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ORIGINAL ARTICLE

The implementation of eras in Belgian esophageal surgery centers

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Abstract
Esophagectomy for cancer is a highly invasive procedure with significant post-operative morbidity and mortality. The literature suggests a clear volume outcome correlation. Since 2019, esophageal surgery has been centralized in Belgium. In 2019, enhanced recovery after surgery (ERAS) guidelines were published for esophagectomy. The purpose of this study was to evaluate the level of implementation of these ERAS guidelines in Belgium. Surgeons from centralized esophageal surgery centers in Belgium were questioned. A Delphi questionnaire regarding peri-operative ERAS care and center-specific outcome data were sent to all participating surgeons. An ERAS scoring system was created to estimate and compare the level of ERAS implementation. Length of stay, post-operative pneumonia, anastomotic leakage and 30-day and 90-day mortality were evaluated. A high response rate of 94.1% was achieved. All surgeons used a peri-operative protocol in their center. The mean ERAS score for Belgian surgeons was 15.5 out of 20. The highest ERAS score per center is 18.6. Anastomotic leakage rate is 14.6% and post-operative pneumonia rate is 20.8% in Belgium. The mean length of stay is 12 days. Mortality after 30 days and 90 days are, respectively, 3.2% and 6.6%. This study gives an overview of the Belgian situation regarding the implementation of ERAS protocols in esophageal surgery centers. The overall implementation of ERAS guidelines in Belgium is good, but there is room for improvement in terms of uniformity nationally.

Keywords Esophagectomy · Enhanced recovery after surgery · Perioperative care

Introduction

Esophageal cancer is the 11th most frequent and the 7th most lethal malignancy worldwide [8]. An esophagectomy is a highly invasive surgical procedure with significant post-operative morbidity and mortality. The incidence of major post-operative complications is reported between 26% and 31% [9, 10]. A worldwide review of high-volume centers reports a complication rate Clavien–Dindo IIIb or higher (complications requiring intervention under general or epidural anesthesia, complications threatening the life of a patient and requiring IC support or complications leading to death) of 17.2%, a 30-day mortality of 2.4% and a 90-day mortality of 4.5% [11]. These outcomes are used for benchmarking, and support the high volume–low failure to rescue association often reported in the literature [10, 12].

Esophageal cancer surgery has been centralized in Belgium since July 2019. Volume was used as criterion as well as patient outcome data to select these centers. Volume criteria included 20 esophageal resections annually and 75 resections during a 3-year period. At present, there are 8 acknowledged esophageal surgery centers in Belgium [13].

Enhanced recovery after surgery (ERAS) is a multimodal, multidisciplinary approach to peri-operative patient care to optimize recovery. This ERAS concept was first described by Kehlet et al. in 1997, specifically for colonic surgery. Since then ERAS protocols have been used in many types of surgery [1–3]. The ERAS protocols have resulted in a shorter length of hospital stay and fewer complications, both resulting in cost reductions [1]. In 2019, ERAS guidelines were published with recommendations for pre-, intra- and post-operative management of patients after esophageal surgery [4]. The implementation of ERAS protocols in

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esophageal surgery reduces the rate of major complications and reduces the length of stay and costs [5–7].

The aim of this study is to evaluate the level of implementation and application of the ERAS guidelines in esophageal surgery in Belgium.

To the best of our knowledge, the level of implementation and compliance of ERAS after esophagectomy has only been reported in two national studies, a Canadian [14] and Italian study [15].

Materials and methods

A national survey was conducted to evaluate the level of implementation of ERAS guidelines in esophageal surgery centers in Belgium. There are eight centralized high-volume esophageal surgery centers in Belgium. The questionnaire was distributed between July 2023 and November 2023. The study was approved by the Ethics Committee on 13-04-2023 (project number THE-2023-0108). All surgeons gave written informed consent.

The questionnaire was drafted and electronically distributed to the surgeons using REDCap®, which is a secure, web-based software platform designed for capturing data for research studies [16, 17]. The questionnaire included 36 questions. These questions were divided in six sections: demographic data of the surgeons, pre-operative ERAS elements, intra-operative ERAS elements, post-operative ERAS elements, patient outcome indicators and difficulties encountered during daily implementation and application of the ERAS protocol. All ERAS element questions were based on the *Guidelines for Perioperative Care in Esophagectomy: ERAS Society Recommendations from 2019* [4]. This guideline consists of 39 elements, but all non-surgical elements or elements that are known as standard of care in Belgium or elements in which no recommendation could be made were excluded. Finally, 22 ERAS elements were included in our questionnaire.

