Predictors of complication after groin dissection: a single-centre experience

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Background: Inguinal lymphadenectomy (ILND) has historically been associated with substantial morbidity. The objective of this study was to obtain contemporary ILND morbidity rates and to identify potentially preventable risk factors.

Methods: We carried out a retrospective review of medical records for all superficial, deep, and combination groin dissections performed at a single, high-volume academic centre between January 2007 and December 2020. We collected data points for patient, disease, and surgery characteristics, and cancer outcomes. The outcome of interest was any complication within 30 days of surgery. Complications included wound infection, wound necrosis or disruption, seroma, drainage procedure, hematoma, and lymphedema. We performed multivariate logistic regression using SAS version 9.4.

Results: We identified 139 patients having undergone 89 superficial, 12 deep, and 38 combined dissection types, respectively. Melanoma accounted for 84.9% of cases. Of these patients, 56.1% had an adverse postoperative event within 30 days. Increasing age (odds ratio [OR] 1.04, 95% confidence interval [CI] 1.01–1.07, $p < 0.01$) and number of positive lymph nodes harvested (OR 1.22, 95% CI 1.00–1.50, $p = 0.05$) were associated with more complications. Patients with deep dissection showed a lower likelihood of complications than those with superficial dissection (OR 0.15, 95% CI 0.03–0.84, $p < 0.05$).

Conclusion: Complication rates after ILND remain high. We identified a number of risk factors, providing opportunities for better selection and prevention.

Contexte : La lymphadénectomie inguinale (LI) a toujours été associée à une morbidité importante. Cette étude avait pour but de mesurer les taux de morbidité actuellement associés à la LI et d'en identifier les facteurs de risque potentiellement évitables.

Méthodes : Nous avons procédé à une revue rétrospective des dossiers médicaux de tous les cas de curage inguinal superficiel, profond et complet effectués dans un seul centre hospitalier universitaire achalandé entre janvier 2007 et décembre 2020. Nous avons recueilli des données relatives aux caractéristiques des malades, des maladies et des chirurgies, de même que l'issue des cancers. Le paramètre principal était toute complication survenant dans les 30 jours suivant la chirurgie. Les complications incluaient infection, nécrose ou déhiscence de la plaie, sérome, pose de drain, hématome et lymphœdème. Nous avons procédé à une analyse de régression logistique multivariée à l'aide du logiciel SAS Enterprise 9.4.

Résultats : Nous avons recensé 139 personnes ayant subi un curage inguinal : 89 superficiels, 12 profonds et 38 complets. Un mélanome justifiait l'intervention dans 84,9 % des cas. Parmi ces malades, 56,1 % ont eu une complication postopératoire dans les 30 jours suivants l'intervention. Un âge avancé (rapport des cotes [RC] 1,04, intervalle de confiance [IC] de 95 % 1,01–1,07, $p < 0,01$) et le nombre de ganglions lymphatiques positifs réséqués (RC 1,22, IC de 95 % 1,00–1,50, $p = 0,05$) ont été associés à plus de complications. Les curages profonds ont été associés à une probabilité moindre de complications comparativement aux curages superficiels (RC 0,15, IC de 95 % 0,03–0,84, $p < 0,05$).

Conclusion : Les taux de complications suivant la lymphadénectomie inguinale restent élevés. Nous avons identifié certains facteurs de risque qui sont autant d'occasions de mieux sélectionner les malades et d'améliorer la prévention.

Inguinal lymphadenectomy (ILND) is a surgical procedure used for the management of regionally advanced or recurrent malignancies such as melanoma.[1,2] It is classified into different types, based on Ploeg's definitions.[1] Superficial dissection includes removing all the tissue and lymph nodes in the inguinofemoral area, extending to the apex of the femoral triangle and deep to the fascia lata, with skeletonization of the vessels. Deep dissection involves the removal of all the tissues running along the inguinofemoral and the deep iliac vessels up to the common iliac. In some cases, the superficial and deep dissection procedures are combined. These operations have historically been associated with a high risk of morbidity that affects the patient's quality of life.[3–10] Negative postoperative outcomes include both acute and chronic complications. Adverse events such as wound infection, seroma, skin necrosis, flap complications, or wound dehiscence[5–7] often lead to extended hospital stays, delayed return to normal activities, and reduced quality of life.[2,8–10]

The frequency of superficial, deep, and combined dissection procedures has steadily decreased owing to the advent of less invasive techniques such as sentinel lymph node biopsy (SLNB)[11–13] and, more recently, because of selective dissection protocols such as the second Multicenter Selective Lymphadenectomy Trial (MSLT-2).[12,14] Furthermore, the development of systemic treatment options, such as targeted therapy and immunotherapy, has resulted in a superselection of more complex patients or those with treatment failure being directed to surgery. As a result, there are fewer opportunities to improve surgical outcomes, reduce adverse events, and ensure optimal training.

