Wide Variation in Perioperative Care in Anatomical Lung Resections in the Netherlands: A National Survey

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This study aimed to describe perioperative care after anatomical lung resection in the Netherlands, before publication of Enhanced Recovery After Surgery/European Society of Thoracic Surgeons (ERAS/ESTS) guidelines in 2019. An online survey was sent to all 43 Dutch lung surgical centers in December 2017, addressing topics in the 4 phases of perioperative care (preoperative, admission, perioperative, postoperative). Respondents were requested to report care that would be delivered to a standardized patient without perioperative complications. To compare current care with ERAS/ESTS guidelines, we assigned an ERAS/ESTS score per hospital, weighted for evidence level per recommendation. Higher scores indicate higher application of recommendations. Response rate of centers was 100%, median response rate per question was 98% (interquartile range 94–100). Some perioperative recommendations are commonly applied (>85%), such as minimally invasive surgery and regional anesthesia; others, such as admission carbohydrate drinks, are not (<35%). Wide variation was observed regarding patient counselling, pre- and postoperative admission logistics, anemia correction, fluid management, pain management, and chest drain management. Median 62% (interquartile range 53%–72%) of the maximum ERAS/ESTS score was achieved. Large variation in ERAS/ESTS score between hospitals were found in all phases (preoperative: 6.0 [6.5–10.5] points, admission: 5.0 [1.0–6.0] points, perioperative: 21.5.0 [16.0–22.5] points, postoperative: 8.0 [5.0–8.5] points). Large variation exists in perioperative care after anatomical lung resection in the Netherlands. Given previously published data linking variation in perioperative care to variation in outcomes, standardization of perioperative care in lung surgery, preferably based on the ERAS/ESTS guidelines, may be warranted but requires further study.

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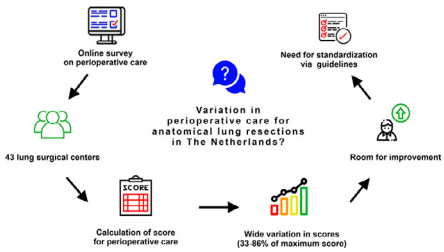

Wide variation in perioperative lung surgical care in the Netherlands.

Central Message

Wide variation in perioperative care in lung resections: a factor in postoperative outcome? We advocate standardization of care.

Perspective Statement

Variation in perioperative care is considered to influence outcome after anatomical lung resections irrespective of case mix factors. The need for standardization and optimization of perioperative care is underscored by the variation in perioperative care between Dutch centers demonstrated in this study.

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; COPD, chronic obstructive pulmonary disease; DLCO, diffusing capacity of the lung for carbon monoxide; ECOG, Eastern Cooperative Oncology Group; ERAS, enhanced recovery after surgery; ERATS, enhanced recovery after thoracic surgery; ESTS, European Society of Thoracic Surgeons; FEV_1, forced expiratory volume in 1 second; LMWH, low molecular weight heparin; LOS, length of stay; MUST, malnutrition universal screening tool; NNCR, Netherlands National Cancer Registry; NSAID, nonsteroid anti-inflammatory drug; PETCT, positron emission tomography-computed tomography; PROMS, patient reported outcome measures; SNAQ, short nutritional assessment questionnaire; VATS, video-assisted thoracic surgery; VO_2max, maximum volume of oxygen consumption; VTE, venous thromboembolic event

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INTRODUCTION

Recent studies in the United States and Europe suggest that there is variation in outcome measures after lung surgery, such as length of stay (LOS), which may be due to variations in care delivery.[1,2] A nationwide retrospective analysis of the Netherlands National Cancer Registry data supports this hypothesis. Th Netherlands National Cancer Registry data analysis demonstrated a substantial variation in LOS after anatomical lung resections for lung cancer across all Dutch lung surgical centers.[3] For reference, the organization of lung surgical care in the Netherlands is summarized in Table 1.

Since large variation persisted after correcting for case mix (patient, tumor, and surgical characteristics), these differences in LOS between hospitals were attributed to differences in perioperative care.[3] A similar analysis of the more elaborate compulsory Dutch Lung Cancer Audit for Surgery database by our research team confirmed this finding.[4] In this database, a statistically significant correlation between LOS in uncomplicated patients and LOS in complicated patients was found, suggesting that LOS is a hospital characteristic, irrespective of complications or case mix variation. Thus, it seems that outcomes after anatomical lung resection are influenced by variations in perioperative care practice. Currently no Dutch perioperative care guideline exists and detailed knowledge about perioperative care practice in lung surgical care in the Netherlands is lacking.

