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Original Article

Procedural Aspects of Epidural Catheter Placement: A Prospective Observational Study of 173 Epidural Catheter Insertions

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Objective: The risks and benefits of epidural analgesia have been studied extensively, but information regarding many other aspects of epidural catheter insertion is limited. The authors aimed to add information regarding procedural pain, procedure duration, failure rates, and the effect of experience to the ongoing discussion on this procedure.
Design: A prospective observational study.
Setting: A Danish tertiary hospital.
Participants: Patients scheduled to undergo video-assisted thoracic surgery.
Interventions: Epidural catheter insertion in 173 patients undergoing video-assisted thoracic surgery for lung cancer.
Measurements and Main Results: The authors recorded the time required for the epidural insertion procedure, the attempts used, insertion level, access use, patient position, placement technique used, and the designation of the physician placing the catheter. Furthermore, the authors asked the patients to evaluate the expected procedural pain, and after the procedure the authors asked them to evaluate the actual level of pain experienced. Six and 24 months after discharge, the authors examined persistent sequelae by using questionnaire assessments. The median procedure duration was 13 minutes, with 75% of the catheters placed within 22 minutes. Actual procedure-related pain (mean score [M] = 3.5, SD = 2.0) was significantly ($p < 0.0001$) less than that expected before the procedure (M = 4.9, SD = 2.0). The patients' expected pain, attempts required for successful catheter placement, and approach used to access the epidural space significantly affected the actual procedure-related pain ($p = 0.001$, $p \leq 0.003$, and $p = 0.023$, respectively). Persistent pain and sensory disturbances were observed in 11% and 4% of the patients, respectively, after 6 months and in 6% and 4% of the patients, respectively, after 2 years.
Conclusions: In this study, the authors examined several lesser-known aspects of epidural procedures. The use of epidural analgesia as part of the pain management plan after surgery requires a more complex evaluation instead of merely discussing the possibility of procedural infections, hematomas, or neurologic injuries. The procedure time, patients' expected and experienced pain related to the procedure, and the potential long-term side effects should be a part of the decision-making process.

Key Words: epidural analgesia; epidural catheter insertion; expected pain; experienced pain; Numeric Rating Scale; NRS; procedural pain, pain

EPIDURAL CATHETER (EDC) insertion for pain relief is a common procedure practiced by most anesthesiologists. Epidural analgesia has been considered "the gold standard" in thoracic surgery for decades.[1] Although thousands of catheters are inserted every day, and some of the risks and benefits have

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been studied extensively, little information is available regarding many other aspects of this procedure. The authors aimed to provide information on some of these lesser-known procedural aspects by using descriptive statistics for the epidural procedure, emphasizing the time required for catheter placement as well as the procedure-related pain, and by examining which factors influenced the pain associated with the procedure. The authors hypothesized that procedural pain would depend on both patient-specific and physician-specific factors.

Methods

Study Design and Participants

This prospective observational study examined the procedural aspects of epidural catheter insertion in patients undergoing video-assisted thoracic surgery (VATS) for lung cancer. The authors reported a cross-sectional examination of the epidural procedure and a cohort follow-up after 6 months and 2 years to include any protracted side effects. The Regional Scientific Ethical Committees for Southern Denmark approved the study. Patients received oral and written information before participation, and written consent was obtained from all participants. The authors screened patients scheduled for elective VATS lobectomy and wedge or segmental parenchymal resection for known or suspected lung cancer for inclusion in a trial examining pain after surgery (ClinicalTrials.gov, NCT02359175). The exclusion criteria were age <18 years, previous chest surgery, daily use of analgesics, pregnancy, contraindications to study medications, or placement of an epidural catheter. If included in the trial, the patients were included in the present observational study.