The aim of this study was to identify risk factors for adverse events after ILND. By obtaining a contemporary rate of early postoperative complications and associated risk factors, we can identify possible targets for improvement of surgical outcomes. A better ability to assess the risk of adverse events offers the potential to develop perioperative strategies that can decrease their incidence.

Methods

We performed a retrospective review of all patients who underwent ILND between January 2007 and December 2020 at the McGill University Health Centre, a tertiary surgical oncology referral centre located in Montréal, Canada. After securing institutional research ethics board approval, we queried the hospital operative database to identify all cases of superficial, deep, and combined dissection procedures performed by surgical oncologists. We excluded patients who had undergone concurrent popliteal dissection. In addition to collecting clinical follow-up data, 2 trained clinicians collected the following variables for each case: patient characteristics (sex, date of birth, smoking history, history of diabetes, height, weight, body mass index [BMI], hypothyroidism, history of radiation therapy), disease information (primary tumour characteristics [i.e., location, histology, thickness, mitosis, ulceration, lympho-vascular invasion, regression, perineural invasion, *BRAF*]); surgical technique details (site, date of surgery, presentation, indication, use of prophylactic antibiotics, use of antithrombotic prophylactic, use of a sequential compression device [SCD], performing surgeon, dissection type, incision type, use of sartorius flap, operative time, presence of intraoperative complications, blood loss, Foley placement, postoperative compressive bandaging, drainage, duration of immobilization, use of postoperative antibiotics, total length of hospital stay, total lymph nodes harvested, and total positive lymph nodes harvested), and perioperative care (wound infection, signs of wound necrosis, use of wound care services, drainage procedure, signs of hematoma, lymph edema, lymphorrhea, date of drain removal, other complications, emergency department postoperative admission, use of neoadjuvant therapy, use of adjuvant systematic treatment, use of adjuvant radiotherapy, patient status, and date of recurrence). The outcome of interest was the occurrence of an adverse event within 30 postoperative days, categorized as part of 1 of the following groups: wound infection, wound necrosis or dehiscence, seroma, hematoma, and lymphedema. We defined a wound infection as any clinical symptom of infection such as erythema, warmth, or notable discharge at the surgical wound requiring treatment with antibiotics or drainage. We included infected seromas in this category. We defined wound necrosis as

Table 1. Patient and disease characteristics

Characteristic	No. (%)* of patients who underwent inguinal lymphadenectomies, *n* = 139
Sex	
Female	81 (58.3)
Male	58 (41.7)
Age, yr, mean ± SD†	60.6 ± 16.3
Smoker	
Yes	9 (6.5)
No	130 (93.5)
Diabetes	
Yes	8 (5.7)
No	131 (94.3)
Cardiovascular disease	
Yes	45 (32.4)
No	94 (67.6)
Hypothyroidism	
Yes	12 (8.6)
No	127 (91.4)
Previous radiation therapy	
Yes	4 (2.8)
No	135 (97.2)

SD = standard deviation.
*Unless otherwise specified.
†Minimum 14; maximum 92; median 62; mode 6.

necrotic edges of the wound that necessitated secondary wound healing for closure and wound dehiscence as a partial or complete separation of the layers of the wound. We defined seroma as the occurrence of a swelling or collection of fluctuating fluid in the inguinal area, whether or not a drainage procedure was performed. Last, we defined lymphoedema as any swelling of the involved limb reported as a clinical observation.

We used frequencies and percentages for description of patient and group characteristics. Selection of potential predictors for analysis was based on the quality of data for each variable and the cohort size. We assessed association of variables with early complications by univariate and multivariable logistic regression analyses models using SAS version 9.4 (SAS Institute Inc.). The final model included sex, age, diabetes, indication, dissection type, total number of lymph nodes harvested, and total number of malignant lymph nodes harvested.

Results

A total of 141 ILNDs were performed during the study period. Of these, we excluded 2 owing to limited access to data. Key patient and disease characteristics are shown in Table 1. Of the 139 procedures, 81 (58.2%) were performed on females. Mean patient age at surgery was 59 years for females (standard deviation [SD] 16.2) and 62 years for males (SD 16.5). Most patients did not smoke or have diabetes or a documented history of cardiovascular disease, hypothyroidism, or receiving radiation therapy to the groin area.

