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The Effects of an Educational Intervention on Nursing Knowledge of Post-Operative Care of Patients after Minimally Invasive Esophagectomy Surgery

Kelli Curry
kelli.curry10@uky.edu

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The Effects of an Educational Intervention on Nursing Knowledge of Post-Operative Care of
Patients after Minimally Invasive Esophagectomy Surgery

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing
Practice at the University of Kentucky

By

Kelli Curry MSN, APRN

Lexington, KY

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Abstract

Background: Minimally invasive esophagectomy surgery is commonly performed by thoracic surgeons on patients with esophageal cancer. The post-operative care of these patients is meticulous and follows a protocol developed by the thoracic surgeons at the University of Kentucky. At UK Chandler Medical Center, concerns have been raised regarding nurses' lack of education of the protocol, and therefore decreased implementation. Increasing nursing knowledge pertaining to this protocol by performing educational in-services periodically and standardizing and implementing formal education as part of nursing orientation will decrease the knowledge gap and improve patient outcomes and increase utilization of the post-operative protocol.

Purpose: The purpose of this project was to increase nurses' knowledge, help bridge the knowledge gap between providers and nurses caring for esophagectomy patients and therefore increase compliance with the post-operative care protocol for minimally invasive esophagectomy patients. This practice change was accomplished via an educational in-service for nursing staff.

Design: This was a quasi-experimental study.

Methods: This study was performed at the University of Kentucky in the Cardiothoracic ICU. Retrospective chart reviews were performed in the Fall of 2023 and prospective chart reviews were performed in the Spring of 2024. These chart reviews focused on obtaining demographic data as well as four objectives to assess compliance to the post-operative esophagectomy protocol: documentation of nasogastric tube to low wall suction, number of times the patient ambulated per day, post-operative day of foley catheter removal, and initiation and advancement of enteral tube feeds. The outcome of an anastomotic leak was also tracked.

In addition, the Cardiothoracic ICU bedside nurses were invited to attend an educational in-service. Participants performed a pre-test in which they identified their baseline knowledge of post-esophagectomy care. After the in-service, they completed a post-test questionnaire to identify any change in knowledge.

Results: There were 5 participants for pre- and post-test surveys. Statistically significant increases in knowledge ($n = 5, p = .003$) and confidence ratings ($n = 5, p = .005$) were found after the in-service. In the chart reviews, there was one statistically significant finding, an improvement in the frequency of ambulation on post-operative day two, in which ambulation frequency increased from 1.13 before in-service to 2.45 after in-service ($p\text{-value} = .02$).

Identifying the improvement in ambulation could indicate increased compliance with the post-operative protocol.

Conclusion: Further research is needed regarding various methods for nursing education and the effects on patient outcomes. This study shows that educating nurses on post-operative protocols can make a statistically significant improvement in post-operative care, but the impact of this could be better investigated with a larger sample size of participants in an educational in-service, as well as a larger cohort of patients.

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Will Providing a Nursing Educational In-Service Improve the Post-Operative Care of Esophagectomy Patients?

Background and Significance

Esophageal cancer makes up about 1% of cancers diagnosed in the United States, with a lifetime risk of about 1 in 127 for men and about 1 in 434 for women (American Cancer Society, 2024). While these statistics may not be overwhelming, it is important to share information about esophageal cancer, because surgery can be curative with early diagnosis. There are two types of esophagectomy that are performed across the world by specially trained surgeons, open and minimally invasive. Both open and minimally invasive surgical approaches have relatively high complication rates, but open esophagectomies tend to have more complications than minimally invasive. Minimally invasive esophagectomy is the surgical procedure of choice for the team of thoracic surgeons at the University of Kentucky. This specialized surgery is performed with instruments that are placed through numerous small incisions in the chest and abdomen, and involves removing the diseased part of the esophagus and manipulating the stomach into the chest to create a new anastomosis. Undergoing a minimally invasive esophagectomy will forever alter a patient's life, as the anatomical changes in the esophagus and stomach require them to change the way they eat. However, since this is commonly performed due to cancer of the esophagus, the procedure may also be lifesaving.

A surgical procedure of this magnitude with relatively high complication rates requires very meticulous post-operative care. This care is provided by bedside nurses in the Cardiothoracic ICU and progressive care areas at the University of Kentucky. The thoracic surgeons at the University of Kentucky follow a standardized post-operative protocol to enhance patient recovery, but this protocol had not previously been made known to the bedside nursing

staff. Previous practice to educate nursing staff on post-operative patient care needs consisted of a quarterly “HuddleUp” lecture series with varied topics and hands-on training during nursing orientation. Bedside nurses weren’t specifically educated on the Esophagectomy post-operative protocol until 2023. In January 2023, the HuddleUp topic was regarding esophagectomy care and Fall of 2023 for the educational in-service discussed in this paper.