In several other surgical fields, perioperative care has been standardized by development and implementation of Enhanced Recovery After Surgery (ERAS) programs. It has been shown that these programs enable rapid recovery after surgery with short LOS, while reducing complications, readmissions, and cost.[5,6] The multidisciplinary programs rely on consistently informing, engaging and preparing patients preoperatively and applying a set of perioperative care interventions that collectively improve outcomes through the "marginal gains" principle. In 2019 the first ERAS Society/European Society of Thoracic Surgeons (ESTS) guidelines for lung surgery have been published.[7]

This study aimed to gain insight into the perioperative care practice in Dutch lung surgical centers, prior to publication of the abovementioned guidelines. Our hypothesis was that if wide variation in perioperative care was confirmed, standardization and optimization of perioperative care, preferably following the ERAS/ESTS guidelines, could be an important tool to improve outcome.

We conducted an online survey, in which respondents were asked to report perioperative care, that they would provide to a standardized anatomical lung resection patient.

Since the ERAS/ESTS guidelines were published during the analysis of the survey data, the opportunity was taken to compare the survey answers to the ERAS/ESTS guidelines.

Table 1. Lung Surgery in the Netherlands

- Small country (41,543 km^2), densely populated (17.4 million)[a]
- Easily accessible, mostly public, healthcare facilities[a]
- Universal healthcare insurance coverage[a]
- 79 public hospitals, of which 8 academic centers (2018)[b]
- 43 lung surgical centers (including all academic centers)
  - Lung surgery performed by:
    - general thoracic surgeons (29/43)
    - cardiothoracic surgeons (10/43)
    - both (4/43)
  - A center is typically led by 2 4 surgeons with shared responsibility for perioperative care for patients in the center

[a]Dutch Ministry of Health, Welfare and Sport. (2018). Healthcare in the Netherlands. [Online] Available at: https://www.government.nl/documents/leaflets/2016/02/09/healthcare-in-the-netherlands. [Accessed 27 Januari 2020].

[b]National Institute of Public Health and the Environment (RIVM) (2018). Ziekenhuiszorg>Cijfers&Context>Aanbod. [Online] Available at: https://www.volksgezondheidenzorg.info/onderwerp/ziekenhuiszorg/cijfers-context/aanbod#!node-aantal-instellingen-voor-medisch-specialistische-zorg. [Accessed 27 Januari 2020].

METHODS

An online survey was developed, using multiple choice and multiple answer questions (Supplementary material Table 1). The survey was sent to all Dutch lung surgical centers (n = 43, 1 surgeon per center) in December 2017. The addressed surgeon was an experienced staff member, able to attest to the current practice of his and/or her lung surgical center. Several reminders were sent through email (up to 3 times), and the last 3 centers were reminded through telephone to stimulate high response rate. We continued contacting until every respondent had completed the survey. No incentive was offered to the participants. The survey was promoted in meetings of both general thoracic surgeons and cardiothoracic surgeons. Characteristics of the respondents were queried, that is, hospital type, surgeon type (cardiothoracic and/or general thoracic), hospital volume, specialty responsible for postoperative care, median LOS, as reported to the Dutch Lung Cancer Audit for Surgery in 2016, and the involvement of a case manager as coordinator of perioperative care.

Respondents were requested to report care that would be delivered to a standardized patient without perioperative complications (Table 2). The patient was based on median patient characteristics of patients undergoing anatomical resection for lung cancer in 2016 in the Netherlands, derived from the Dutch Lung Cancer Audit for Surgery database. Topics related to the 4 phases of perioperative care were addressed, as used by the ERAS society: the preoperative, admission, perioperative and postoperative phase.[7] For each phase, general

Table 2. Standardized Patient Case

Patient:
66-year-old man

Medical history/ physical condition:
Mild COPD, ASA classification 2, ECOG performance scale 0, BMI 22.

Diagnostic work-up (including PET-CT and CT guided biopsy):
Peripheral cT1bN0M0 adenocarcinoma of the lung in the right upper lobe.

Pulmonary function tests:
FEV1 84% of predicted, DCLO 70% of predicted, VO_2max 17.2 mL/min/kg.

Surgery:
Elective right upper lobectomy and systematic mediastinal lymph node dissection

ASA, American Society of Anesthesiologists; BMI, body mass index; COPD, chronic obstructive pulmonary disease; DLCO, diffusion capacity of the lung for carbon monoxide; ECOG, Eastern Cooperative Oncology Group; FEV_1, forced expiratory volume in 1 second; (PET-) CT, (positron emission tomography-)computed tomography; VO_2max, maximum volume of oxygen consumption.s

perioperative care topics were addressed as well as thoracic surgery specific topics.[5,8,9]

Data was stored under code, not directly traceable to individuals.