Table 2 (part 1 of 2). Technical factors

Factor	No. (%)* of patients who underwent inguinal lymphadenectomies, *n* = 139
Surgeon volume†	
High	84 (60.4)
Medium	46 (33.2)
Low	9 (6.4)
Pathology	
Melanoma	118 (84.8)
Sarcoma	12 (8.6)
Other‡	9 (6.4)
Presentation	
Recurrent disease	85 (61.2)
Incident disease	54 (38.8)
Indication	
Clinically evident disease	79 (56.8)
Radiologic-only disease	27 (19.4)
Sentinel node–positive disease	33 (23.7)
Dissection type	
Superficial	89 (64.0)
Deep	12 (8.6)
Combined	38 (27.4)
Prophylactic antibiotics	
Yes	93 (66.9)
No	1 (0.7)
NA	45 (32.3)
Antithrombotic prophylactic	
Yes	86 (61.8)
No	7 (5.2)
NA	46 (33.1)
Sequential compression device use	
Yes	86 (61.8)
No	2 (1.4)
NA	51 (36.6)
Operative time, min, mean ± SD§	
Superficial, *n* = 85	172.6 ± 54.1
Deep, *n* = 11	235.6 ± 138.2
Superficial and deep, *n* = 36	307.8 ± 105.9
All, *n* = 132	214.7 ± 99.50

Table 2 (part 2 of 2). Technical factors

Factor	No. (%)* of patients who underwent inguinal lymphadenectomies, *n* = 139
Intraoperative complications¶	
Yes	2 (1.4)
No	137 (98.5)
Blood loss, mL, mean ± SD; *n* = 91**	75.4 ± 107.8
Foley placement	
Yes	84 (60.4)
No	9 (6.4)
NA	46 (33.0)
No. of drains left	
0	34 (24.4)
1	78 (56.1)
2	26 (18.7)
3	1 (0.7)
Duration of immobilization, h, mean ± SD; *n* = 79††	9.9 ± 10.0
Duration of postoperative antibiotic use, d, mean ± SD; *n* = 80‡‡	0.1 ± 0.4
Total lymph nodes harvested, mean ± SD; *n* = 139§§	11.5 ± 5.3
Total positive lymph nodes, mean ± SD; *n* = 139¶¶	2.1 ± 3.3

NA = not available; SD = standard deviation.

*Unless otherwise specified.

†Based on mean annual case volume during the study period.

‡Other pathologies include lipoma (*n* = 1), neuroendocrine carcinoma (*n* = 1), squamous cell carcinoma (*n* = 1), and Merkel cell carcinoma (*n* = 6).

§Measured from skin incision to dressing application at the end of the procedure.

- Superficial: minimum 89.0; maximum 394.0; median 166.0; mode 115.0.
- Deep: minimum 83.0; maximum 596.0; median 194.0.
- Superficial and deep: minimum 145.0; maximum 583.0; median 298.5; mode 210.0.
- All: minimum 83.0; maximum 596.0; median 192.0; mode 115.0.

¶Includes ventilation difficulty, bleeding.

**Minimum 0.0; maximum 400.0; median 20.0; mode 0.0.

††Defined as recovery room arrival time to the first mobilization out of the bed. Minimum 0.0; maximum 24.0; median 12.0; mode 0.0.

‡‡Minimum 0.0; maximum 2.0; median 0.0; mode 0.0.

§§Minimum 0.0; maximum 32.0; median 10.0; mode 8.0.

¶¶Minimum 0.0; maximum 24.0; median 1.0; mode 1.0.

Most surgeries (84.9%) were performed for a diagnosis of melanoma. The second most frequent diagnosis was sarcoma (8.6%). Less frequent pathologies included neuroendocrine carcinoma, squamous cell carcinoma, and Merkel cell carcinoma. Most lymphadenectomies were performed for recurrent disease (61.1%), most often clinically evident (56.8%) versus radiologically evident only (19.4%). About a quarter of cases (23.7%) were operated for microscopic-only disease (sentinel lymph node–positive).