Plans for post-operative care were communicated to nursing staff from the thoracic surgery team by orders placed in the chart, direct bedside handoff regarding management of lines/tubes/drains from the operating surgeon immediately post-op, and/or conversations during daily rounds. Members of the thoracic surgery team observed that nurses often had questions about the management of tubes/lines/drains in esophagectomy patients during the post-operative period, and this prompted concerns about a gap in educational practices for nursing staff. The surgical team mostly received these questions while patients were recovering in the Cardiothoracic ICU, but they also heard them in Progressive Care areas. The esophagectomy patients spend their first three or four post-operative days in the ICU, but some patients may spend their entire hospital stay in the ICU. This depends on bed availability after downgrade orders are placed.

Research reveals a wide range of approaches to post-operative management of esophagectomy patients, due to variety in surgeons’ techniques and post-operative care preferences for feeding access and drain placement. Low et al. (2018) provided a strong recommendation for the use of a multidisciplinary standardized clinical pathway, but there is no standardized protocol to guide all facilities where esophagectomy surgery is performed. Post-operative levels of care vary, but there are some common themes throughout the literature. One of these involved where patients should be admitted after surgery. Merritt et al. (2020) discussed

that the patients in their study did not routinely get admitted to the ICU post-operatively. Low et al. (2018) strongly asserted that not all patients need routine ICU care post-operatively, and that lower risk patients could be managed in a progressive care unit.

Another common theme from the research was a focus on early ambulation to prevent pulmonary complications (Low et al., 2018; Kondo et al., 2023). Research also revealed a focus on early nutrition, though there are various approaches for nutrition delivery. Some surgeons elect to place jejunostomy tubes for feeding, others place nasojejunal tubes intraoperatively, and some surgeons do not place any feeding access and prefer to allow early oral nutrition (Low et al., 2018; Merritt et al., 2020). Due to a variety of surgical approaches, the general complexity of recovery from esophageal surgery, and relatively high complication rates, the widespread adoption of rapid recovery protocols has remained limited.

There are a variety of consequences that can occur from improper management of post-esophagectomy patients. Some of these include pneumonia, atrial fibrillation, dehydration leading to acute kidney injury, hypotension, urinary tract infection, and/or anastomotic leak due to hypotension and/or malnutrition. According to Merritt et al. (2020), atrial fibrillation, respiratory failure, and anastomotic leak can add significant additional hospital days to the length of stay. “The incidence of anastomotic leak ranges from 5 to 40 percent after esophagectomy” (Raymond, 2024, Procedure Specific Complications, para. 3). After an esophagectomy, patients will have an altered blood supply and there is only one artery that will provide blood flow to their gastric conduit; therefore, even one episode of hypotension could be very detrimental to anastomotic healing. If an anastomotic leak is identified, this may require additional interventions, leading to a longer hospital stay. Post-operative respiratory morbidity (such as pneumonia) has also been found to significantly decrease overall survival after esophagectomy

surgery (Horinouchi et al., 2023). Due to the relatively high frequency of post-esophagectomy complications, as well as the possible severity of these complications the meticulous care provided by the Cardiothoracic nurses is of vital importance. Increasing focus on educating these nurses provides greater knowledge and confidence on the care required.

Purpose/Objectives

The purpose of this project was to improve nurse knowledge and adherence to a standardized post-operative protocol for the management of esophagectomy patients, via an educational in-service. This educational in-service was developed to educate nurses on the desired post-operative management of specific tubes/lines/drains in place and the importance of adherence to the protocol.

One of the desired objectives achieved from the implementation of this ongoing educational change was an increase in compliance to the standardized post-operative protocol by increasing nursing knowledge of post-esophagectomy care after intervention (this was assessed by pre-test and post-test design, as well as chart reviews). Other objectives were identified by retrospective and prospective chart reviews in the fall of 2023 and spring of 2024. The specific objectives from chart reviews were:

1. documentation of nasogastric tubes to low wall suction
2. number of times a patient ambulated each post-operative day
3. post-op day of foley catheter removal
- 4.timing for initiation and advancement of tube feed nutrition.

Other data reviewed included hospital length of stay, post-operative complications (anastomotic leak), and patient co-morbidities. The assessment of these objectives and increased compliance after intervention were indicative that the educational intervention was successful.

Review of Literature

The focus of this literature review was to examine the available research on the effectiveness of nursing education on knowledge and adherence to care protocols. Specifically, regarding a post-operative protocol and post-operative care for esophagectomy patients. These search strategies included utilizing PubMed and CINAHL databases to find research articles. Key words were nursing, education, esophagectomy, enhanced recovery after surgery, thoracic surgery, outcomes, and urinary catheter. Inclusion criteria included: hospital setting, nursing education intervention performed, and focus on post-operative patients. Exclusion criteria were a non-hospital setting, education not focused on nursing care, and focus on non-operative patients. The literature search yielded 15 relevant articles that were reviewed. Two of these articles were meta-analyses, two were systematic reviews, and six were retrospective studies.