ERAS/ESTS Score

To compare the survey answers to the ERAS/ESTS guidelines, a score (ERAS/ESTS score) was developed. Points were assigned to the answers that most resembled the recommendations, with a maximum of 1 point per topic.[5,7,8] If a question did not exactly match the recommendation, a maximum of 0.5 points was assigned for that topic. Subsequently, the points were multiplied by a weighting factor based on the level of evidence as described in the ERAS/ESTS guidelines: topics with high level of evidence were multiplied by 5, topics with moderate level of evidence multiplied by 3 and topics with low level of evidence by 1.[7] The total maximum score was 64; 15.5 for the preoperative phase, 9 for the admission phase, 30.5 for the perioperative phase, and 9 for the postoperative phase. The assignment of points to specific answers and the accompanying level of evidence are shown in Table 4. The survey assessed 23 topics of the 45 recommendations of the ERAS/ESTS guidelines.

Total scores and scores in the different phases were compared between groups based on hospital type (academic vs teaching and/or community hospital), surgeon type (cardiothoracic and/or general thoracic), hospital volume defined as number of anatomical lung resections per year (21−50, 51−75, 76−100, >100), medical specialist responsible for postoperative care (pulmonologist and/or surgeon), and the involvement of a case manager as coordinator of perioperative care (yes and/or no).

Perioperative Topics Not Mentioned in the ERAS/ESTS Guidelines

The survey contained also topics not mentioned in the ERAS/ESTS guidelines. Therefore, we did not apply a weighted score to these topics, and results are presented descriptively.

Statistics

In most questions, the answer "Not known" was an option. "Not known" was considered as missing data. Data are reported as percentage of total answers (including missing data) and number, or median (interquartile range). Percentages of missing data are reported per topic.

Comparisons between groups were done with nonparametric tests because of the group sizes, namely Mann-Whitney U test and Kruskal-Wallis test. Two-sided $P < 0.05$ was considered statistically different. The Statistical Package SPSS version 25, IBM, Armonk, New York, was used to analyze the data.

RESULTS

Response rate of centers was 100% (43 lung surgical centers). Respondent characteristics are shown in Table 3. There was a high rate of missing data for LOS (21%).

Table 4 provides detailed results on the application of ERAS/ESTS recommendations, as well as the ERAS/ESTS score assigned per topic. Table 5 details the results on topics not mentioned in the ERAS/ESTS guidelines.

Median response rate per question was 98% [94%−100%] (Table 4 and 5).

In the majority of centers, the perioperative care after anatomical lung resections is described in care pathway protocols (81%, n = 35) (Table 5); and in 49% (n = 21) these protocols contain daily clinical goals for the patient during admission (eg, drain is removed on Day X, start oral intake Day X, mobilize in chair Day X) (Table 4).The most striking results of all topics in the 4 phases are presented in chronological order. In the preoperative phase, most centers (>70%) inform patients with explanation of a gross outline of the perioperative care with expected LOS (Table 4). Most centers physically prepare their patients by screening for malnutrition and nearly all centers (88%) refer patients to a physiotherapist preoperatively; smoking cessation support is commonly offered, but not standard (Table 4).

A large percentage (>60%) of patients is admitted on the day before surgery (Table 5). Fasting rules are strict (>6 hours preoperatively) in most centers and preoperative carbohydrate loading is uncommon (Table 4). Anxiolytic premedication is used in a vast majority of centers, followed by a minimally invasive operation; more variation is present in the choice of analgesic technique, with almost half choosing epidural analgesia and almost half a peripheral nerve block (Table 4). Centers are also divided in the postoperative phase on their approach to chest drain management, using either water seal or suction

Table 3. Respondent Characteristics (n = 43 Lung Surgical Centers)

		Missing Data % (n/n, Not Known/ Total Missing)
Hospital type		0
Academic center	19% (8)	
Teaching hospital	70% (30)	
Community hospital	12% (5)	
Specialist performing lung resections		0
General thoracic surgeon	67% (29)	
Cardiothoracic surgeon	23% (10)	
Both	9% (4)	
Hospital volume (number of anatomical lung resections per year)		0
21–50	33% (14)	
51–75	37% (16)	
76–100	28% (12)	
>100	2% (1)	
Specialist responsible for postoperative care		0
Pulmonary physician	51% (22)	
General thoracic or cardio thoracic Surgeon	49% (21)	
Both	2% (1)	
Median length of stay (days)		21% (7/9)
3	2% (1)	
4	5% (2)	
5	40% (17)	
6	16% (7)	
7	9% (4)	
8	5% (2)	
9	2% (1)	
Specialist nurse/case manager coordinates perioperative care		2% (1/1)
Yes	77% (33)	
No	23% (9)	
Not reported	2% (1)	

and adopting different thresholds for drain removal (Tables 4 and 5). Early mobilization and physiotherapy support are common in almost all centers, as well as a normal diet on the day of operation (Tables 4 and 5). A minority of centers provides patients with daily updates of the expected discharge date; post discharge follow-up by telephone is uncommon as well (Table 5).