Primary outcome in this study is the level of implementation of the ERAS guidelines in esophageal surgery centers in Belgium. An ERAS scoring system, as shown in Fig. 1, was created to evaluate, estimate and compare the level of ERAS implementation between centers. In this study's ERAS scoring system, only the 22 selected and questioned ERAS elements are included. The element of early enteral feeding is scored, but the route of enteral feeding remains unclear so is excluded. The element of the pyloroplasty has no recommendation in the guideline, and is, therefore, excluded from the scoring system, resulting in 20 included guideline elements. Every element is scored with the same weight, since there is no evidence about the importance of the different elements in respect to the others. Resulting in a maximum ERAS score of 20 points. ERAS scores were determined per surgeon using the questionnaires and the scoring system shown in Fig. 1. Individual ERAS scores were grouped per center and combined to create a center-specific score.

Patient-related outcomes (anastomotic leakage, postoperative pneumonia, length of stay, re-admission rate, 30-day mortality and 90-day mortality) were delivered by each center, cross-referenced to the online available report

BELGIAN ERAS SCORE FOR ESOPHAGEAL SURGERY

ERAS element	Recommendation	Grade of recommendation	ERAS score in detail	Total ERAS score
Preoperative phase				total = 6
Nutritional assessment by qualified dietician	should be done	strong	YES = 1	1
High risk malnutrition patients receive enteral support	should be done using feeding tubes in the GI tract	strong	YES (jejunostomy or NG tube) = 1	1
Prehabilitation program			all done = 1	1
Excercise	advised	moderate, extrapolated	YES = 0.2	
Protein supplementation	advised	moderate, extrapolated	YES = 0.2	
Glycemia control	advised	moderate, extrapolated	YES = 0.2	
Blood pressure control	advised	moderate, extrapolated	YES = 0.2	
Psychological intervention	advised	moderate, extrapolated	YES = 0.2	
Smoke & alcohol cessation	stop 4 weeks prior to surgery	strong	alcohol: YES = 0.5 ; smoking: YES = 0.5	1
Preoperative fasting	long preop fasting avoided: liquids till 2h prior to surgery	Strong	fluids until 2h prior to surgery + solids till 6h prior to surgery = 1	1
Mechanical bowel preparation	not routinely, only on indication for colonic reconstruction	Strong	not routinely/on indication = 1	1
Operative phase				total 7
Timing of Surgery	3-6wk after chemotherapy + 6-10wk after neoadjuvant chemoradiotherapy	moderate	3-6wk + 6-10 wk = 1	1
Acces	minimally invasive	moderate	MI (laparoscopic/robot) = 1; hybrid procedure = 0.5	1
Conduit	Organ: stomach. First choice: Tubulized gastric conduit	strong	tubulized stomach = 1 ; stomach = 0.5	1
Lymphnodes			all 3 correct = 1	1
Upper third esophagus tumor	3-field lymphadenectomy	strong	0.33	
Middle third esophagus tumor	2-field lyphadenectomy	strong	0.33	
Lower third esophagus tumor	2-field lyphadenectomy	strong	0.33	
Perianastomotic drain in cervical anastomosis	avoid	moderate	NO = 1	1
NG tube	recommended + removed POD 2	strong	romoval POD 2 = 1	1
Chest tube	use of chest drain should be minimized + single drain is as effective as two, with less pain	moderate	0 or 1 chest drain = 1	1
Postoperative phase				total 7
Monitoring postop	not routinely requires ICU, individualized, depends on center facilities	strong	ICU or PACU = 1	1
Pain management	thoracic epidural = first line approach postop analgesia	strong	epidural = 1	1
Fluid management periop	neutral balanced fluid therapy, positive balance absolutely avoided	strong	neutral = 1	1
Early enteral feeding	early enteral nutrition, route remains unclear	strong	oral or jejunostomy or nasojejunal tube = 1	1
Early active mobilisation	start on POD 0, predetermined targets, daily increase	strong	POD 0 = 0.5 ; targets = 0.25 ; daily increase = 0.25	1
Foley catheter removal	after removal of epidural, POD 2-4	moderate	POD 2-4 = 1	1
Antitrombotic profylaxis	both mechanical + LMWH	strong	both = 1	1
				total ERAS score = 20

Fig. 1 Belgian ERAS scoring system for esophageal surgery

from the Belgian Cancer registry, but not audited per center [18].