Educational interventions have been found to improve nurses' knowledge of evidence-based practice, skills, attitudes, and behavior, and to improve patient outcomes (Sapri et al., 2022; Alex et al., 2022). Education has been found to increase nurses' confidence when performing catheter care (Alex et al., 2022) and pain assessments (Drake & Williams, 2017). In a systematic review of research that examined the effects of educational interventions for bedside nurses, Alex et al. (2022) asserted that "actively engaging nurses who provide direct patient care is essential, in planning and implementing targeted educational interventions specific to learning needs" (p 1). These findings helped to guide the educational in-service for this project towards the nurses involved in providing direct patient care to post-esophagectomy patients. The evidence also showed that an educational intervention can help nursing staff feel more confident with pain assessment and documentation, and this supported the possibility that such an intervention may improve nurse assessment of lines/tubes/drains in post-operative

esophagectomy patients. Furthermore, although there is a lack of research pertaining to the effects of nurse education on the care of post-esophagectomy patients specifically, both topics discussed in the systematic reviews detailed above (foley catheter management and acute pain management) are clinical issues that patients may encounter after esophagectomy.

To further elaborate on the types of nursing educational interventions performed and identify what would work best, Alex et al. (2022) recommended designing educational interventions that can be tailored to the nurses' learning needs, and asserted the importance of involving nurses in the development of the program. There were a few articles that discussed the importance of an Enhanced Recovery After Surgery (ERAS) protocol to follow pre-operatively, intra-operatively, and post-operatively. Tang et al. (2022) found that the use of an ERAS protocol could decrease hospital length of stay, pain scores and hospital costs, but there was no statistical decrease in complication rate. Merritt et al. (2020) also found that an ERAS post-operative protocol could help decrease hospital length of stay but did not have a significant impact on complication rates. Therefore, the use of an ERAS post-operative protocol and an educational in-service presentation has some benefit for the nurses who care for this specialized patient population.

The use of an educational in-service to educate nurses regarding clinical care has already been shown to be beneficial, but these interventions become of greater importance by improving patient outcomes as well. This improvement in patient outcomes would likely decrease length of stay and the need for additional procedures

Theoretical/Conceptual Framework

The theoretical framework utilized during this intervention was the Plan-Do-Study-Act framework. This framework focuses on four different stages that all play a vital role in working

towards quality improvement in healthcare. The first phase is “Plan,” which consists of identifying what you hope to achieve with your intervention. This plan could be established based on an already identified knowledge gap, e.g., the observations from the thoracic surgery team regarding the nursing care for the esophagectomy patients. The “Do” phase consists of performing the intervention. The “Study” phase consists of studying the results from the “Do” phase. Lastly, the “Act” phase consists of the results from the intervention and implications for further research (AHRQ, n.d.).

This specific framework was chosen because the timeline is variable and this can be performed on a quick timeline, pending the amount of time needed for Planning and Doing. This framework also has clearly defined steps and easily allows for repeating the steps involved, if needed, based upon the implications identified in the “Act” phase. The quality improvement process is vital, especially when this intervention can help improve patient outcomes and should be performed in a logical and timely manner. The “Act” phase also helps to identify implications for future research, which can be very helpful to future researchers that may be interested in an all-inclusive post-esophagectomy nursing care intervention.

Methods

Design

This project employed a quasi-experimental pre-test-post-test design with retrospective and prospective chart reviews, to identify the effectiveness of an educational in-service on the dependent variable of practice change due to increased nursing knowledge.

Setting

This study was conducted in the Cardiothoracic Intensive Care Unit at the University of Kentucky Medical Center. The post-esophagectomy patients spend at least their first three to four days immediately after surgery in this setting; therefore, it is imperative that these nurses are knowledgeable in regard to the post-operative guidelines for care of these patients. In its their Mission Statement, the University of Kentucky states, “Through our DIRECT values, in support of our mission and commitment to patient care, education and research, our 2025 vision will inspire us toward an achievable future” (UK Healthcare, n.d.). This project was congruent with the University of Kentucky’s goal to improve patient care through education and research.

A variety of stakeholders were involved in this study. First and foremost, were the bedside nurses in the Cardiothoracic Intensive Care Unit, who were responsible for participating in the educational in-service to affect practice change. This practice change was assessed by pre-test and post-test surveys, and by assessing compliance with the post-operative esophagectomy protocol by reviewing previously mentioned objectives. Nursing documentation was of vital importance for the chart review aspect of this study as well. The next group of stakeholders were the patients, as they were directly affected by the care and patient participation is of vital importance for post-operative care. Additional stakeholders included the thoracic surgery team, as this post-operative care is vitally important to the outcomes from the surgery. Lastly, the management and nursing educators for the Cardiothoracic ICU were stakeholders in this study.