ERAS/ESTS Score

The median total ERAS/ESTS score per center was 39.5 points (62% of maximum score); minimum score was 21.0 points (33% of maximum score) and maximum 55.0 points (85% of maximum score) (interquartile range 34.0–46.0) (Fig. 1). For visualization purposes the percentage of the maximum achievable ERAS/ESTS score was categorized by color as low (red, <50% of maximum score), intermediate low (orange, 50%–64% of maximum score), intermediate high (yellow, 65%–79% of maximum score) or high (green, ≥80% of maximum score). Figure 2 provides an overview of scores per center, per phase. Median scores were 6.0 (6.5–10.5) points (58% of maximum score) for the preoperative phase, 5.0 (1.0–6.0) points (56% of maximum score) for admission phase, 21.5.0 (16.0–22.5) points (70% of the maximum score) for the perioperative phase and 8.0 (5.0–8.5) points (89% of the maximum score) for the postoperative phase, respectively. In the admission phase, 10 centers had a score of zero.

Total ERAS/ESTS score as well as preoperative phase score was statistically significantly higher for general thoracic surgeons than for cardiothoracic surgeons (42.5 [37.0–47.5] vs 36.5 [31.0–38.5], P = 0.016; 10.5 [8.0–13.0] vs 6.5 [3.0–8.5], P = 0.009). Statistically significant differences were found in postoperative phase score with regard to hospital volume (5.0 [4.0–8.0] for volume 21–50, 8.0 [6.5–9.0] for volume 51–75, 8.0 [7.0–9.0] for volume 76–100, 5.0 [5.0–5.0] for volume >100; P = 0.040). No statistically significant differences in total ERAS®/ESTS scores or scores per phase were found with regard to nonacademic centers vs academic medical centers, specialist responsible for postoperative care (pulmonologist and/or surgeon), and the involvement of a case manager as coordinator of perioperative care (yes and/or no).

DISCUSSION

The aim of this study was to gain insight into the perioperative care in Dutch lung surgical centers, just prior to the publication of the ERAS/ESTS guidelines. The survey showed that large variation exists between Dutch lung surgical centers regarding perioperative care for patients undergoing anatomical lung resection. Since the survey concerned a standardized patient, based on the median characteristics of patients registered in the Dutch Lung Cancer Audit for Surgery database of 2016, the answers represent the perioperative care as intended in a standardized, uncomplicated case, without data on individual patient outcome data, case mix variables and protocol adherence. Consequently, the present study does not reflect a representation of actually delivered care.

We compared the survey to the ERAS/ESTS guidelines, revealing that substantial variation exists in the degree to which these recommendations are already incorporated in perioperative care — just before the publication of the ERAS/ESTS guidelines. Rogers et al showed that increased compliance with an ERAS-type perioperative care protocol, rather than the individual elements, reduces LOS and morbidity in lung resection patients.[8] This is in accordance with experiences in several countries, where the introduction of ERAS-type protocols has promoted reduction in LOS, costs, and complications by optimizing and standardizing perioperative care in lung resection