Key procedure-related characteristics are shown in Table 2. Of the 139 lymphadenectomies, 64% were superficial dissections, 8.6% were deep dissections, and 27.3% were combined superficial and deep dissections. Prophylactic antibiotic and antithrombotic use were documented in 66.9% and 61.9% of operative records, respectively. A sequential compression device was applied in 61.9% of patients, and a Foley catheter was inserted in 60.4%. Mean operative time (measured from incision time to application of dressing) was 172.6 minutes, 235.6 minutes, and 307.8 minutes for superficial, deep, and combined dissections, respectively. Of the 139 patients, 49.4% had a sartorius flap while 28.5% did not, and 22.5% had missing information. Mean blood loss was 75.8 mL for all procedures, and an intraoperative complication was noted in only 1.4% of patients. At the end of the procedure, a drain was left in 75.5% of patients, with 56.1%, 18.7%, and 0.7% having 1, 2, or 3 drains, respectively. According to medical order timestamps, postsurgical immobilization lasted an average of 9.9 hours, including the recovery room stay. The mean number of total lymph nodes harvested was 11 of all procedure types, and the mean number of positive lymph nodes harvested was 2. Of all records, 5.7% needed home care services during the 30 days after surgery.

The frequency of any complication reported was 65.2%, 16.7%, and 50.0% for superficial, deep, and combined dissections, respectively (Table 3). When stratified by type of cancer, 55.9% of all melanoma, 50.0% of sarcoma, and 77.8% of other patients reported the occurrence of any postoperative complication. The 2 most common complications were wound infections (26.6%) and seromas (26.6%); 5.76% of patients had a wound disruption. Of the 37 patients with a seroma, 83.8% required a drainage procedure. The median number of drainage procedures was 2. Only 2 patients (1.4%) developed a hematoma. Clinically evident lymphoedema was recorded within 30 postoperative days in 34 patients (24.5%). Overall, 5.76% of patients required home care services to manage a postoperative complication and 16.6% returned to the emergency department during the 30-day postoperative period.

Stratifying by procedure type, we observed a slightly higher adverse outcome rate among patients who underwent a superficial dissection through a transverse incision. However, incision type was not reported in 29.2% ($n = 26$) of patients with superficial dissection, and 34.6% of those with missing information also had complications. With respect to deep dissection, we did not perform stratification by incision type owing to small sample size ($n = 12$).

Table 3. Frequency of complications, by type

Postoperative complication	No. (%)* of patients, $n = 139$
Any complications	
Yes	78 (56.2)
No	61 (43.8)
Wound infection	
Yes	37 (26.6)
No	102 (73.4)
Wound necrosis or disruption	
Yes	8 (5.7)
No	131 (94.3)
Seroma	
Yes	37 (26.6)
No	102 (73.4)
Drainage procedure	$n = 37$
Yes	31 (83.7)
No	6 (16.3)
No. of drainage procedures, mean ± SD; $n = 31$†	2.19 ± 2.07
Hematoma	
Yes	2 (1.4)
No	137 (98.6)
Lymphedema	
Yes	34 (24.5)
No	105 (75.5)
Other complications	
Yes	6 (4.4)
No	133 (95.6)
Use of additional health services	
Wound care	
Yes	16 (11.5)
No	123 (88.5)
Emergency room visit	
Yes	23 (16.5)
No	116 (83.5)

SD = standard deviation.
*Unless otherwise specified.
†Minimum 1; maximum 10; median 2; mode 1.

After assessing distribution of data, we omitted variables with disproportionate categories or high rates of missing data from modelling analyses (e.g., previous radiation therapy). We performed univariate analysis with available reliable data (Table 4). Multivariate analysis presented age, dissection type, and number of positive lymph nodes as statistically significant predictors of complications (Table 5). For every year increase in the patient's age, the odds of a complication increased by 3.8% (OR 1.04, 95% CI 1.01–1.07, $p < 0.01$). Deep dissections were associated with lower complication rates than superficial dissections and combined lymphadenectomies. Deep dissection procedures show 84.7% lower odds of having complications than superficial dissection (OR 0.15, 95% CI 0.03–0.84, $p < 0.05$).

Finally, malignant nodal yield was shown to affect adverse events; for every additional positive lymph node