Due to the small number of esophageal surgeons and centers in Belgium, mainly descriptive statistical analysis was done using SPSS Statistics 29. Furthermore, possible correlation was examined between ERAS score and outcome indicators per center using the Pearson correlation coefficient.

Results

Sixteen of the seventeen esophageal surgeons answered the questionnaire, resulting in a response rate of 94.1%, but one surgeon only partially filled-in the questionnaire. All surgeons responded that they use a protocol for the perioperative care for esophageal surgery in their center. 75% of the surgeons have full knowledge of the ERAS guideline for esophageal surgery and 25% reported to have only some knowledge.

Results for the implementation of the pre-, intra- and post-operative ERAS elements are shown in Tables 1, 2 and 3 respectively. In the pre-operative phase, all surgeons reported to determine a nutritional status of the patients by a dietician and in high-risk patients enteral support is started using a jejunostomy as advised in the ERAS guidelines. There is some variability in the implementation and use of prehabilitation programs. Pre-operative alcohol- and smoke cessation is very well implemented, as well as an exercise program. Elements of prehabilitation programs with the possibility to improve are glycemic control, blood pressure control and psychological intervention. In 37.5% of the cases, patients need to fast longer than needed and 31.3% of the surgeons ask patients to perform unnecessary mechanical bowel preparation.

Table 1 Implementation of pre-operative ERAS elements

Pre-operative ERAS elements	Percentage of implementation (%)
Nutritional status evaluation by dietician	100
Nutritional support in high-risk patients	100
Alcohol cessation	93.8
Smoking cessation	93.8
Protein supplementation	68.8
Glycemic control	43.8
Blood pressure control	31.3
Psychological intervention	25.0
Exercise program	81.3
Pre-operative fasting	37.5 Longer than needed
	62.5 ERAS protocol (2 h liquids and 6 h solids)
Mechanical bowel preparation	43.8 Never
	25.0 On indication (planned colonic reconstruction)
	31.3 Routinely

Table 2 Implementation of intra-operative ERAS elements

Intra-operative ERAS elements	Percentage of implementation (%)
Surgical timing after neoadjuvant therapy	100
Preferred surgical access	25.0 Hybrid
	62.5 Laparoscopically
	12.5 Robot assisted
Preferred conduit: stomach	100
NG tube	37.5 Removed on POD 2
	62.5 Removed after POD 2
Cervical drain: not placed	43.8
Thoracic drain	6.3—None
	56.3—1 drain
	37.5—2 drains

Table 3 Implementation of post-operative ERAS elements

Post-operative ERAS elements	Percentage of implementation (%)
Post-operative monitoring ICU/PACU	100
Thoracic epidural	100
Fluid management	26.7 Negative balance
	73.3 Neutral balance
	0.0 Positive balance
Early enteral feeding	60.0
Early mobilization	40.0 POD 0
	53.3 POD 1
	6.7 on the ward
Foley catheter	6.7 not routinely
	20.0 removed <POD 2
	73.3 Removed POD 2–4
Thrombosis prophylaxis (mechanical and low molecular weight heparin)	100

In the intra-operative phase, all surgeons use a minimally invasive technique, 25% uses a hybrid approach, 62.5% performs the procedure totally minimally invasive and 12.5% operates robotically assisted. For drain management, there is still a wide variability in application. The nasogastric tube is left in situ for more than the advised 2 days in 62.5% of the cases, a cervical drain is still placed by more than half of the surgeons and 37.5% of the surgeons still place two thoracic drains.

In the post-operative phase, early enteral feeding is only applicated by 60% of the surgeons. Only 40% of the surgeons mobilize the patient immediately on the day of the operation.

Using the ERAS scoring system (Fig. 1), ERAS scores were determined per surgeon as well as per center. The mean ERAS score of all Belgian esophageal surgeons is 15.53 (SD 2.4). The highest individual ERAS score is 19.40 and the lowest individual score is 11.46. The highest ERAS score per center achieved is 18.58. All ERAS scores per center are shown in Table 4.