Study Procedures

Before surgery, the anesthesiologist placed a midthoracic epidural catheter according to the standard procedure at the authors' department. Before catheter insertion, patients were informed about the procedure, including risks and benefits, according to the department's predefined standard operating procedure, and they were asked to rate the level of procedural pain they expected using the 11-point Numeric Rating Scale (NRS) and inquired about any previous experience with the procedure. The physicians placing the catheters ranged in clinical experience from residents in training to fellows and consulting physicians in thoracic anesthesia. The authors used lidocaine (20 mg/mL with epinephrine 5 μg/mL and $NaHCO_3$ 0.1 mmol/mL) as a local anesthetic in the skin and underlying soft tissue, and an 18-gauge Touhy needle (Perican, 28G; B Braun Medical Inc, Melsungen, Germany) with a 20-gauge catheter (Perifix Standard, 20G; B Braun Medical Inc) for the procedure. The initial insertion level was predefined in the study protocol as thoracic level Th5/Th6, whereas either Th4/Th5 or Th6/7 could be chosen for the subsequent attempt. If further attempts were needed, the chosen level was based on the physician's preference. After placement and negative aspiration of blood or cerebrospinal fluid, a test dose of 2-to 3- mL of lidocaine (20 mg/mL and epinephrine 5 μg/mL) was injected to confirm proper catheter location. Sensory block was verified using cold sensation. The procedural technique used for catheter insertion was based on the physician's preference. Preprocedural midazolam or fentanyl was not used routinely, but the protocol allowed their use at the anesthesiologist's discretion. Immediately after the procedure, the authors asked the patient to rate the pain associated with the procedure. If assistance was needed for catheter placement, a hierarchical approach was used, with fellows assisting residents and attending physicians assisting fellows. In all patients, VATS was planned using a strictly monitor-based and nonrib-spreading approach.

Six and 24 months after discharge from the hospital, the authors sent questionnaires to the included patients to inquire about possible long-term side effects after the procedure. The questionnaire was designed specifically to examine intermittent and persistent pain and changes in sensation related to the epidural catheter insertion procedure. The reporting of sensory sequelae included symptoms at the insertion site and any disturbances in sensation in the hands and fingers. A translated version of the questionnaire is included in the supplementary file.

Outcomes/Variables

The authors registered sex, age, height, and weight as baseline characteristics. The authors recorded the expected and experienced pain as continuous metric NRS scores assessed by the patients immediately before and after the procedure, respectively, along with information about previous experiences with epidural procedures. The time required for placing the catheter (minutes), insertion level, patient position, procedural approach (median/paramedian), method used to identify the epidural space, and the number of attempts used for successful placement of the catheter were registered. The number of attempts was grouped into the following 3 categories: 1 or 2 attempts, 3 or 4 attempts, or >4 attempts. The levels used for catheter insertion were grouped into thoracic levels Th4/5, Th5/6, Th6/7, and Th7/8 to Th9/10. The authors defined the time used for the procedure as the time from skin contact with the disinfection solution until the start of the test dose injection after catheter placement. Every skin puncture was defined as a new attempt to place an epidural catheter. Epidural failure was defined as an insufficient clinical effect for any reason (eg, inability to identify the epidural space, inability to correctly insert the epidural catheter, or lack of response to injected analgesics without predefined time limits). Finally, the use of midazolam/fentanyl and the designation (resident, fellow, or attending) of the physician placing the catheter were recorded.

Statistical Analysis

The participants' baseline demographics and descriptive statistics are presented as frequencies and percentages or mean (M) and SD. Intergroup heterogeneity for baseline outcomes was tested using Student's t-test for the continuous variables and Fisher's exact test for the categorical variables. Analysis

of variance was used to test for baseline differences among the 3 physician designation groups. The authors used a paired-sample t-test to test for differences in the expected and actually experienced procedural pain. The authors also used multiple linear regression to fit a model for experienced pain by using patient age, sex, expected pain, and previous experience with the procedure as covariates. The number of attempts to place the catheter, insertion approach, physician's designation, and use of procedural medications also were added as covariates. The authors visually evaluated the normality assumptions using the models' residuals. Statistical tests were two-sided, and the significance level was set at $p < 0.05$. All analyses were performed using Stata/BE version 17 (StataCorp LLC, College Station, Texas). Study data were collected and managed using REDCap electronic data capture tools hosted at the Odense University Hospital, Denmark.[2]