Table 4. Application of ERAS/ESTS Recommendations and ERAS/ESTS Scores

Care Topic/Question (Level of Evidence for Weighting)	Answer	Point Assignment for ERAS/ESTS Score	% of Centers (n)	Missing Data % (n/n, Not Known/ Total Missing)
Preoperative phase				
Preadmission information, education and counselling (low)	Detailed counselling with daily goals and expected LOS	1.0	19% (8)	0% (0/0)
	Gross outline with expected LOS	1.0	74% (32)	
	Gross outline without expected LOS	0.5	5% (2)	
	No counselling	0	2% (1)	
Perioperative nutrition —screening (high)	Preoperative screening for malnutrition with validated method (SNAQ, MUST)	1	70% (30)	7% (3/3)
	No screening	0	23% (10)	
Perioperative nutrition — intervention (moderate)	Dietician consulted preoperatively (at deviant screening)	0.5	65% (28)	9% (4/4)
	Dietician not consulted	0	26% (11)	
Smoking cessation (high)	Assistance is offered	0.5	63% (27)	19% (8/8)
	Assistance is not offered	0	19% (8)	
Anemia management — correction if Hb <6 mmol/L (high)	Yes/ Yes, with medication	1.0	30% (13)	7% (3/3)
	As determined by anesthesiologist	0.5		
	Yes, by red blood cell transfusion/No		9% (4)	
		0	54% (23)	
Pulmonary rehabilitation and prehabilitation (low)	Physiotherapist is consulted preoperatively	0.5	88% (38)	5% (1/2)
	Physiotherapist is not consulted	0	7% (3)	
Admission				
Preoperative fasting (high)	No solids 6 h before surgery	0.5	63% (27)	0% (0/0)
	No solids from midnight before surgery	0	38% (16)	
Preoperative fasting (high)	No fluids 2 h before surgery	0.5	54% (23)	0% (0/0)
	No fluids 6 h before surgery/ from midnight before surgery	0	46% (20)	
Preoperative carbohydrate loading (low)	Yes	1.0	33% (14)	5% (2/2)
	No	0	63% (27)	
Preanesthetic medication — routine use (moderate)	No	1.0	23% (10)	2% (1/1)
	Yes	0	74% (32)	
Perioperative phase				
VTE prophylaxis — type (moderate)	Elastic compression stockings + LMWH	1.0	2% (1)	0% (0)
	Elastic compression stockings or LMWH	0.5	95% (41)	
	None	0	2% (0)	
VTE prophylaxis — extended use (low)	Extended prophylaxis 4—6 wk after surgery	0.5	14% (6)	0% (0)
	No extended prophylaxis	0	86% (37)	
Antibiotic prophylaxis — use perioperatively (high)	Yes	1.0	98% (42)	0% (0)
	No	0	2% (1)	
	Peripheral block (intercostal, paravertebral)	1.0	49% (21)	0% (0)

(*continued*)

Table 4. (*continued*)

Care Topic/Question (Level of Evidence for Weighting)	Answer	Point Assignment for ERAS/ESTS Score	% of Centers (n)	Missing Data % (n/n, Not Known/ Total Missing)
Regional anesthesia and pain relief - type of analgesic modalities used (high)	(Patient controlled) thoracic epidural analgesia	0.5	47% (20)	
	Only patient controlled analgesia /oral analgesia	0	5% (2)	
Regional anesthesia and pain relief - use of single shot blockage (intercostal/ paravertebral) (high)	Yes	1.0	63% (27)	0% (0)
	No	0	37% (16)	
Regional anesthesia and pain relief -standard postoperative oral pain medication provided (low)	Acetaminophen and NSAID	1.0	51% (22)	2% (1/1)
	Acetaminophen or NSAID	0.5	47% (20)	
	Weak opioid/morphine/ methadone	0	0	
Perioperative fluid management – use of standard protocol (moderate)	Yes	0.5	47% (20)	16% (4/7)
	No	0	37% (16)	
Atrial fibrillation prevention (high)	Prophylaxis with medication	0.5	2% (1)	2% (1/1)
	No prophylaxis	0	95% (41)	
Surgical technique; minimally invasive surgery – standard use of approach (high)	(Uniportal) VATS / RATS	1.0	100% (43)	0% (0)
	Thoracotomy	0	0% (0)	
Postoperative phase				
Chest drain management – no. of drains (moderate)	0 or 1	1.0	100% (43)	0% (0)
	2 or more	0	0% (0)	
Chest drain management – drainage system (low)	Digital	1.0	65% (28)	9% (1/4)
	Digital, if available	0.5	2% (1)	
	Water system/ dry valve system	0	23% (10)	
Chest drain management – drain suction settings (low)	Water seal	1.0	40% (17)	2% (1/1)
	1h -10 cmH2O, then water seal/ -5 - -10 cmH2O suction	0.5	7% (3)	
	-10 cmH2O suction/ -20 cmH2O suction	0	51% (22)	
Chest drain management –condition for removal of the last drain (moderate)	<400–450 mL/24 h; no maximum fluid production	1.0	63% (27)	0% (0)
	200–300 mL/24 h if trend is downwards/individually determined	0.5	2% (1)	
	100–200 mL/24 h	0	35% (15)	
Early mobilization –postoperative day at which patient is mobilized (low)	0 or 1	1.0	95% (41)	0% (0)
	1 or 2	0.5	2% (1)	
	2 or more	0	0% (0)	