Patient outcome data are also summarized in Table 4. Anastomotic leakage rates are between 9% and 23%, with a mean of 14.6% in Belgium. The percentage of post-operative pneumonia is between 9% and 25%, with a mean of 20.8% in Belgium. The mean length of stay is 12 days. Mortality after 30 days and 90 days are, respectively, 3.2% and 6.6%.

A potential correlation between the level of ERAS implementation in a center and the patient outcome was determined by the Pearson correlation coefficient. A negative correlation was seen between the level of ERAS implementation and anastomotic leak rate ($r = -0{,}781$; $p = 0{,}022$; $N = 8$) as well as the length of stay ($r = -0{,}782$; $p = 0{,}022$; $N = 8$), shown in Figs. 2 and 3.

Difficulties encountered during the daily implementation and application of the ERAS protocol were financial issues (40%), low staffing issues (46.6%), staffing issues in the ICU/PACU (20%), resistance of nurses in the ward (26.6%), logistical issues (46.6%) and insufficient education of caregivers (13.3%). In total, 93.3% of the surgeons reported to encounter at least one of these difficulties.

Discussion

This is the first study in Belgium to provide a national picture of the implementation of ERAS protocols in esophageal surgery. To the best of our knowledge, a similar national study has only been published in Canada in 2023 [14] and in Italy in 2021 [15].

In this Belgian survey, 100% of respondents reported the use of ERAS protocols compared to only 40% of the surgeons in a similar Canadian study [14]. However, inter-individual differences were noted between surgeons working in the same center. Heterogenic responses were mainly seen concerning the prehabilitation programs and the intra-operative drain placement (cervical and thoracic). The highest level of adherence to the protocol was seen in the post-operative phase. Inter-individual differences between surgeons could be explained by fewer adherences to the protocol due

Table 4 ERAS scores and patient outcomes per center

Nr. Center	ERAS score	Anastomotic leakage (%)	Postop pneumonia (%)	LOS (days)	Mortality 30 days (%)	Mortality 90 days (%)	Readmission rate (%)
1	15.56	12.5	25	10	1.5	6.9	8
2	16.85	14.5	21	11	2.2	4.8	14
3	14.61	15	15	13	1.8	2.2	8
4	15.67	14	23	13	2.3	6.7	15
5	17.80	9	9	10	5.7	6.4	2
6	18.58	13	22	12	3.5	5.4	7
7	13.06	23	16	15	7.0	7.6	.
8	12.09	18	22	15	5.5	9.4	10