Results

Patient eligibility screening started on April 29, 2015, and the authors included patients consecutively from April 30, 2015 to December 14, 2017. The authors screened 810 patients with known or suspected pulmonary neoplasms who were scheduled to undergo elective VATS. The authors excluded 637 patients based on predefined inclusion and exclusion criteria, yielding 173 epidural placement patients for the observational study. In 12 patients (6.9%), the epidural catheter could not be placed, or the effect verified; thus, the primary analysis included these patients. The participant flow is depicted in Figure 1, and the baseline characteristics are shown in Table 1. The specified list of exclusions is provided in the supplementary file. As seen in the table, the patients who underwent successful catheter insertion and those with failed procedures showed no statistically significant differences in baseline characteristics. Similarly, apart from sex, none of the other baseline parameters showed statistically significant differences related to the designation of the physician performing the epidural catheter insertion (data not shown). The group of patients who had the catheter inserted by an attending physician included more women than expected by chance (χ^2 [2, n = 161] = 7.6353, p = 0.022). In 12 of the 173 patients (6.9%), the epidural catheter could not be placed, and the surgical procedure was performed without supplementary epidural analgesia. In cases involving successful catheter placement, the overall rate of assistance was 20%; that is, help was required from a senior colleague in one-fifth of the procedures. When stratified according to designation, the corresponding rates were 31% among residents and 15% among fellows. None of the attending physicians required assistance in placing the catheter during the study period. Descriptive statistics for the insertion procedure are presented in Table 2 for all procedures (n = 161), and stratified according to the physician designation. The descriptive statistics for failed epidural insertions are shown in the supplementary file.

The findings for the expected and experienced pain associated with epidural catheter insertion are presented in Figure 2. Experienced pain (M = 3.5, SD = 2.0) was significantly less than what the patients expected before the procedure (M = 4.9, SD = 2.0), with a difference of 1.4 in the mean NRS score (95% CI 1.1-1.8, t[160] = 7.57, $p < 0.0001$). Even among patients who did not receive midazolam or fentanyl during the procedure, the experienced pain (M = 3.2, SD = 1.9) was significantly less than the expected pain before the procedure (M = 4.9, SD = 1.9, t[134] = 8.69, $p < 0.0001$).

The median procedure duration was 13 minutes, with 25% of the catheters placed within 8 minutes and 75% placed within 22 minutes. The minimum time required to insert a functioning catheter was 4 minutes; 95% of the catheters were placed within 40 minutes; and the maximum time required for the procedure was 55 minutes in 1 patient. Most catheters (66%) were positioned in one or 2 attempts using the "hanging-drop" technique (86%) and a median approach (77%) on a sitting patient (99%). Almost half (49%) were inserted at the preferred level of Th5/6, with 93% placed in either the primary or secondary position, as stated in the study's protocol.

Table 3 presents the results of the regression analysis. The fitted model was statistically significant (R^2 = 0.31, F[10, 141] = 6.45, $p < 0.001$), and both the patients' expectations of pain, the number of attempts the physician used for the successful placement of the EDC, and the procedural approach used added significantly to the prediction. For every 1-point increase in the expected pain score, the experienced pain increased by 0.3 NRS points (95% CI 0.1-0.4, standard error [SE]: 0.1, p = 0.001). Subsequent attempts exceeding the selected baseline of 1-to-2 increased the experienced procedural pain significantly. Using 3-to-4 insertion attempts increased experienced pain by 1.4 points (95% CI 0.6-2.2, SE: 0.4, p = 0.001), and >4 attempts increased the experienced pain by 1.7 points (95% CI 0.6-2.8, SE: 0.5, p = 0.003). Using the paramedian approach to access the epidural space added 0.8 points to experienced pain (95% CI 0.1-1.5, SE: 0.3, p = 0.023). Patient age, sex, previous experience with the procedure, the clinical experience of the physician placing the EDC, and the use of procedural medication did not influence experienced procedural pain.

Of the 161 questionnaires sent to the patients at 6 months postoperatively, 136 were completed and returned, corresponding to a response rate of 85%. At 24 months, 50 of the 161 questionnaires were returned (31%). The results are presented in Table 4. The results showed that approximately one-third (30%) of the patients experienced pain at the procedure site after discharge, and that most cases of postoperative pain were temporary, with 11% persisting at 6 months and 6% persisting after 2 years. Sensory sequelae showed a similar pattern, with approximately one-fifth of the patients (19%) reporting disturbances after the procedure, which declined to 4% at 6 months and stabilized at this level after 2 years (4%). The results when stratifying patients according to the extent of surgical trauma are presented in the supplementary file.