Potential site-specific facilitators and barriers to implementation: As mentioned above, commitments to patient care, education and research are all in the mission statement for UK HealthCare; therefore, most UK employees are familiar and passionate about the use of educational interventions and research. Some specific facilitators of this study were the charge

nurses and thoracic surgery providers who reinforced the education, bedside nurses orienting new staff, clinical nurse specialists, and management. Some barriers to implementation were likely burnout from nursing staff and unwillingness to participate in another educational in-service for a research study, as it could have interrupted their workflow. Another barrier may have been lack of support from management or charge nurses, due to a desire to avoid adding more stress to the already busy bedside nurses.

Sample

The target population for this study was the Cardiothoracic ICU bedside nurses caring for post-esophagectomy patients, as well as post-esophagectomy patients for chart review. This educational intervention was aimed at the nursing staff, so the inclusion criteria included working in the Cardiothoracic ICU. This is a 32-bed ICU in which up to three post-esophagectomy patients may be cared for at any given time. The charge and resource nurses were also included in the sample, as they served as resources for the bedside nurses. Exclusion criteria included nurses working in other ICUs, non-nurses, nurses caring for patients that did not have an esophagectomy surgery, and patients that did not have an esophagectomy. There were five participants in the educational in-service, with pre-test and post-test. There were 19 chart reviews.

Procedure

This project was submitted to the Institutional Review Board at the University of Kentucky for approval to ensure the safety of human subjects. IRB approval was obtained in August of 2023.

The intervention in this project consisted of an educational in-service in the form of a PowerPoint presentation about post-operative care for esophagectomy patients. A pre-test survey was completed prior to the educational presentation, and a post-test survey was completed immediately afterward. Educational information discussed in this presentation included a basic overview of minimally invasive esophagectomy surgery, as well as a breakdown on basic management and what to expect on each post-operative day. The presentation covered the proper management of nasogastric and jejunostomy tubes, as well as when liquid medications would be started via jejunostomy tube, when the patient may be able to have PO intake, how many times the patient should ambulate each day, and when the foley catheter should be removed.

This study also involved performing retrospective chart reviews in the Fall of 2023 and prospective chart reviews in the Spring of 2024. These were performed by the primary investigator and the goal of these reviews was to identify nursing compliance with four objectives discussed in the educational in-service: always maintaining the nasogastric tube to low wall suction, patients ambulating three times per day, foley catheter removal on post-operative day 1, initiation of enteral tube feeds on post-operative day 3 and advancement of enteral tube feeds on post-operative day 4. The patient's length of hospital stay, co-morbidities (smoking and BMI), and post-operative complication (anastomotic leak) were also recorded, in order to ascertain if compliance to the listed objectives had any correlation to length of stay.

Measures and Instruments

The specific variables measured in this study were the levels of nursing knowledge and confidence in the care of esophagectomy patients, as well as whether there was an effect on patient care, outcomes and/or complications after education on the protocol. Assessment

regarding patient care and outcomes were identified by performing chart reviews and questionnaires.

The instrument utilized for data collection for this study was a questionnaire, which contained multiple choice questions regarding management of drains/lines/tubes for esophagectomy patients. A correct answer was given 1 point, while an incorrect answer was given 0 points. The questionnaire also included a Likert scale in which each nurse could rank their knowledge level and their comfort level caring for esophagectomy patients. Additional demographic questions assessed an estimate of the number of esophagectomy patients the nurse had cared for previously and number of years working in the Cardiothoracic ICU to identify level of experience. This questionnaire was set up in a pre-test and post-test format.

Data Collection and Analysis

Completed pre- and post-test surveys were kept in a secured location and participants were de-identified by filling out a pre-numbered pre-test survey. The participants were then told to write this same number on top of the post-test survey; therefore, the data could be linked to pair the surveys for data analysis purposes. This educational in-service and survey collection occurred in December of 2023.

Also, during data collection, the electronic medical records were accessed to assess documentation pertaining to specific objectives, as well as complications and hospital length of stay. During this process, a data sheet was created that listed the patient's Medical Record Number and the correlation to an assigned participant number. After the patient information was de-identified, this participant number was utilized on a documentation sheet to track specific objectives. There was no attempt to re-identify the protected health information. This protected

health information (PHI) was stored on the primary investigator's password protected, firewall protected and encrypted laptop computer. This data collection occurred from the Fall of 2023 through the Spring of 2024. Data were tallied by the PI.

Data collected from this project consisted of continuous, ordinal, and nominal data. Due to this wide range of data, there were various methods of analysis while utilizing SPSS. Data from the pre- and post-tests from the educational in-service were analyzed by utilizing a paired samples t-test. This was utilized so that data would be linked to better stratify improvement in knowledge from a specific participant. Data from the chart reviews were analyzed utilizing independent samples t-test, as well as a Mann-Whitney U test to evaluate the hospital length of stay. Data from both categories were analyzed utilizing means with standard deviations. These various methods were utilized to most accurately analyze data to identify any correlations.