Table 4: Univariate logistic associations for risk of any complication

Predictor	Description	*n*	OR point estimate	95% CI
Sex	Male v. female	139	1.133	0.573–2.242
Age	For every 1-year increase	139	1.033	1.010–1.056
Smoker	Yes v. no	139	0.946	0.243–3.684
Diabetes	Yes v. no	139	1.284	0.294–5.597
Cardiovascular disease	Yes v. no	139	0.720	0.348–1.489
Hypothyroidism	Yes v. no	139	0.105	0.013–0.836
Presentation	Initial v. recurrence	139	1.953	0.963–3.964
Indication	Sentinel node positive (ref.)	33	–	–
	Clinical	79	0.697	0.298–1.632
	Radiologic	27	0.344	0.120–0.987
Dissection type	Superficial (ref.)	89	–	–
	Deep	12	0.107	0.022–0.519
	Superficial deep	38	0.534	0.247–1.156
No. of drains left	Continuous, for every 1 increase	139	2.015	1.182–3.433
Operative time	Continuous, for every 1 increase	132	1.002	0.968–1.038
Blood loss	Continuous, for every 10 mL increase	139	0.999	0.960–1.039
Duration of immobilization	Continuous, for every 1 h increase	79	1.016	0.967–1.066
Duration of postoperative antibiotic use	Continuous, for every 1 d increase	80	0.942	0.245–3.614
Duration of postoperative hospital stay	Continuous, for every 1 d increase	80	0.950	0.687–1.313
Total LN harvested	Continuous, for every 1 increase	139	1.060	0.990–1.135
Total positive LN harvested	Continuous, for every 1 increase	139	1.197	1.018–1.408
Intraoperative complications	Yes v. no	139	1.322	0.081–21.575

CI = confidence interval; LN = lymph node; OR = odds ratio; ref. = reference.

Table 5. Multivariate logistic associations for risk of any complication

Predictor	Description	OR point estimate	95% CI
Sex	Male v. female	0.852	0.377–1.929
Age	For every 1 yr increase	1.038	1.009–1.067
Diabetes	Yes v. no	0.974	0.193–4.912
Indication	Sentinel node positive (ref.)	–	–
	Clinical	0.467	0.168–1.295
	Radiologic	0.262	0.062–1.107
Dissection type	Superficial (ref.)	–	–
	Deep	0.153	0.028–0.838
	Superficial deep	0.388	0.120–1.254
Total LN harvested	Continuous	1.064	0.960–1.180
Total positive LN harvested	Continuous	1.224	0.999–1.498

CI = confidence interval; LN = lymph node; OR = odds ratio; ref. = reference.

dissected, the risk of a 30-day complication increases by 22.4% (OR 1.22, 95% CI 1.00–1.50, $p < 0.05$).

Discussion

Inguinal lymphadenectomy is the operation of choice in many cancers. However, it is a complex procedure, historically associated with a high risk of substantial postoperative morbidity, which affects both quality of life and survival.[15] The management of regional lymph nodes in cancer has evolved substantially over the past 2 decades. For instance, in melanoma, systematic ILND has been replaced by SLNB, an operation with much less risk of morbidity.[12,13,16] In addition, sentinel nodes that harbour only micrometastatic disease are now followed clinically, with a completion dissection offered only to those who develop clinical or radiologic disease.[12,14,16] These achievements have deferred ILND to much more aggressive, clinically palpable disease or subsequent relapse. With fewer of the more complex cases being directed to dissection, opportunities to achieve adequate training for these complex procedures and to optimize surgical outcomes have also decreased substantially. The advent of effective systemic therapy further reinforces the need for a reassessment of the impact of these surgeries as postoperative complications inevitably delay access to treatment.[17] There is also evidence showing that complications are associated with significant implication for earlier cancer

recurrence and death.[18,19] Past ILND studies have been limited by small sample sizes, with most ranging from 50 to 120 patients.[8,15,20] We therefore performed this study in a large cohort of patients undergoing ILND to determine the factors affecting early postoperative complication rate and to identify potential opportunities for innovative protocols to improve surgical outcomes. Similarly to other smaller series, we observed a high rate of complications (56.1%) in patients within 30 days of undergoing superficial, deep, or combined dissection for cancer.[21–23]

In this series, age was a statistically significant predictor of an early postoperative complication. With 60% of all cancers occurring in patients older than 65 years, a "grey storm" is expected in oncologic services.[24–26] Innovative approaches toward patient selection and preparation may provide an opportunity to intervene and mitigate against negative outcomes. For example, in other complex surgical procedures, prehabilitation is recognized as a new approach to cancer care, with emphasis on preoperative care that tackles goals to improve physical activity, nutritional intake, and psychological well-being as a means of optimizing surgical outcomes.[27–29] Studies provide evidence of prehabilitation as an effective intervention in reducing postoperative morbidity in older patients undergoing surgery for colorectal, liver, and pancreatic malignancies.[30–33] To our knowledge, there are no prehabilitation protocols designed for complex ILND; this gap in care represents an interesting avenue for research. Findings of newly published clinical trials in locally advanced melanoma support the use of neoadjuvant therapy.[34,35] Authors identified the positive effects of introducing protocols that focused on patient knowledge to include proactive care (i.e., wound care treatment and early recognition of wound complications).[36,37] As integration of neoadjuvant therapy into melanoma treatment plans gains popularity, there is opportunity to develop prehabilitation and patient education interventions during extended preoperative periods. With the recognition that not all older patients present the same risk level, a multidimensional frailty score system would help to identify those with lower physiologic reserve who have a greater chance of postoperative morbidity.[38–40] Few studies have looked at these types of tools in the surgical treatment planning of cutaneous malignancies.[41,42] The FRAIL (Fatigue, Resistance, Ambulation, Illnesses, a Loss of Weight) score, validated by Morley and colleagues, is an example of a clinical decision support tool that accurately identifies patients who would benefit most from prehabilitation.[43] It has been used in nonmelanoma skin pathologies and presents itself as a reliable predictive tool for postoperative outcomes.[42,44]