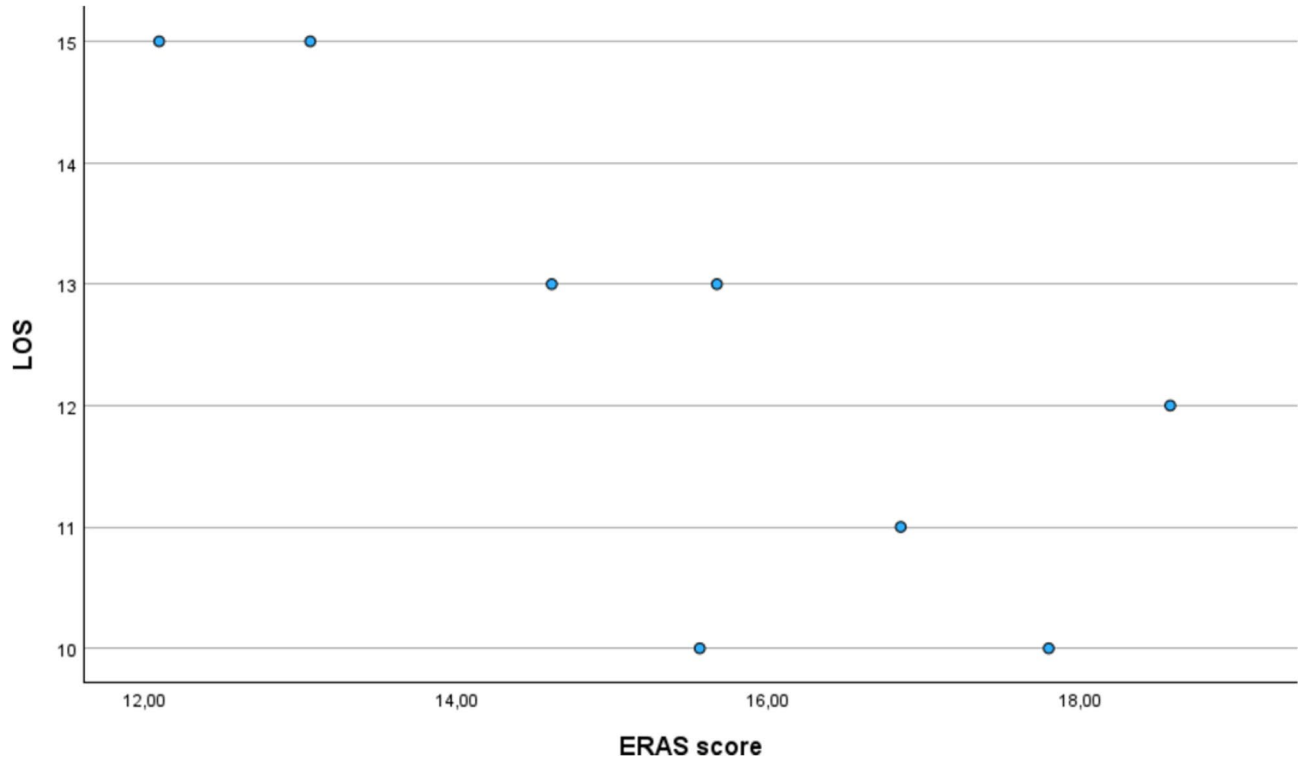

Fig. 2 Scatterplot: correlation between ERAS and length of stay (LOS)

