cancer, the occurrences were as follows: injury to the inferior vena cava in 22 (1.7%) patients, vascular injury requiring repair with a vascular graft in 1 (0.08%) patient, obturator nerve injury in 2 (0.1%) patients, and ureteral injury in 2 (0.1%) patients. In ovarian cancer, the incidence of injury to the inferior vena cava was 16 (1.4%), vascular injury requiring repair with a vascular graft was 0, obturator nerve injury occurred in 5 (0.4%) patients, and ureteral injury

occurred in 4 (0.3%) patients.

In 39 patients (1.5%), small (<1 cm) lacerations of the inferior vena cava (IVC) were observed and were repaired with primary suturing (6.0 Prolene). The average age of patients with IVC injury was calculated to be 61.5 ± 10.3 years, and the average body mass index was 31.6 ± 6.2 (kg/m^2). Among patients with IVC injuries, 18 (46.2%) had hypertension, 10 (25.6%) had diabetes mellitus and 6 (15.4%) had asthma. The extent of LND involved lymph node excision up to the inferior mesenteric artery in 15 (38.5%) patients, and up to the left renal vein in 24 (61.5%) patients. Tumors in patients included cervical cancer in 1 (2.6%), endometrial cancer in 22 (56.4%) and ovarian cancer in 16 (41.0%). Pelvic lymph node involvement was present in 13 (33.3%) patients, while para-aortic lymph node involvement was noted in 12 (30.7%) patients. Sixteen (41.0%) patients were diagnosed with stage I–II, while 23 (59%) were classified as stage III–IV. One (2.6%) patient had concomitant colon cancer, and one (2.6%) had a surgical history due to colon cancer. Interval debulking surgery was performed in 9 (23.1%) patients following neo-adjuvant chemotherapy, and complementary surgery (pelvic-para-aortic LND, omentectomy, exploration) was conducted in 3 (7.7%) patients after being diagnosed with incidental endometrial cancer post-hysterectomy. One (2.6%) patient was diagnosed with Buerger's disease. Although all patients received thromboprophylaxis, 3 (7.7%) patients developed venous thrombosis in their legs during postoperative follow-up, along with leg swelling.

There were 3 (0.1%) cases of vascular injury requiring repair with a vascular graft. The clinical features of the cases are presented in Table 1. No complications were observed in any patients during postoperative follow-up after grafting. In Case 1, lymph node metastasis was present, and the adventitia and muscular layer of the common iliac artery were invaded. As a result of a 2 cm loss of the adventitia layer during LND, an approximately 2–3 cm segment was excised and repaired with a graft. In Case 2, a full-thickness incision of approximately 2 cm was made using an electrocautery device, necessitating repair with a graft. Case 3 was admitted with a preliminary diagnosis of ovarian cancer based on imaging. Intraoperatively, the mass was noted to be retroperitoneal, and upon excision, approximately 3 cm of the external iliac vein was observed to be damaged due to deep invasion, leading to repair with a graft. The pathological result was identified as Schwannoma.

The clinical features of the 8 (0.3%) patients with obturator nerve injury are listed in Table 2 (Fig. 1). In Case 3, the obturator nerve was sealed with a Ligasure device but not cut. The patient had no postoperative complaints upon observation. In the other 7 cases, the obturator nerve was severed using scissors or an electrocautery device. The proximal and distal ends of the nerve were sutured end-to-end with 6.0 or 7.0 Prolene, particularly around the myelin sheath. Five (71.4%) patients exhibited no postoperative findings. Two (28.6%) patients experienced restricted adduction in the affected limb, particularly when getting out of bed during the first week. By the first month of postoperative follow-up, both patients had returned to normal adduction.

Ureteral injury occurred in 9 (0.3%) patients (Table 3). In Case 1, the ureter was transected at the entry point into the bladder and sealed with a Ligasure device. Ureteroneocystostomy and double J stent placement were performed for repair. In Case 2, due to incidental cervical cancer following hysterectomy, parametrectomy + vaginal cuff excision and pelvic-paraaortic LND were conducted. In Case 3, a patient who had been treated with primary radiotherapy for cervical cancer approximately 3 years prior developed a recurrence, leading to lateral extended endopelvic resection (LEER), during which approximately 5 cm of the left ureter was excised due to tumor invasion into the ureter. Since primary repair was not possible, a Boari flap procedure was performed. It was observed that the patient had urinary leakage from both ureters and the bladder postoperatively. Bilateral percutaneous nephrostomy catheters were placed. Within the first month postoperatively, the patient was diagnosed with multi-organ failure and subsequently passed away. Cases 6 and 7 were patients who underwent interval debulking surgery following neo-adjuvant chemotherapy. The diagnosis of urinary leakage in patient 8 was established through postoperative antegrade urinary system imaging. A double J stent was placed via cystoscopy. There was no improvement in the ureter. In the fourth month postoperatively, the patient was diagnosed with liver metastasis. A percutaneous nephrostomy catheter was placed. The patient passed away in the seventh month postoperatively. The medical history of Case 9 revealed that the patient had been operated on for colon cancer approximately six years ago. In conclusion, there were no complications observed during the postoperative follow-up of the six patients who underwent intraoperative diagnosis and primary repair, as well as the patients who had ureteroneocystostomy.