Results

Five nurses participated in the educational in-service. Of these participants, 80% were female, 60% had been a registered nurse in the Cardiothoracic ICU for 6 or more years and all had cared for six or more esophagectomy patients. See Table 1 for demographic data and Table 2 for nursing experience data. The average level of confidence in caring for post-esophagectomy patients in the pre-test was a 3.60 (on a scale of 1-5); this level of confidence rose to a 5.00 in the post-intervention data. This increase in confidence was found to be statistically significant, with a *p*-value of .005. The increase of nursing knowledge from pre-test to post-test was also found to be statistically significant, with a *p*-value of .003 (Table 3) and all participants achieving a score of 100% on the post-tests.

Of the chart reviews performed, participants were found to be mostly male (14 males, 5 females) with a mean age of 57.13 for pre-intervention participants and 62.73 for post-

intervention participants; neither of these findings were statistically significant (Table 4).

Average BMI for these patients was 27.35 in the pre-intervention group, and 24.71 in the post-intervention group (Table 4). And smoking status (former/current vs non-smoker) was found to not be statistically significant (Table 4).

The objectives identified in chart reviews revealed a statistically significant improvement in post-operative care in the frequency of ambulation of patients on post-operative day two. The mean of ambulation pre-intervention was 1.13 with a range of 0 – 2 walks per day, while the post-intervention data revealed a mean of 2.45 with a range of 1 – 4 walks per day. These data revealed a *p-value* of .02, which was the only statistically significant finding, although the mean of ambulation frequency increased on each post-operative day from pre- to post-intervention groups. Foley catheter removal compliance also improved, but the hospital length of stay was found to be longer in the post-intervention group (Table 5). The post-operative complication of esophageal anastomotic leak was also found to not be statistically significant between pre- and post-intervention groups (Table 5).

Discussion

The aim of this project was to increase nurses' knowledge, confidence, and post-operative protocol compliance by providing them with education on previously established post-operative protocols. It is evident that based on the data collected, nursing knowledge and confidence were improved to a statistically significant degree. Greater adherence to the post-operative protocol was shown to be statistically significant as well, regarding an improvement in ambulation on post-operative day 2 (Table 5). This correlates with existing literature regarding educational interventions aimed at nursing care. For example, Drake and de C. Williams (2017) performed a meta-analysis of 12 studies that focused on providing educational interventions to

nurses regarding assessment and documentation of pain. Five of those studies were found to have only strong levels of methodological quality. All five studies involved a didactic/lecture-based intervention, while four offered ongoing support to the nursing staff. There are ample opportunities for ongoing research pertaining to esophagectomy post-operative care. It has been shown that nursing-focused education can help improve knowledge and patient outcomes in other areas, and future research could connect these findings with post-operative esophagectomy care specifically.

Previous literature also identified a connection between nursing adherence to a post-operative clinical protocol and improved patient outcomes. Merritt et al. (2020) identified that adherence to a clinical protocol pertaining to esophagectomy patients could decrease hospital length of stay. While the data for this project did not reflect a decrease in length of hospital stay, future research could focus on length of stay and barriers to discharge after the patient is medically ready. While the only variable with statistical significance in this project was an increase in ambulation on post-operative day 2, Kondo et al. (2023) identified that low levels of physical activity after esophagectomy was an independent predictor for the development of pneumonia. Any post-operative complication, including pneumonia, can prolong a patient's hospital stay (Merritt et al., 2020). Further research could help to evaluate why ambulation was the only objective that showed a statistically significant change post-intervention. The other three variables required documentation of status on a tubes/lines/drains flowsheet, and there may be more of an emphasis on that documentation from administration than on the documentation of ambulation. Also, compliance with nasogastric tubes to low-wall suction, foley removal and j-tube nutrition were high in the pre-intervention group's retrospective chart reviews. This could have been from baseline knowledge obtained from "HuddleUP" presentations or other

educational procedures that were implemented prior to this study. Although not statistically significant, in the post-intervention group, 100% of foley catheters were removed on POD1. This could be clinically significant for decreasing incidence of urinary tract infections, because UTIs could increase hospital length of stay. Lastly, ambulation is more time-intensive for nursing staff and requires patient agreement as well. It would be beneficial to help identify barriers to patients ambulating three times a day that occurred on POD 0, 1, 3 and 4.