ERAS, enhanced recovery after surgery; ESTS, European Society for Thoracic Surgeons; LMWH, low molecular weight heparin; LOS, length of stay; MUST, malnutrition universal screening tool; NSAID, nonsteroid anti-inflammatory drug; RATS, robot assisted thoracic surgery; SNAQ, short nutritional assessment questionnaire; VATS, video-assisted thoracic surgery; VTE, Venous thromboembolic event.

patients.[10–13] The overall achieved median of 62% of the maximum ERAS/ESTS score, suggests that there is room for further standardization and optimization of perioperative care according to ERAS/ESTS guidelines. From our data we cannot conclude whether compliance to a certain recommendation is more important than another and/or what the clinical consequences of high and low compliance may be. The evidence behind the recommendations is described in the ERAS/ESTS guidelines.[7]

The only respondent characteristic that resulted in statistically significant different ERAS/ESTS scores was the surgeon type: general thoracic surgeons scored higher when compared to cardiothoracic surgeons. This might be related to the fact that general thoracic surgeons in the Netherlands traditionally

Table 5. Perioperative topics not mentioned in the ERAS/ESTS guidelines

Care Element/Question	Answer	% of Centers (n)
Preoperative phase		
How is the perioperative care for anatomical lung resections recorded in your hospital?	No care pathway	0 (0)
	In a care pathway with gross outline	33 (14)
	In a detailed care pathway with description of daily goals	19 (8)
	In a perioperative protocol without care pathway	49 (21)
	Other	0 (0)
	Missing	0 (0)
Does the patient know the discharge criteria?	Yes, oral information	16 (7)
	Yes, written information	37 (16)
	No	33 (14)
	Missing	14 (6)
Is the application for complementary post-discharge care (nursing home/rehabilitation home) done before preoperative admission?	Yes	14 (6)
	No	72 (31)
	Missing	14 (6)
Admission phase		
When is the patient admitted to the hospital?	At the day of surgery	40 (17)
	The day before surgery	61 (26)
	Missing	0 (0)
Perioperative phase		
Is anesthesia provided by a dedicated anesthetist?	Yes	35 (15)
	No	61 (26)
	Missing	5 (2)
Is the lung resection supported by dedicated operating room nurses?	Yes	61 (26)
	No	40 (17)
	Missing	0 (0)
Is an arterial line used?	Yes	81 (35)
	No	12 (5)
	Missing	7 (3)
Is a central venous line used?	Yes	9 (4)
	No	86 (37)
	Missing	5 (2)
Postoperative phase		
What is the condition to remove the (last) chest drain, concerning fluid production?	Fluid production <100 mL/24 h	2 (1)
	Fluid production <200 mL/24 h	28 (12)
	Fluid production <450 mL/24 h	42 (18)
	No maximum fluid production	5 (2)
	Other	23 (10)
	Missing	0 (0)
What is the condition to remove the (last) chest drain, concerning air leakage flow?	No air leakage	49 (21)
	Air leakage <20 mL/min	40 (17)
	Air leakage <40 mL/min	9 (4)
	Other	2 (1)
	Missing	0 (0)
Is the last chest drain clamped before removal?	Yes	81 (35)
	No	16 (7)
	Missing	2 (1)
At which day is the (last) chest drain removed, as anticipated?	The day of surgery	0 (0)
	Postoperative day 1	49 (21)
	Postoperative day 2	42 (18)
	Postoperative day 3	5 (2)
	Other	2 (1)
	Missing	2 (1)

(*continued*)

Table 5. (*continued*)