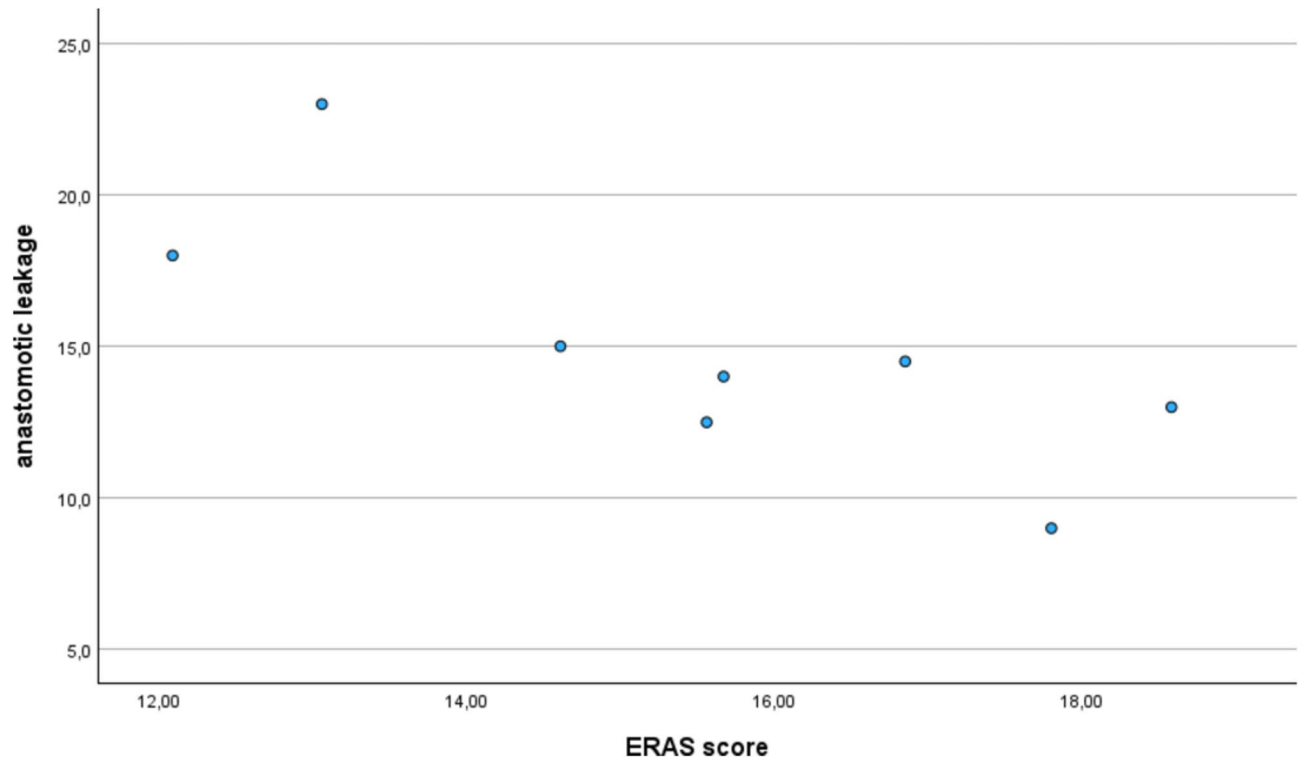

Fig. 3 Scatterplot: correlation between ERAS and anastomotic leak rate (AL)

to personal preference, experience and especially the moderate to low scientific evidence for several ERAS criteria

The ERAS elements with the best implementation (>90%) are nutritional assessment and supplementation, smoke and alcohol cessation, surgical timing, minimally invasive surgical access, conduit choice, post-operative monitoring, thoracic epidural for pain management and thrombosis prophylaxis. The ERAS elements with room for improvement are prehabilitation programs, pre-operative fasting, unnecessary mechanical bowel preparation, cervical drain placement, thoracic drain placement, early post-operative mobilization and early enteral feeding.

Compared to the literature, there seems to be a good overall level of implementation of the ERAS guidelines for esophageal surgery in Belgium. A similar Canadian study reports self-reported adherence levels of more than 80% in 6/12 pre-operative ERAS recommendations, 2/8 intra-operative ERAS recommendations and 7/23 post-operative ERAS recommendations. Meaning that less than half of the ERAS recommendations are well implemented and well adhered [14]. An Italian multi-centric study published in 2021 showed adherence of ERAS protocols in the pre-operative, intra-operative and post-operative phase of, respectively, 69.8%, 60.3% and 82.5% [19]. In both these countries, esophageal surgery is not centralized and, therefore, low-volume centers as well as general surgeons are also included in these studies with maybe less knowledge and less dedication to the ERAS guidelines for esophageal surgery, explaining the lower rate of implementation and adherence compared to our study.

Patient outcomes after esophageal surgery in Belgium are similar to reported outcomes in the literature. Anastomotic leakage was seen in 14.6% and post-operative pneumonia in 20% of the cases in Belgium. An international review of high-volume centers reported, respectively, 11.4% and 14.6% [11, 20]. A meta-analysis of Pucetti et al. published in 2022 shows an anastomotic leak rate of 8.3% and a post-operative pneumonia rate of 17% [21]. In Belgium, the mean length of stay is 12 days, similar to the literature in which length of stay of 10 or 11 days is reported [6, 21]. Mortality in esophageal surgery after 30 days and after 90 days is, respectively, 3.2% and 6.6% in Belgium. These numbers seem to be in line with a worldwide review of high-volume centers reporting a 30-day mortality of 2.4% and a 90-day mortality of 4.5% [11, 20].

A potential negative correlation was seen between the level of ERAS implementation and anastomotic leak rate ($r = -0{,}781$; $p = 0{,}022$; $N = 8$) as well as the length of stay ($r = -0{,}782$; $p = 0{,}022$; $N = 8$), based on the center-specific outcome data reported by the centers and de national cancer registry. Suggesting a potential outcome benefit for centers with a high level of ERAS implementation; however, this is based on limited and self-reported outcome data and with limited scientific evidence concerning the different ERAS elements.

The strength of this study is the high response rate of 94.1%. In a similar Italian national study, the response rate was only 65% [15] and in a similar Canadian national study, the response rate was 54.4% [14], but both countries do not have a centralization.

An ERAS scoring system was created and used in this study to measure, express and compare the level of ERAS implementation. The ERAS score is objective, standardized and reproducible, but not validated. In the literature, there is to the best of our knowledge no similar scoring system used to define the level of ERAS implementation. A pitfall is that only surgical ERAS elements were included in the scoring system. In addition, elements in Belgium known as standard of care were not included in the ERAS scoring system. Therefore, the score is not covering the full ERAS guideline for esophageal surgery. Another pitfall is that all elements get the same weight, since there is no evidence in the literature about the weight of one element with respect to the other. The focus of a new study could be to optimize this ERAS scoring system by covering every element of the ERAS guideline and incorporate a weight per element after studying the weight of every element with respect to the other elements.