Type of dissection carries considerable weight on the risk of complications, disfigurement, and mortality.[45–47] Previously published literature presents contradictory results; some studies report similar complication rates while others show higher odds of complication among those with deep dissection. Dasmahapatra and colleagues found no difference in complication or lymphedema rate between the 2 operations.[2] Spillane and colleagues reported the same.[48] Conversely, James found higher odds of complication in deep dissection patients.[49] Our findings diverged, with lower odds of complications for deep dissection than superficial dissection. We speculate that these findings are a result of small sample sizes across the literature. In fact, the average number of reported cases in published literature is less than 100, whereas we report a series of 139.

In our study, we observed that for every additional positive lymph node dissected, the risk of complication increased in a statistically significant manner. Patients with greater burden of disease tend to require more aggressive dissections, often yielding higher numbers of lymph nodes harvested.[50] However, with respect to palpable lymphadenopathy, our data did not show any difference in complication incidence. This is similar to a recent mixed-methods study, complemented with a retrospective review and semi-structured interviews reporting no significant differences concerning perioperative outcomes including postoperative complications.[51] Promising research is emerging concerning the use of neoadjuvant therapy (immunotherapy and targeted therapy) with high rates of pathologic complete response.[52] Although it is not yet the standard of care for stage III melanomas, these studies suggest the important role of presurgical therapy in potentially reducing disease burden in bulky clinical disease, thereby decreasing postoperative complications. Restricted access to operating rooms during the COVID-19 pandemic resulted in increased use of preoperative systemic therapy, with good results. Nevertheless, longer follow-up is required to validate the impact on cancer-specific outcomes.[52]

Limitations

This study has several limitations. The infrequency of the procedure resulted in a relatively small sample size. That being said, our study has a larger number of procedures than older publications, most of which report on fewer than 100 patients. In addition, we were limited to data documented in medical records, which tend to be inconsistent in availability and detail (e.g., BMI). This remains a common challenge in retrospective chart audits, making some statistical correlations impossible. Despite these limitations, we have shown that the rate of complications after groin lymphadenectomy remains high. We have identified opportunities for future multisite, collaborative research, including prospective standardized data collection and quality improvement interventions for the care of patients undergoing inguinal lymph node dissection. This surgery carries high risk of complications; meticulous patient selection, preoperative planning, and optimization, in addition to presurgical systemic treatment to downstage the disease burden, may help to minimize the morbidity of ILND.

Conclusion

Early postoperative complication rates after ILND remain high. A number of risk factors were identified, providing opportunities for better case selection and prevention.