Care Element/Question	Answer	% of Centers (n)
Is a chest drain used standardly (>80% of cases) following a pneumonectomy?	Yes	33 (14)
	No	58 (25)
	Other	7 (3)
	Missing	2 (1)
Where is the patient recovered directly postoperatively following an uncomplicated procedure?	General ward in <3 hours	14 (6)
	General ward in <12 hours	14 (6)
	12−24 hours at post anesthesia care unit (PACU)	14 (6)
	1 night at the intensive care unit (ICU)	30 (13)
	1 night at the high/medium care unit	16 (7)
	Other	12 (5)
	Missing	0 (0)
At which patient ward is the patient admitted thereafter, following an uncomplicated procedure?	Pulmonology ward	65 (28)
	Cardiothoracic (surgery) ward	28 (12)
	Other	7 (3)
	Missing	0 (0)
Is the physiotherapist consulted postoperatively?	Yes	86 (37)
	No	7 (3)
	Missing	7 (3)
At which day is the patient allowed to start oral intake (food/drinks)?	The day of surgery	81 (35)
	Postoperative day 1	9 (8)
	Postoperative day 2	0 (0)
	Postoperative day 3	0 (0)
	Other	0 (0)
	Missing	0 (0)
At which day is the patient fully reliant on oral pain medication?	The day of surgery	2 (1)
	Postoperative day 1	12 (5)
	Postoperative day 2	44 (19)
	Postoperative day 3	35 (15)
	Postoperative day 4 or later	0 (0)
	Other	0 (0)
	Missing	7 (3)
Is the patient informed daily about the aimed discharge date?	Yes	14 (6)
	No	74 (32)
	Missing	12 (11.6)
How many chest X-rays are used according to protocol?	0	9 (4)
	1	40 (17)
	2	21 (9)
	3	19 (8)
	4	5 (2)
	Standard daily until discharge	0 (0)
	Other	7 (3)
	Missing	0 (0)
Are patients followed-up (by phone) after discharge by a case manager?	Yes	58 (25)
	No	35 (15)
	Other	0 (0)
	Missing	7 (3)

ERAS, enhanced recovery after surgery; ESTS, European Society for Thoracic Surgeons.

undergo a minimum of 4 years surgical training in general surgery. Therewith they are probably more exposed to and may be more keen on the ERAS-concept in daily surgical care than cardiothoracic surgeons.

While some recommendations are already incorporated in perioperative practice, standardization of perioperative care with a detailed care pathway with explicit daily goals, discharge criteria and expected date of discharge, may enable centers to provide better patient education and limit variation in postoperative care provision between health care professionals.[5,6] Within this pathway, clear guidance on early mobilization, perioperative analgesic strategies, and chest drain management is likely to contribute to enhanced recovery after anatomical lung resection.[8,14]

Our survey showed variation between centers in a number of topics not mentioned in the ERAS/ESTS guidelines (such as

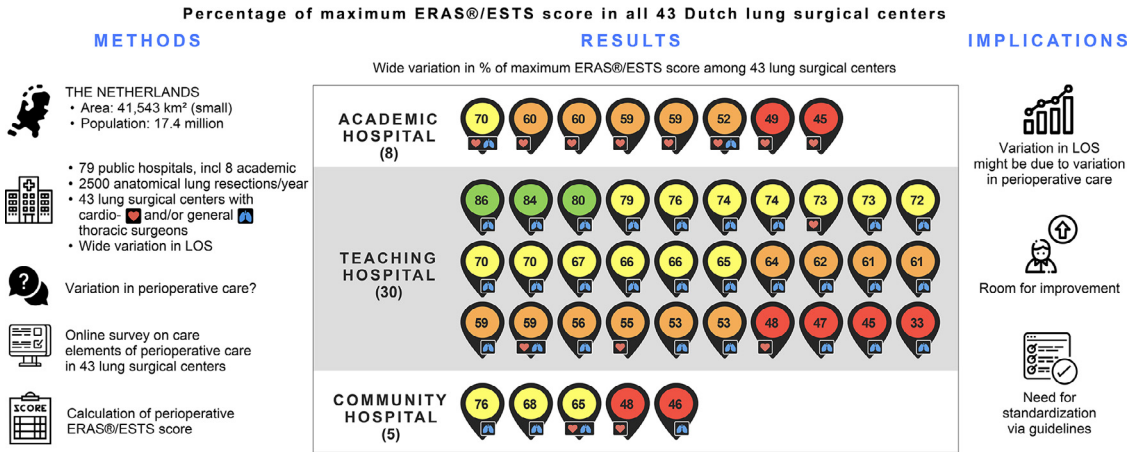

Figure 1. Percentage of maximum ERAS/ESTS score in all 43 Dutch lung surgical centers. To gain insight into current perioperative care after anatomical lung resections in the Netherlands, a national survey was performed among all 43 lung surgical centers. An ERAS/ESTS score was calculated per center. ERAS/ESTS scores are expressed as percentages of the maximum score; the color depicts low (red, <50% of maximum score), intermediate low (orange, 50%–64% of maximum score), intermediate high (yellow, 65%–79% of maximum score) or high (green, ≥80% of maximum score) scores. The type of hospital and the type of surgeon (general thoracic (blue lung icon), cardiothoracic (red heart icon), or both) is shown. The wide variation in scores (range 33%–86% of maximum score), despite the small size of the country with good access to healthcare facilities, may influence postoperative outcome after lung resections; standardization and optimization may be warranted. ERAS, enhanced recovery after surgery; ESTS, European Society for Thoracic Surgeons; LOS, length of stay. (Color version of figure is available online.)