This project helped to positively improve the bedside nurses' perceptions of caring for post-esophagectomy patients; this was accomplished by helping nurses to feel more confident in the post-operative care. As previously discussed, there were statistically significant improvements in nursing knowledge and nursing confidence after the practice change of educating nurses on post-operative protocols. Based on this statistical significance, there are plans to implement a practice change and continue educating bedside nurses about a standard post-operative protocol. In order to increase the sample size, the delivery method will be changed to a format more flexible with their schedule to hopefully improve participation. These delivery methods include utilizing web-based training opportunities so that nurses can complete the training at a time that works with their schedule, as opposed to an educational in-service that might be scheduled during their shift or on an off-day. This educational web-based training can be completed by new nurses to establish a foundation of knowledge pertaining to post-esophagectomy care, as well as at routine intervals by more experienced nurses that may just need a refresher of the post-operative care protocol.

As mentioned by Alex et al. (2022), digital platforms provide an easily accessible and efficient way of upskilling nurses, increase participation rates, and improve the delivery of additional audio-visual resources (p. 9). While there may be a low level of evidence supporting

the role of multidisciplinary standardized clinical pathways, there is a strong recommendation for the continued use of pathways; therefore, it is imperative for nurses to receive this education. (Low et al., 2018).

Implications for Practice, Education, Policy, and Research

The findings of this study support education for nursing staff. Ongoing education is of vital importance in healthcare and evidence-based practice is frequently evolving as patient care and surgeries become more complex. Further research could help identify the best educational strategies, reveal whether the knowledge gained from educational interventions is retained long-term, and clarify the effect of nurse education on patient outcomes. Future practice changes will include utilizing online educational formats to help improve nursing participation and determine if an increase in nurses' knowledge of post-operative esophagectomy care will help improve ambulation in these patients. This online education will be expanded to include ICU and progressive care areas and will be completed during orientation to the cardiothoracic service line and during annual competency training for bedside nurses to increase adherence to the post-operative protocol. Increasing accessibility for this education will also help to educate travel nurses and allow for quick reference for nurses after initial training is completed.

To decrease the cost implications of this study, an electronic format would be the best educational format. As previously discussed, an educational PowerPoint will be made into a web-based training format so that it may be readily shared with a multitude of nurses at various points in their career. Transitioning this educational in-service to an electronic version of training will also allow nurses to retain the information to utilize for quick reference as needed. This increased accessibility will help to decrease the cost of the education, and will likely decrease costs from post-operative complications that increase hospital stay. Previous research shows that

the average cost of a day in the ICU is about \$3200/day if the patient is not on mechanical ventilation and about \$4000/day if they are, and these data are almost 20 years old; it is almost certainly more expensive now (Dasta et al., 2005). One article found that the mean cost of a hospital stay after esophagectomy was \$19,198 and mean length of stay of 8.7 days; with a mild complication (such as a UTI), the mean cost rose to \$21,840 and length of stay of 10.5 days, while a moderate severity complication (such as pneumonia), increased to \$27,655 and a length of stay of 12.3 days (Carrott et al., 2012). The decrease of post-operative complications will help the patients and the institution with a shorter hospital length of stay, fewer healthcare costs, and greater throughput for patients.

Further research could also focus on additional co-morbidities and possible effects on post-operative complications. Two co-morbidities common in this patient population are smoking and malnutrition. Smoking is a risk factor for esophageal cancer and smoking status could possibly increase post-operative pulmonary complications. Malnutrition can be a complication of the disease process due to PO intolerance from an obstructing esophageal mass or chemotherapy treatment. While malnutrition may not rule a patient out from esophagectomy surgery, documentation of nutritional status in correlation with incidence of post-operative complications could be beneficial to future research.

Limitations

This study had many limitations. The first limitation was the sample size of five nurse participants and 19 chart reviews; a larger sample size could help to further identify statistically significant data. Some of these limitations may be due to the educational in-service being performed at lunchtime during dayshift, when nurses may have been unable to participate. The number of chart reviews performed is a limitation because more data points could help to

identify any correlations with nursing knowledge and the desired objectives. During this timeframe of data collection, there were fewer esophagectomy surgeries scheduled and performed due to the holidays and the end of the year. Surgeons may have had limited operating room availability or were traveling for the holidays, and patients may not want to have surgery that would require typically a one-week hospital stay around the holidays. There were five additional esophagectomy surgeries that were aborted for various reasons (evidence of metastatic disease was the main reason for the procedure to be aborted).

Additional limitations include the generalizability of this study to other populations. Esophagectomy patients are a very specialized group with many possible post-operative complications that may not be reproducible with other populations. Time limitations were also a major factor due to the entire study occurring over five months. Further studies for a longer duration would likely have more participants and possibly help identify statistically significant improvements with increased protocol adherence.

Another limitation for this study was that a number of patients did not have a jejunostomy feeding tube placed during surgery. The jejunostomy feeding tube may not have been placed when patients had a history of previous complex abdominal surgeries, some of which may have included the use of mesh for surgical repairs. There were two patients in the pre-intervention group and three in the post-intervention group that did not have a jejunostomy tube placed. As a result, the data pertaining to jejunostomy tube feeds were not analyzed.