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References

1. van der Ploeg AP, van Akkooi AC, Schmitz PI, et al. Therapeutic surgical management of palpable melanoma groin metastases: superficial or combined superficial and deep groin lymph node dissection. *Ann Surg Oncol* 2011;18:3300-8.
2. Dasmahapatra KS, Karakousis CP. Therapeutic groin dissection in malignant melanoma. *Surg Gynecol Obstet* 1983;156:21-4.
3. Henderson MA, Gyorki D, Burmeister BH, et al. Inguinal and ilioinguinal lymphadenectomy in management of palpable melanoma lymph node metastasis: A long-term prospective evaluation of morbidity and quality of life. *Ann Surg Oncol* 2019;26:4663-72.
4. Moody JA, Botham SJ, Dahill KE, et al. Complications following completion lymphadenectomy versus therapeutic lymphadenectomy for melanoma - A systematic review of the literature. *Eur J Surg Oncol* 2017;43:1760-7.
5. Serpell JW, Carne PW, Bailey M. Radical lymph node dissection for melanoma. *ANZ J Surg* 2003;73:294-9.
6. Sabel MS, Griffith KA, Arora A, et al. Inguinal node dissection for melanoma in the era of sentinel lymph node biopsy. *Surgery* 2007;141:728-35.
7. Poos HP, Kruijff S, Bastiaannet E, et al. Therapeutic groin dissection for melanoma: risk factors for short term morbidity. *Eur J Surg Oncol* 2009;35:877-83.
8. Chang SB, Askew RL, Xing Y, et al. Prospective assessment of postoperative complications and associated costs following inguinal lymph node dissection (ILND) in melanoma patients. *Ann Surg Oncol* 2010;17:2764-72.
9. Bland KI, Klamer TW, Polk HC Jr, et al. Isolated regional lymph node dissection: morbidity, mortality and economic considerations. *Ann Surg* 1981;193:372-6.
10. Beitsch P, Balch C. Operative morbidity and risk factor assessment in melanoma patients undergoing inguinal lymph node dissection. *Am J Surg* 1992;164:462-5.
11. Morton DL, Thompson JF, Cochran AJ, et al. Sentinel-node biopsy or nodal observation in melanoma. *N Engl J Med* 2006;355:1307-17.
12. Bello DM, Farries MB. The Landmark Series: MSLT-1, MSLT-2 and DeCOG (management of lymph nodes). *Ann Surg Oncol* 2020;27:15-21.
13. Morton DL, Thompson JF, Cochran AJ, et al. Final trial report of sentinel-node biopsy versus nodal observation in melanoma. *N Engl J Med* 2014;370:599-609.
14. Faries MB, Thompson JF, Cochran AJ, et al. Completion dissection or observation for sentinel-node metastasis in melanoma. *N Engl J Med* 2017;376:2211-22.
15. Gould N, Kamelle S, Tillmanns T, et al. Predictors of complications after inguinal lymphadenectomy. *Gynecol Oncol* 2001;82:329-32.
16. Hieken TJ, Kane JM III, Wong SL. The role of completion lymph node dissection for sentinel lymph node-positive melanoma. *Ann Surg Oncol* 2019;26:1028-34.
17. Puza CJ, Bressler ES, Terando AM, et al. The emerging role of surgery for patients with advanced melanoma treated with immunotherapy. *J Surg Res* 2019;236:209-15.
18. Beecher SM, O'Leary DP, McLaughlin R, et al. The impact of surgical complications on cancer recurrence rates: A literature review. *Oncol Res Treat* 2018;41:478-82.
19. Nojiri T, Hamasaki T, Inoue M, et al. Long-term impact of postoperative complications on cancer recurrence following lung cancer surgery. *Ann Surg Oncol* 2017;24:1135-42.
20. Finck SJ, Giuliano AE, Mann BD, et al. Results of ilioinguinal dissection for stage II melanoma. *Ann Surg* 1982;196:180-6.
21. Stuiver MM, Westerduin E, ter Meulen S, et al. Surgical wound complications after groin dissection in melanoma patients - a historical cohort study and risk factor analysis. *Eur J Surg Oncol* 2014;40:1284-90.
22. Gaarenstroom KN, Kenter GG, Trimbos JB, et al. Postoperative complications after vulvectomy and inguinofemoral lymphadenectomy using separate groin incisions. *Int J Gynecol Cancer* 2003;13:522-7.
23. Glarner CE, Greenblatt DY, Rettammel RJ, et al. Wound complications after inguinal lymph node dissection for melanoma: is ACS NSQIP adequate? *Ann Surg Oncol* 2013;20:2049-55.
24. Ellison EC, Pawlik TM, Way DP, et al. The impact of the aging population and incidence of cancer on future projections of general surgical workforce needs. *Surgery* 2018;163:553-9.
25. Yancik R, Ries LA. Aging and cancer in America. Demographic and epidemiologic perspectives. *Hematol Oncol Clin North Am* 2000;14:17-23.
26. Ries LAG; National Cancer Institute. (U.S.). Division of Cancer Prevention and Control. SEER Cancer Statistics Review, 1973-1996. U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health, National Cancer Institute. Available: https://bit.ly/39SpjBR (accessed 2022 May 10).
27. West MA, Wischmeyer PE, Grocott MPW. Prehabilitation and nutritional support to improve perioperative outcomes. *Curr Anesthesiol Rep* 2017;7:340-9.
28. Gupta R, Gan TJ. Preoperative nutrition and prehabilitation. *Anesthesiol Clin* 2016;34:143-53.
29. Ferreira V, Agnihotram RV, Bergdahl A, et al. Maximizing patient adherence to prehabilitation: what do the patients say? *Support Care Cancer* 2018;26:2717-23.
30. Scheede-Bergdahl C, Minnella EM, Carli F. Multi-modal prehabilitation: addressing the why, when, what, how, who and where next? *Anaesthesia* 2019;74:20-6.
31. Dewulf M, Verrips M, Coolsen MME, et al. The effect of prehabilitation on postoperative complications and postoperative hospital stay in hepatopancreatobiliary surgery a systematic review. *HPB (Oxford)* 2021;23:1299-310.
32. Bongers BC, Dejong CHC, den Dulk M. Enhanced recovery after surgery programmes in older patients undergoing hepatopancreatobiliary surgery: What benefits might prehabilitation have? *Eur J Surg Oncol* 2021;47:551-9.