Discussion

This study showed that the EDC procedure can be performed rapidly, and is associated with only mild pain in most

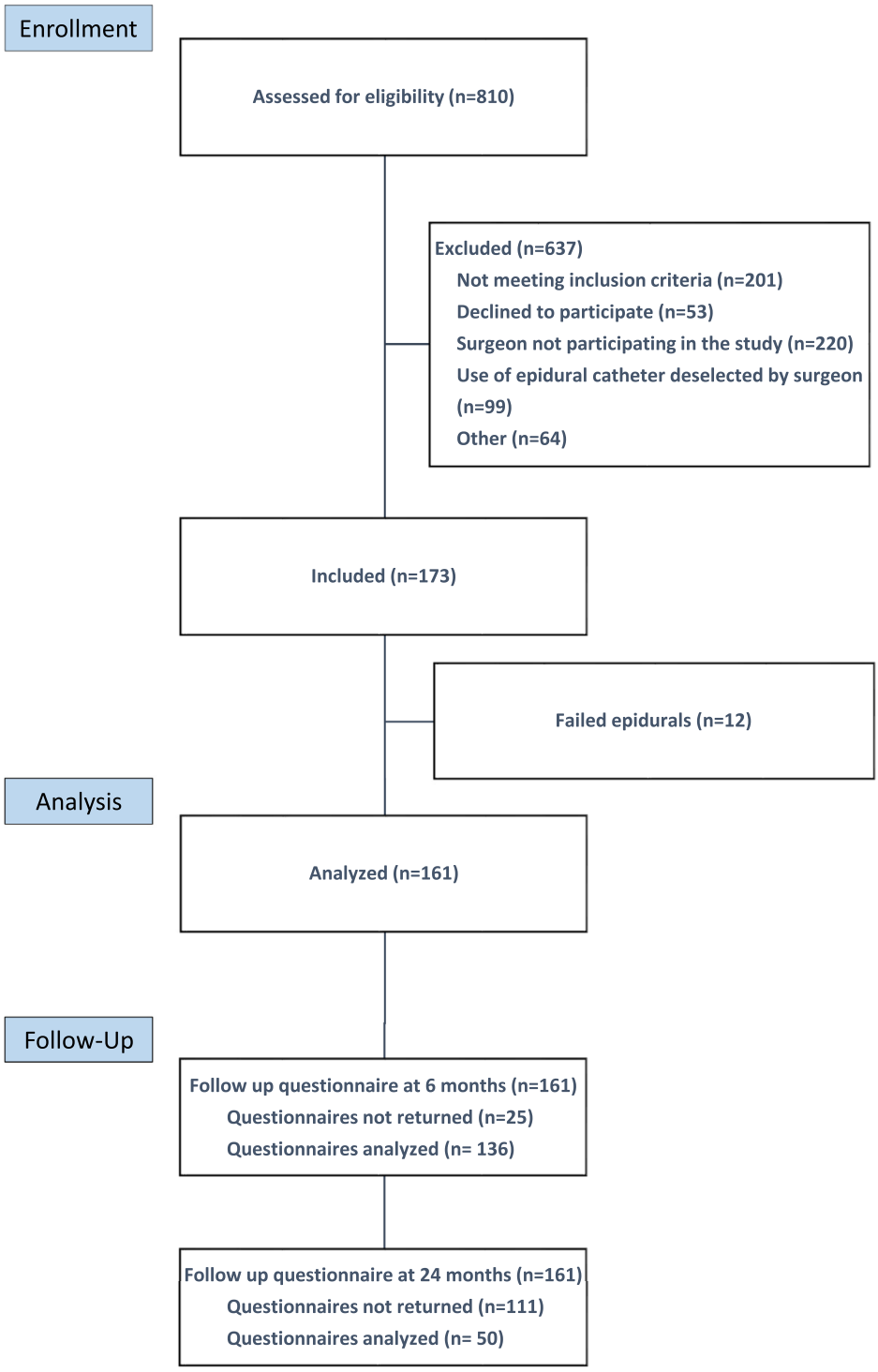

Fig 1. Participant flow.

cases. Three-quarters of the patients underwent catheter placement within 22 minutes and had procedural pain NRS score ≤5. When categorized into pain groups,[3,4] the actual pain associated with the procedure was reported as no/mild pain in most patients (58%), moderate pain in 38% of the patients, and severe pain in only 4% of the patients. The authors showed that the use of procedural medication in this study had only a minor influence on experienced pain, and the observed levels were comparable to those observed for the EDC procedure.[5-7] The authors also found that patients expected the procedure to be significantly more painful than they subsequently experienced. This was consistent with the findings of previous