TABLE 1. Vascular injury cases repaired with vascular grafts.

No	Primary tumor	Age	BMI	Injured vascular	Type of surgery	Count of PLN	Count of PaLN	Stage
1	Serous type EC	61	31.6	Common iliac artery	Type 1 H + O + PPaLND	11	7	4B
2	Squamous type CC	57	29.4	Eksternal iliac artery	Type 3 H + O + PLND	15	-	1B1
3	Schwannoma	48	31.2	Eksternal iliac vein	Type 1 H + O + PLND	7	-	-

EC: Endometrial cancer; CC: Cervical cancer; BMI: Body mass index (kg/m^2); H + O + PPaLND: Hysterectomy + oophorectomy + pelvic paraaortic lymph node dissection; PLND: Pelvic lymph node dissection; PLN: Pelvic lymph node; PaLN: paraaortic lymph node.

TABLE 2. Clinical characteristics of obturator nerve injury cases.

No	Primary tumor	Age	BMI	Type of surgery	Count of PLN	Count of PaLN	Stage
1	Squamous type CC	35	22.0	Type 3 H + PPaLND	16	8	1B3
2	Endometrioid type EC	64	30.5	Type 1 H + O + PLND	9		3C1
3	Endometrioid type EC	47	30.5	Type 1 H + O + PPaLND	31	5	1A2
4	Granulosa type OC	62	28.7	Type 1 H + O + PPaLND	16	12	1A
5	Serous type OC	54	29.0	Type 1 H + O + PPaLND	21	4	3C
6	Serous type OC	66	30.5	Type 1 H + O + PPaLND	31	14	3C
7	Serous type OC	71	30.1	Type 1 H + O + PPaLND	30	11	1C
8	Serous type OC	70	28.7	Type 1 H + O + PPaLND	18	14	2A

EC: Endometrial cancer; CC: Cervical cancer; OC: Ovarian cancer; BMI: Body mass index (kg/m^2); H + O + PPaLND: Hysterectomy + oophorectomy + pelvic paraaortic lymph node dissection; PLN: Pelvic lymph node; PaLN: paraaortic lymph node; PLND: Pelvic lymph node dissection.

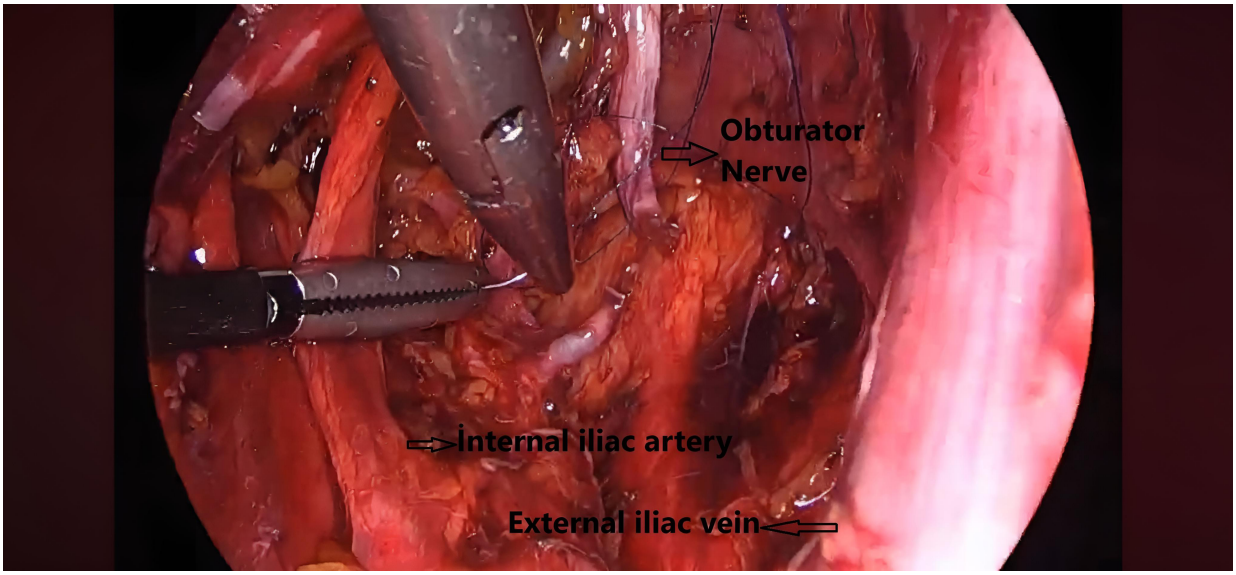

FIGURE 1. Obturator nerve cut image.