Reviewing a patient's hospital length of stay was also a limitation due to difficult hospital discharge situations. There were a few patients that were evaluated inpatient by physical and occupational therapy services and received recommendations for rehabilitation after discharge from the hospital. Due to the timing needed for referrals and insurance approval to rehab

facilities, this may incorrectly represent the hospital length of stay in correlation to the nursing care provided.

The last implication to be discussed is the previously utilized educational in-service referred to as a “HuddleUP.” This is an educational lecture series that is performed by healthcare providers pertaining to a variety of topics; the lecture topic in January of 2023 was about esophagectomy patients and post-operative care. This intervention may have already increased the baseline knowledge of nursing staff, which could have altered pre-test data collected.

Conclusion

In summary, a practice change focusing on educating nurses about post-operative protocols can help to increase nursing knowledge and confidence when caring for post-operative esophagectomy patients. This increase in knowledge and confidence that is reflected in patient outcomes identifies opportunities for future research on a larger scale. Establishing an educational practice change that makes educational opportunities more widely available for nursing staff to participate in may have further effects on patient outcomes. There are opportunities for further research regarding additional objectives on patient outcomes that can also be studied to identify additional benefits of educational programs focused on nursing staff.

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List of Tables

Table 1. Demographic Summary of Participants ($N = 5$)

Age	<i>n</i> (%)
<25 years old	2 (40%)
26-30 years old	2 (40%)
31-35 years old	1 (20%)
>36 years old	0 (0)
Gender	
Female	4 (80%)
Male	1 (20%)
Prefer not to answer	0 (0%)

Table 2. Participants Nursing Experience ($N = 5$)

Years as a Nurse	<i>n</i> (%)
<1 year	0(0)
1-2 years	1(20%)
3-5 years	1(20%)
6 or more years	3(60%)
Years working in CTICU	
<1 year	0 (0%)
1-2 years	1 (20%)
3-5 years	1 (20%)
6 or more years	3 (60%)
How many esophagectomy patients cared for:	
0 patients	0 (0%)
1-5 patients	0 (0%)
6-10 patients	2 (40%)
11 or more patients	3 (60%)

Table 3.
Survey Participants Pre- and Post-Test Results ($N= 5$)

	potential range	Pre-intervention mean (SD)	post-intervention mean (SD)	<i>p</i>
Confidence in caring for post-esophagectomy patients	1-5	3.60 (.548)	5.00 (.00)	.005
Knowledge score on tests	0-100	56 (15.17)	100 (.00)	.003

Table 4. Patient Demographic data ($N = 19$)

	Pre-Intervention ($n = 8$)	Post-Intervention ($n = 11$)	p
Gender			
Male	5 (62.5%)	9 (81.8%)	.603
Female	3 (37.5%)	2 (18.2%)	
Current/Former Smoker			
Yes	1 (12.5%)	3 (27.3%)	.603
No	7 (87.5%)	8 (72.7%)	
	Mean (SD)	Mean (SD)	p
Age	57.13 (12.38)	62.73 (12.32)	.342
BMI	27.35 (6.08)	24.71 (4.12)	.273

Table 5. Chart Reviews Analysis ($N = 19$)

	Pre-intervention ($n = 8$) mean (SD); range	Post-intervention ($n = 11$) mean (SD); range	p
Frequency of ambulation			
POD 0	0 (0.0)	0 (0.0)	--
POD 1	1.25 (0.71); 0 – 2	1.82 (0.87); 1 – 3	.15
POD 2	1.13 (0.99); 0 – 2	2.45 (1.21); 1 – 4	.02
POD 3	1.13 (.64); 0 – 2	2.09 (1.81); 0 – 6	.17
POD 4	1.13 (1.36); 0 – 4	1.82 (1.66); 0 – 5	.35
	Pre-intervention ($n = 8$) n (%)	Post-intervention ($n = 10$) n (%)	p
NG to Low-Intermittent Wall Suction			
Yes	8 (100%)	8 (80%)	.48
No	0 (0%)	2 (20%)	
Foley Catheter removed on POD 1			
Yes	6 (75%)	11 (100%)	.16
No	2 (25%)	0 (0%)	
	median (interquartile range)	median (interquartile range)	p
Hospital length of stay	9 (7.25 – 15.25)	11 (7 - 14)	.97
Anastomotic Leak			
Yes	3 (37.5%)	3 (27.3%)	1.00
No	5 (62.5%)	8 (72.7%)	