The main limitation of this study is the limited number of esophageal surgeons and centers in Belgium. This means that only descriptive statistical analysis could be done. However, this study produced a nice overview of the Belgian situation regarding the use of ERAS protocols in esophageal surgery centers.

Conclusion

This study gives an overview of the Belgian situation regarding the use and implementation of ERAS protocols in esophageal surgery centers. Although the overall implementation in Belgium is good to very good, there is still heterogeneity seen between surgeons and centers. Therefore, there is room for improvement in terms of uniformity nationally.

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Declarations

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References

1. Ljungqvist O, Scott M, Fearon KC (2017) Enhanced Recovery After Surgery: A Review. JAMA Surg. 152(3):292–298. https://doi.org/10.1001/jamasurg.2016.4952. (**PMID: 28097305**)
2. Tanious MK, Ljungqvist O, Urman RD (2017) Enhanced Recovery After Surgery: History, Evolution, Guidelines, and Future Directions. Int Anesthesiol Clin. 55(4):1–11. https://doi.org/10.1097/AIA.0000000000000167. (**PMID: 28901977**)
3. Kehlet H (1997) Multimodal approach to control postoperative patho- physiology and rehabilitation. Br J Anaesth. 78:606–17
4. Low DE, Allum W, De Manzoni G, Ferri L, Immanuel A, Kuppusamy M, Law S, Lindblad M, Maynard N, Neal J, Pramesh CS, Scott M, Mark Smithers B, Addor V, Ljungqvist O (2019) Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. World J Surg. 43(2):299–330. https://doi.org/10.1007/s00268-018-4786-4. (**PMID: 30276441**)
5. Ashok A, Niyogi D, Ranganathan P, Tandon S, Bhaskar M, Karimundackal G, Jiwnani S, Shetmahajan M, Pramesh CS (2020) The enhanced recovery after surgery (ERAS) protocol to promote recovery following esophageal cancer resection. Surg Today. 50(4):323–334. https://doi.org/10.1007/s00595-020-01956-1
6. Zhang M, Wang H, Wang X, Zhang L, Shen C, Tian C, Xu X, Li X, Li Z, Zhang SK, Han BB (2022) Cost-effectiveness comparisons of enhanced recovery after surgery (ERAS) vs. non-ERAS for esophageal cancer in China: a retrospective comparative cohort study. Ann Transl Med. 10(18):995. https://doi.org/10.21037/atm-22-4169
7. Written on behalf of the AME Thoracic Surgery Collaborative Group, Shen Y, Chen X, Hou J, Chen Y, Fang Y, Xue Z, D'Journo XB, Cerfolio RJ, Fernando HC, Fiorelli A, Brunelli A, Cang J, Tan L, Wang H (2022) The effect of enhanced recovery after minimally invasive esophagectomy: a randomized controlled trial. Surg Endosc. 36(12):9113–9122. https://doi.org/10.1007/s00464-022-09385-6
8. Ferlay J, Ervik M, Lam F, Laversanne M, Colombet M, Mery L, Piñeros M, Znaor A, Soerjomataram I, Bray F (2024). Global Cancer Observatory: Cancer Today. Lyon, France: International Agency for Research on Cancer. Available from: https://gco.iarc.who.int/today, accessed [16-06-2024].
9. van Kooten RT, Voeten DM, Steyerberg EW, Hartgrink HH, van Berge Henegouwen MI, van Hillegersberg R, Tollenaar RAEM, Wouters MWJM (2022) Patient-Related Prognostic Factors for Anastomotic Leakage, Major Complications, and Short-Term Mortality Following Esophagectomy for Cancer: A Systematic Review and Meta-Analyses. Ann Surg Oncol. 29(2):1358–1373. https://doi.org/10.1245/s10434-021-10734-3
10. Abdelsattar ZM, Habermann E, Borah BJ, Moriarty JP, Rojas RL, Blackmon SH (2020) Understanding Failure to Rescue After Esophagectomy in the United States. Ann Thorac Surg. 109(3):865–871. https://doi.org/10.1016/j.athoracsur.2019.09.044. (**Epub 2019 Nov 9 PMID: 31706867**)