TABLE 3. Clinical characteristics of ureter injury cases.

No	Primary tumor	Age	BMI	Type of surgery	Count of PLN	Count of PaLN	Stage
1	Squamous type CC	64	48.0	Type 1 H + O + PLND	24		1A2
2	Squamous type CC	48	31.2	Upper vagina excision + Parametria + O + PPaLND	24	6	1B2
3	Squamous type CC	51	29.4	LEER + PLND	4		3B
4	Serous type EC	69	30.1	Type 1 H + O + PPaLND	16	11	2C
5	Endometrioid type EC + OC	76	32.3	Type 1 H + O + PPaLND	8	6	3C1
6	Serous type OC	62	28.0	(IVD) Type 1 H + O + PPaLND	21	6	3C
7	Serous type OC	42	32.6	(IVD) Type 1 H + O + PPaLND	13	5	3C
8	Squamous type CC	48	22.1	Type 3 H + O + PPaLND	11	13	1B3
9	Serous type OC	77	25.4	Type 1 H + O + PPaLND	14	9	2A

EC: Endometrial cancer; CC: Cervical cancer; OC: Ovarian cancer; BMI: Body mass index (kg/m^2); H + O + PPaLND: Hysterectomy + oophorectomy + pelvic paraaortic lymph node dissection; IVD: Interval debulking; LEER: Lateral extended endopelvic resection; PLN: Pelvic lymph node; PaLN: paraaortic lymph node; PLND: Pelvic lymph node dissection.

4. Discussion

The study examined major complications (2.3%) occurring during retroperitoneal lymph node dissection associated with gynecological malignancies. Although these cases are rare, they can lead to significant morbidity and mortality in patients. We found that the incidence of complications related to morbidity was very low in patients who were diagnosed and repaired intraoperatively.

The obturator nerve originates from the lumbar spinal nerves L2–4 and innervates the adductor muscles [8]. The obturator nerve exits the lumbar plexus from the posterior surface of the psoas muscle, travels medially and inferiorly to the lower part of the obturator fossa, and subsequently leaves the pelvis through the obturator canal. It then divides into anterior and posterior branches. The site of branching occurs in 52% within the obturator canal, 25% in the thigh, and 23% in the intrapelvic region [9]. The function of the anterior branch is to innervate the skin of the inner thigh. Injury to this nerve can result in numbness and pain in the thigh. Damage to the posterior branch may lead to weakness in thigh adduction and difficulty in performing movements such as crossing one foot over the other and standing up from bed [8]. In cases of intraoperative injuries, nerve repair can be performed using non-absorbable sutures of 5.0–6.0 in end-to-end, end-to-side or side-to-side configurations. When the nerve ends cannot be approximated, a graft may be used [10]. Studies examining obturator nerve injury post LND found an incidence rate of 0–3.4% [8, 11]. No postoperative findings or electromyography deficits were observed in the eight patients who underwent repair [8]. One patient who did not receive nerve repair experienced limitations in adduction and sensory loss [8]. Based on the literature and our own data, it can be concluded that intraoperative recognition and repair of injuries lead to safe and complete recovery in almost all patients. For repair, end-to-end suturing is performed using non-absorbable sutures size 7.0 [12, 13]. Fibrin glue is an accepted method in peripheral nerve repair [12, 13]. Successful outcomes can be achieved with nerve grafts (particularly sensory nerves) [12, 13]. Although nerve wrapping or tubing techniques are alternatives, there is no reported literature on their use specifically for obturator nerve injuries. Commonly used materials for tubing include silicone, autologous vessels, and muscle autografts. In our cohort, eight patients (0.3%) experienced obturator nerve injury. In our study and in the literature, obturator nerve damage appears to be well below 1%. It is generally observed to be due to carelessness and fatigue during surgery. In one patient, the obturator nerve was sealed with a Ligasure device but was not cut. This patient had no complaints during postoperative observation. In seven cases, the obturator nerve was severed using scissors or an electrocautery device. End-to-end suturing was performed during repair. Two patients (28.6%) experienced limitations in adduction movements of the affected limb while getting out of bed during the first week. By the one-month postoperative follow-up, both patients had returned to normal adduction. In the long term, the quality of life in none of the patients was affected. We believe that the muscles functioning with other nerves rapidly compensate for movements in adduction when the obturator nerve is damaged.