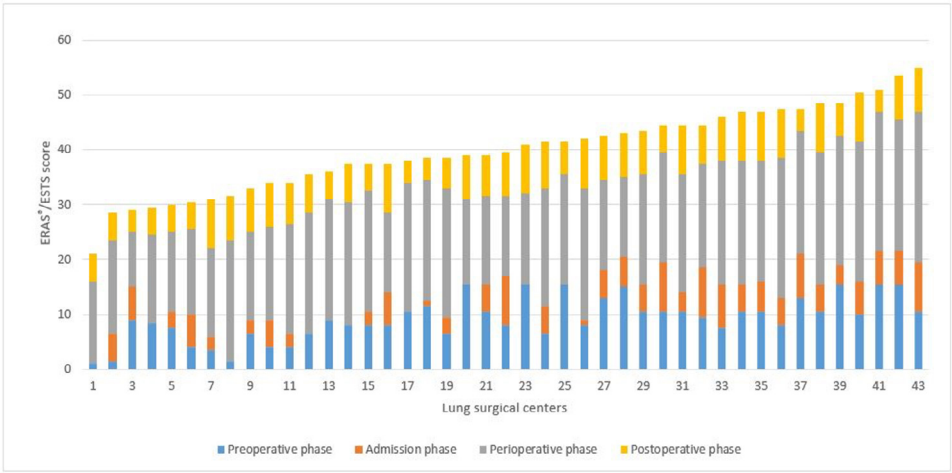

Figure 2. ERAS/ESTS score for perioperative care per lung surgical center in the Netherlands. The ERAS/ESTS score is composed of points assigned to perioperative care as reported by 43 lung surgical centers in the Netherlands through an online survey, before the ERAS/ESTS guidelines were published in 2019.[7] Points were weighted for the level of evidence as described in the guidelines.[7] The higher the score, the more resemblance there was between the reported perioperative care and the recommendations in the guidelines. On the X-axis all hospitals are presented, ordered by their total ERAS/ESTS score. On the Y-axis the total ERAS/ESTS score is presented, with a maximum of 64. The different colors represent the scores in the 4 phases of the ERAS/ERATS guidelines. ERAS, enhanced recovery after surgery; ESTS, European Society for Thoracic Surgeons.

same day admission), which may influence the duration of recovery and LOS. Despite the fact that same day admission will not reduce time from operation to discharge, it is an easy and elegant way to reduce pressure on scarce resources and keep people out of the hospital environment (with exposure to nosocomial infections) as long as possible.

A limitation of this study is that the survey was completed by 1 surgeon per center, including the questions on topics that in daily practice are executed by other health care professionals, for example, anesthesiologists, pulmonologists or case managers. Another limitation lies in the use of a self-reported survey, thereby introducing response bias. Nevertheless, we consider

the use of a survey as the appropriate method to collect data on our research question.

The comparison of reported practice with the ERAS/ESTS guidelines has 2 limitations. Firstly, the ERAS/ESTS guidelines were published after the survey was sent, hence, the questions of the survey did not completely match the recommendations of the guidelines and some topics were not incorporated (eg, postoperative nausea and vomiting management and the use of urine catheters); on the other hand, some extra topics, not mentioned in the guidelines were explored. Secondly, the ERAS/ESTS score used for this comparison is not a validated tool, relying relatively more on recommendations supported by a higher level of evidence. Potentially important recommendations contributing positively in perioperative care, but lacking high level evidence support, are underrepresented in our model.

Despite these limitations, our study provides insight into current perioperative care in the Netherlands and into the level of incorporation of ERAS/ESTS guidelines.

Our findings show that there is room for further standardization and optimization of perioperative care by preferably implementing the ERAS/ESTS guidelines, with the objective of improving clinical outcomes. Our survey helps to define underdeveloped topics in perioperative care that need extra attention in the implementation process.

A prospective evaluation of the national implementation of an enhanced recovery after thoracic surgery protocol, based on the ERAS/ESTS guidelines, is currently being developed. In this future study, we will focus on the relationship between compliance to the enhanced recovery after thoracic surgery protocol and outcome measures, including complication rates, LOS, and patient reported outcome measures.

CONCLUSIONS

Large variation existed between Dutch lung surgical centers in perioperative care for patients undergoing anatomical lung resection, before publication of the ERAS/ESTS guidelines. Given previously published data linking variation in perioperative care to variation in outcomes, standardization of perioperative care in lung surgery, preferably based on the ERAS/ESTS guidelines, may be warranted but requires further study.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.semtcvs.2020.05.015.

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