Appendices

Appendix 1. Pre-Test Questionnaire

Esophagectomy Care Pre-Test

1. What is your age?
 - a. <25 years old
 - b. 26-30 years old
 - c. 31-35 years old
 - d. >36 years old
2. What is your gender?
 - a. Female
 - b. Male
 - c. Prefer not to answer
3. How many years have you been a nurse?
 - a. <1 year
 - b. 1-2 years
 - c. 3-5 years
 - d. 6 or more years
4. How many years have you worked in the Cardiothoracic ICU as a nurse?
 - a. <1 year
 - b. 1-2 years
 - c. 3-5 years
 - d. 6 or more years
5. Roughly, how many post-Esophagectomy patients have you cared for?
 - a. 0 patients
 - b. 1-5 patients
 - c. 6-10 patients
 - d. 11 or more patients
6. How would you rate your confidence level in caring for post-Esophagectomy patients?
 - a. Not at all confident
 - b. Somewhat confident
 - c. Mostly confident
 - d. Totally confident
7. All post-Esophagectomy patients will have a nasogastric tube?
 - a. True
 - b. False

8. The nasogastric tube must be:
 - a. To low intermittent wall suction at all times
 - b. Clamped at all times
 - c. To dependent drainage
 - d. Used to administer medications
9. The nasogastric tube must be flushed with how much water each shift?
 - a. 10mLs
 - b. 30mLs
 - c. 60mLs
 - d. 100mLs
10. On what postoperative day (POD) can the jejunostomy tube be used for medications?
 - a. POD1
 - b. POD2
 - c. POD3
 - d. POD5
11. Only liquid medications may be administered via jejunostomy tube?
 - a. True
 - b. False
12. On what postoperative day will tube feeds be started via jejunostomy tube?
 - a. POD1
 - b. POD2
 - c. POD3
 - d. POD4
13. At what rate are tube feeds advanced?
 - a. 5 mls every 4 hours
 - b. 10 mls every 6 hours
 - c. 10 mls every 12 hours
 - d. 10 mls every 24 hours
14. On what postoperative day will the foley catheter be removed?
 - a. POD1
 - b. POD2
 - c. POD4
 - d. POD6
15. Post-Esophagectomy patients should ambulate how many times per day?
 - a. None
 - b. Daily
 - c. BID
 - d. TID

16. Post-Esophagectomy patients will be strict NPO until:

- a. POD1-3
- b. POD3-5
- c. POD5-7
- d. Forever

Appendix 2. Post-Test Questionnaire

Esophagectomy Care Post-Test

1. What is your age?
 - a. <25 years old
 - b. 26-30 years old
 - c. 31-35 years old
 - d. >36 years old
2. What is your gender?
 - a. Female
 - b. Male
 - c. Prefer not to answer
3. How many years have you been a nurse?
 - a. <1 year
 - b. 1-2 years
 - c. 3-5 years
 - d. 6 or more years
4. How many years have you worked in the Cardiothoracic ICU as a nurse?
 - a. <1 year
 - b. 1-2 years
 - c. 3-5 years
 - d. 6 or more years
5. Roughly, how many post-Esophagectomy patients have you cared for?
 - a. 0 patients
 - b. 1-5 patients
 - c. 6-10 patients
 - d. 11 or more patients
6. How would you rate your confidence level in caring for post-Esophagectomy patients?
 - a. Not at all confident
 - b. Somewhat confident
 - c. Mostly confident
 - d. Totally confident
7. All post-Esophagectomy patients will have a nasogastric tube?
 - a. True
 - b. False

8. The nasogastric tube must be:
 - a. To low intermittent wall suction at all times
 - b. Clamped at all times
 - c. To dependent drainage
 - d. Used to administer medications
9. The nasogastric tube must be flushed with how much water each shift?
 - a. 10mLs
 - b. 30mLs
 - c. 60mLs
 - d. 100mLs
10. On what postoperative day (POD) can the jejunostomy tube be used for medications?
 - a. POD1
 - b. POD2
 - c. POD3
 - d. POD5
11. Only liquid medications may be administered via jejunostomy tube?
 - a. True
 - b. False
12. On what postoperative day will tube feeds be started via jejunostomy tube?
 - a. POD1
 - b. POD2
 - c. POD3
 - d. POD4
13. At what rate are tube feeds advanced?
 - a. 5 mls every 4 hours
 - b. 10 mls every 6 hours
 - c. 10 mls every 12 hours
 - d. 10 mls every 24 hours
14. On what postoperative day will the foley catheter be removed?
 - a. POD1
 - b. POD2
 - c. POD4
 - d. POD6
15. Post-Esophagectomy patients should ambulate how many times per day?
 - a. None
 - b. Daily
 - c. BID
 - d. TID

16. Post-Esophagectomy patients will be strict NPO until:
- a. POD1-3
 - b. POD3-5
 - c. POD5-7
 - d. Forever
17. Did you find this educational session to be helpful?
- a. Definitely agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Definitely disagree
18. Do you feel more confident caring for post-Esophagectomy patients now?
- a. Definitely agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Definitely disagree