Table 1
Baseline Characteristics

	Successful Epidurals Resident (n = 50)	Failed Epidurals Fellow (n = 61)	p Value* Attending (n = 50)	Total (n = 161)	Total (n = 12)	
Female sex	24 (48%)	23 (38%)	32 (64%)	79 (49%)	6 (50%)	1.000
Age (y)	69.9 (7.0)	67.9 (8.2)	68.2 (8.5)	68.6 (7.9)	69.6 (10.5)	0.691
Height (cm)	169.1 (9.1)	172.6 (8.7)	169.8 (9.7)	170.6 (9.2)	171.6 (9.5)	0.733
Weight (kg)	75.7 (14.6)	77.9 (13.8)	75.8 (14.8)	76.6 (14.3)	80.6 (17.8)	0.360
BMI (kg/m^2)	26.5 (4.6)	26.1 (3.5)	26.4 (5.1)	26.3 (4.4)	27.3 (5.0)	0.433

NOTE. Baseline demographics in the group with successful and failed epidurals, respectively. The successful epidurals are stratified on physician charge. Numbers are frequencies (%) or means (standard deviation).

* Fisher's exact test/Student's t test of the differences between the group with successful (n = 161) and failed (n = 12) epidural catheter insertion, respectively.

smaller studies of epidural and spinal anesthesia procedures.[5,7,8]

Both patient- and physician-specific factors have been shown to affect pain perception. For example, age and sex are patient-specific factors that influence pain perception after surgery.[9,10] Furthermore, the nocebo effects of expectations are well-known and can be related to patients' prior experiences based on verbal instructions received or on patients' social observations.[11] However, no previous study has examined nocebo effects in relation to the epidural catheter insertion procedure, and only limited evidence for these effects exists for most medical procedures in general.[11,12] The authors used a regression model to examine whether these patient-specific factors influenced pain related to the epidural procedure, and added physician-specific factors based on perceived clinical relevance, considering the absence of prior studies. The authors' model showed that some, but not all, of the included factors were significant predictors of procedural pain. Contrary to what is known about pain after surgery, the authors found no significant effects of age and sex on the experienced pain related to the epidural insertion procedure. The authors did not find any statistically significant association between previous experience with the procedure and perceived pain. This was consistent with the findings of an earlier study of this specific procedure,[5] but they contradicted the evident nocebo effect of previous experience with painful procedures in newborns.[13] However, the authors found that patients' expectations of pain significantly influenced the level of pain they experienced during catheter insertion. In other medical procedures, the patients' perception of pain has been shown to influence their actual experienced pain,[14-16] and this study showed that this phenomenon holds true for the EDC procedure as well. Among the examined physician-specific factors, only excessive placement attempts and the procedural approach to the epidural space influenced the pain experienced during the procedure, encouraging the use of the median approach and other methods of postoperative pain management if the catheter could not be placed within a reasonable number of attempts. The deduction of the paramedian approach being more painful than the median one aligned with a previous study on women during labor.[17] The physicians' clinical experience did not significantly influence procedural pain. Though somewhat unexpected, this might be related to the graduated handing over of "difficult" epidural catheter insertions to more experienced physicians, thus having the most experienced physicians perform the most challenging procedures. Using this setup will allow the use of the procedure in an educational setting, including anesthesiologists in training, without causing unnecessary pain to the patients. The apparent devalued clinical performance of senior anesthesiologists in comparison with junior anesthesiologists, as seen in Table 2, resulted from assisting lower-charge physicians. If the authors looked only at procedures performed without helping others, the performance related to designation was more like expected. These descriptive statistics are available in the supplementary file. Based on the authors' results, to minimize procedural pain, physicians should focus on addressing patients' expectations of pain and minimizing placement attempts, perhaps using an alternative method of postoperative pain management after exceeding a predefined number of attempts. The use of procedural medication did not affect perceived pain.