33. Chen BP, Awasthi R, Sweet SN, et al. Four-week prehabilitation program is sufficient to modify exercise behaviors and improve preoperative functional walking capacity in patients with colorectal cancer. *Support Care Cancer* 2017;25:33-40.
34. van Akkooi ACJ, Blank C, Eggermont AMM. Neo-adjuvant immunotherapy emerges as best medical practice, and will be the new standard of care for macroscopic stage III melanoma. *Eur J Cancer* 2023;182:38-42.
35. Versluis JM, Menzies AM, Sikorska K, et al. Survival update of neoadjuvant ipilimumab plus nivolumab in macroscopic stage III melanoma in the OpACIN and OpACIN-neo trials. *Ann Oncol* 2023;34:420-30.
36. Tartari E, Weterings V, Gastmeier P, et al. Patient engagement with surgical site infection prevention: an expert panel perspective. *Antimicrob Resist Infect Control* 2017;6:45.
37. Whitby M, McLaws ML, Doidge S, et al. Post-discharge surgical site surveillance: does patient education improve reliability of diagnosis? *J Hosp Infect* 2007;66:237-42.
38. Choi JY, Cho KJ, Kim SW, et al. Prediction of mortality and postoperative complications using the hip-multidimensional frailty score in elderly patients with hip fracture. *Sci Rep* 2017;7:42966.
39. Robinson TN, Wu DS, Pointer L, et al. Simple frailty score predicts postoperative complications across surgical specialties. *Am J Surg* 2013;206:544-50.
40. Kim SW, Han HS, Jung HW, et al. Multidimensional frailty score for the prediction of postoperative mortality risk. *JAMA Surg* 2014;149:633-40.
41. Sharma AS, Flynn JR, Panageas KS, et al. Assessment of frailty can guide decision making for utilization of sentinel lymph node biopsy in patients with thick melanoma. *Ann Surg Oncol* 2021;28:9031-8.
42. Valdatta L, Perletti G, Maggiulli F, et al. FRAIL scale as a predictor of complications and mortality in older patients undergoing reconstructive surgery for non-melanoma skin cancer. *Oncol Lett* 2019;17:263-9.
43. Lange JR, Kang S, Balch CM. Melanoma in the older patient: Measuring frailty as an index of survival. *Ann Surg Oncol* 2011;18:3531-2.
44. Lin HS, Watts JN, Peel NM, et al. Frailty and post-operative outcomes in older surgical patients: A systematic review. *BMC Geriatr* 2016;16:157.
45. Hughes TM, Thomas JM. Combined inguinal and pelvic lymph node dissection for stage III melanoma. *Br J Surg* 1999;86:1493-8.
46. Faut M, Kruijff S, Hoekstra HJ, et al. Pelvic lymph node dissection in metastatic melanoma to the groin should not be abandoned yet. *Eur J Surg Oncol* 2018;44:1779-85.
47. Karakousis CP, Driscoll DL. Groin dissection in malignant melanoma. *Br J Surg* 1994;81:1771-4.
48. Spillane AJ, Saw RP, Tucker M, et al. Defining lower limb lymphedema after inguinal or ilio-inguinal dissection in patients with melanoma using classification and regression tree analysis. *Ann Surg* 2008;248:286-93.
49. James JH. Lymphoedema following ilio-inguinal lymph node dissection. *Scand J Plast Reconstr Surg* 1982;16:167-71.
50. Mann GB, Coit DG. Does the extent of operation influence the prognosis in patients with melanoma metastatic to inguinal nodes? *Ann Surg Oncol* 1999;6:263-71.
51. Küpper S, Austin JL, Dingley B, et al. Extent of groin dissection in melanoma: A mixed-methods, population-based study of practice patterns and outcomes. *Curr Oncol* 2021;28:5422-33.
52. Menzies AM, Amaria RN, Rozeman EA, et al. Pathological response and survival with neoadjuvant therapy in melanoma: a pooled analysis from the International Neoadjuvant Melanoma Consortium (INMC). *Nat Med* 2021;27:301-9.