11. Low DE, Alderson D, Cecconello I, Chang AC, Darling GE, D'Journo XB, Griffin SM, Hölscher AH, Hofstetter WL, Jobe BA, Kitagawa Y, Kucharczuk JC, Law SY, Lerut TE, Maynard N, Pera M, Peters JH, Pramesh CS, Reynolds JV, Smithers BM, van Lanschot JJ (2015) International Consensus on Standardization of Data Collection for Complications Associated With Esophagectomy: Esophagectomy Complications Consensus Group (ECCG). Ann Surg. 262(2):286–94. https://doi.org/10.1097/SLA.0000000000001098. (**PMID: 25607756**)
12. Walters DM, McMurry TL, Isbell JM, Stukenborg GJ, Kozower BD (2014) Understanding mortality as a quality indicator after esophagectomy. Ann Thorac Surg. 98(2):506–11. https://doi.org/10.1016/j.athoracsur.2014.03.041
13. Slokdarmchirurgie: terugbetaling in een gespecialiseerd centrum [Internet]. Riziv.fgov.be; [Geraadpleegd op 16 dec 2023]. Available via: https://www.riziv.fgov.be/nl/professionals/verzorgingsinstellingen-en-diensten/ziekenhuizen/verzorging-in-ziekenhuizen/slokdarmchirurgie-terugbetaling-in-een-gespecialiseerd-centrum.
14. Jogiat U, Sisson D, Sasewich H, Islam T, Low D, Darling G, Turner SR (2023) ERAS guidelines for esophagectomy: adherence patterns among Canadian thoracic surgeons. Updates Surg. 75(5):1203–1210. https://doi.org/10.1007/s13304-023-01478-8. (**Epub 2023 Mar 21 PMID: 36943628**)
15. Italian Society for Study of Diseases of the Esophagus, Parise P, Turi S, Talavera-Urquijo E, Carresi A, Barbieri L, Cossu A, Elmore U, Puccetti F, Rosati R (2021) Application of ERAS protocol in esophagectomy: a national survey among Italian centers performing esophageal surgery. Updates Surg. 73(1):297–303. https://doi.org/10.1007/s13304-020-00963-8
16. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG (2009) Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 42(2):377–81
17. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, McLeod L, Delacqua G, Delacqua F, Kirby J, Duda SN (2019) REDCap Consortium, The REDCap consortium: Building an international community of software partners. J Biomed Inform. https://doi.org/10.1016/j.jbi.2019.103208
18. Belgian Cancer Registry Team (2023) RIZIV/INAMI convention Complex Surgery Oesophagus and Gastro-Oesophageal Junction: global report July 2019- June 2022. RIZIV/INAMI, Brussel. Availabe via: https://www.riziv.fgov.be/SiteCollectionDocuments/summary_evaluation3years_oesophagus_4thyear.pdf
19. Gianotti L, Fumagalli Romario U, De Pascale S, Weindelmayer J, Mengardo V, Sandini M, Cossu A, Parise P, Rosati R, Bencini L, Coratti A, Colombo G, Galli F, Rausei S, Casella F, Sansonetti A, Maggioni D, Costanzi A, Bernasconi DP, De Manzoni G (2019) Association Between Compliance to an Enhanced Recovery Protocol and Outcome After Elective Surgery for Gastric Cancer Results from a Western Population-Based Prospective Multicenter Study. World J Surg. 43(10):2490–2498. https://doi.org/10.1007/s00268-019-05068-x. (**PMID: 31240434**)
20. Low DE, Kuppusamy MK, Alderson D, Cecconello I, Chang AC, Darling G, Davies A, D'Journo XB, Gisbertz SS, Griffin SM, Hardwick R, Hoelscher A, Hofstetter W, Jobe B, Kitagawa Y, Law S, Mariette C, Maynard N, Morse CR, Nafteux P, Pera M, Pramesh CS, Puig S, Reynolds JV, Schroeder W, Smithers M, Wijnhoven BPL (2019) Benchmarking Complications Associated with Esophagectomy. Ann Surg. 269(2):291–298. https://doi.org/10.1097/SLA.0000000000002611. (**PMID: 29206677**)
21. Puccetti F, Wijnhoven BPL, Kuppusamy M, Hubka M, Low DE (2022) Impact of standardized clinical pathways on esophagectomy: a systematic review and meta-analysis. Dis Esophagus.

35(2):doab027. https://doi.org/10.1093/dote/doab027. (**PMID: 34009322**)

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