The ureter enters the pelvis by crossing the common iliac artery. Injury to the ureter during LND typically occurs in this region. Ureteral injury during LND is a rare complication, with an incidence of 0.3% [11, 14]. Repair typically involves placing a double J stent within the ureter (with one end in the bladder and the other end positioned in the ureteropelvic region) and suturing the ends of the ureter together using absorbable sutures. In cases where the injury occurs lower down, a stent is placed within the ureter to facilitate re-implantation at the base of the bladder. In cases of segmental loss of the ureter, the Boari flap procedure (creating a ureter from bladder mucosa) may be utilized [11]. Especially in cases of distal ureter or, in some instances, middle ureter injuries, ureteroneocystostomy is the most appropriate treatment option [14]. If the distal segment is deemed unsuitable for anastomosis, other options include the Boari bladder flap, transuretero-ureterostomy, or renal autotransplantation [14]. Failures of direct end-to-end anastomosis of the ureter typically occur due to factors such as crushing or compression with an instrument, partial or complete transection, thermal damage during coagulation, electrical leakage, denervation and devascularization [14]. Intraoperatively unnoticed injuries may present with symptoms such as flank pain, urinary incontinence, vaginal or urinary leakage, hematuria, fever, azotemia, or urinoma in the early postoperative period. In our study, ureteral injury occurred in 9 patients (0.3%). The incidence of ureteral damage appears to be similar to the literature. The highest rate appears to be in cervical cancer with radical parametrium removal (2.5%). One patient was treated with ureteroneocystostomy and placement of a double J stent. One patient underwent a Boari flap procedure due to segment loss of the ureter. The diagnosis for one patient was made postoperatively, and a double J stent was placed with the aid of cystoscopy. Among the six patients who were diagnosed intraoperatively and received primary repair, there were no complications during their postoperative follow-ups. Among the two patients who did not benefit from repair, one developed early-stage metastasis, while the other had a ureter segment within a tumor. Therefore, we believe that the absence of healing in both patients is related to the remaining tumor.

Major vascular injury has a mortality rate of 1.1% [15]. Vascular variations are significant risk factors for injury. The prevalence of retroperitoneal vascular variations can reach up to 30% [16]. In a study analyzing vascular injuries in approximately 200,000 gynecological surgical procedures, the risk of postoperative venous thromboembolism was found to be 6.3%, and the mortality rate was 1.7% [17]. The need for vascular repair in benign gynecological cases is around 0.1% [17]. In our study, major vascular injury was identified in the form of inferior vena cava laceration in 39 patients (1.5%). All patients underwent primary suturing of the injury. The reason why the rate of vascular damage in our study was lower than the literature was that cases with major damage were recorded. Cases with injuries of approximately 1 cm were included. Despite all patients receiving thrombosis prophylaxis, venous thrombosis occurred in the legs of 3 patients (7.7%), leading to swelling in the affected limbs. There were 3 cases (0.1%) that required vascular repair with the use of a graft. No complications were observed during postoperative follow-ups

in any of the patients who received grafts. Our rates are consistent with the literature, and we believe that the morbidity post-repair, especially for older cancer patients, is low.

The most significant limitation of the study is its retrospective nature. However, we believe that proper file documentation mitigated this limitation. Although the second notable limitation is the small number of cases, such complications are generally rare. The third significant limitation is that surgical procedures were performed by different surgeons over the years.

5. Conclusions

In conclusion, retroperitoneal lymph node dissection associated with gynecological malignancies, while rare (2.3%), can lead to major complications. No long-term functional loss was observed in patients with obturator nerve injury and repair. Inferior vena cava injury and repair with primary suture are relatively common. Long-term follow-up should be done with prospective studies for thrombosis or embolism.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

İSS, BÖ and KG—designed the research study. MÖ—performed the research. AÖ, İÇ and VG—analyzed the data. VG and İÇ—wrote the manuscript. All authors read and approved of the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics committee approval was received from İzmir Katip Çelebi University for the study (Decision no: 0188/2024), and all procedures adhered to the ethical standards outlined in the 1964 Helsinki declaration and its subsequent amendments or equivalent ethical standards. Since this study involved a retrospective review of a database, participant consent was deemed unnecessary.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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