A significant proportion of the patients experienced pain or sensory side effects after the EDC procedure (30% and 19%, respectively). In most patients, these symptoms subsided within a week, but persistent pain and sensory side effects were still present at 6 months (11% and 4%, respectively) and after 2 years (6% and 4%, respectively). Stratifying the patients according to the extent of surgical trauma did not alter the results. Postoperative pain after videoscopic surgery is well-known, with a reported prevalence ranging from 4%-to-47%, and has, in a setting similar to the authors', shown a prevalence of 11% at 3 months postoperatively.[18]

None of the patients in this study experienced any harm related to the EDC procedure. The authors found a procedural failure rate of approximately 7%; that is, in these patients, they could not place or verify the proper function of the catheter after insertion. The authors did not address the failure of epidural analgesia in general, as the scope of the study did not include the postoperative period. This made a comparison with the reported failure rates in other studies difficult. Most studies reported failure rates as any problem during the period with the catheter in situ, including leaks, catheter failure, catheter occlusion, and insufficient blocks. The reported failure rates of epidural catheters varied significantly among studies. In thoracic surgery, most studies reported failure rates of 10%-to- 30%,[19] similar to what the authors saw,

Table 2
Descriptive Statistics

	Charge of physician placing epidural catheter			
	Resident (n=50)	Fellow (n=61)	Attending (n=50)	Total (n=161)
Expected pain (NRS)				
Mean	5.2 (2.0)	4.4 (1.7)	5.3 (2.2)	4.9 (2.0)
Missing	0	0	0	0
Experienced pain (NRS)				
Mean	3.1 (1.7)	3.2 (2.0)	4.3 (2.2)	3.5 (2.0)
Missing	0	0	0	0
Time expenditure (min.)				
Median	11.0 (8.0, 17.0)	12.0 (8.0, 20.0)	19.0 (10.0, 30.0)	13.0 (8.0, 22.0)
Missing	1	1	1	3
Attempts placing EDC				
1-2 attempts	44 (88%)	46 (75%)	16 (32%)	106 (66%)
3-4 attempts	6 (12%)	11 (18%)	21 (42%)	38 (24%)
> 4 attempts	0	4 (7%)	13 (26%)	17 (11%)
Missing	0	0	0	0
EDC insertion level				
Th 4/5	1 (2%)	12 (20%)	4 (8%)	17 (11%)
Th 5/6	33 (66%)	22 (36%)	24 (48%)	79 (49%)
Th 6/7	16 (32%)	21 (34%)	16 (32%)	53 (33%)
Th 7/8 - Th9/10	0	6 (10%)	6 (12%)	12 (7%)
Missing	0	0	0	0
Access used				
Median approach	45 (90%)	44 (75%)	32 (67%)	121 (77%)
Paramedian approach	5 (10%)	15 (25%)	16 (33%)	36 (23%)
Missing	0	2	2	4
Placement technique used				
LOR to air	0	0	2 (4%)	2 (1%)
LOR to saline	10 (21%)	7 (12%)	2 (4%)	19 (12%)
Hanging drop	38 (79%)	53 (88%)	43 (91%)	134 (86%)
Missing	2	1	3	6
Patients position				
Lateral Recumbent	1 (2%)	1 (2%)	0	2 (1%)
Sitting	47 (98%)	58 (98%)	47 (100%)	152 (99%)
Missing	2	2	3	7
Previous EDC				
Previous EDC	7 (14%)	13 (22%)	8 (17%)	28 (18%)
Missing	1	2	2	5
Procedural medication				
Midazolam				
No usage	37 (100%)	43 (100%)	38 (97%)	118 (99%)
Usage 5 mg	0	0	1 (3%)	1 (1%)
Missing	13	18	11	42
Fentanyl				
No usage	35 (90%)	36 (75%)	37 (80%)	108 (81%)
Usage 1 - 50 mcg	3 (8%)	7 (15%)	7 (15%)	17 (13%)
Usage 51 − 100 mcg	1 (3%)	5 (10%)	2 (4%)	8 (6%)
Missing	11	13	4	28
EDC procedure assistance				
Assistance needed	31%	15%	0%	20%

NOTE. Descriptive statistics for placement of the epidural catheters. Numbers are means (SD), medians (IQR) or frequencies (%). Percentages may not total 100 due to rounding.
Abbreviations: EDC, epidural catheter; LOR, loss of resistance; NRS, Numeric Rating Scale; Th4/5, thoracic level T4/T5.

although rates from 1.5%[20] to approximately 50%[21] also have been reported.

Some limitations of this study require consideration. First, the technique used for catheter insertion and the use of procedural medication were based on physician preferences, introducing the possibility of a performer bias. However, the authors did not think this was a problem in the study because the technique used was comparable among groups, and the use of procedural medication was minimal. Second, the authors did not use a standardized script for obtaining preprocedural patient information, but relied on anesthesiologists' information, as described in their department's standard operating

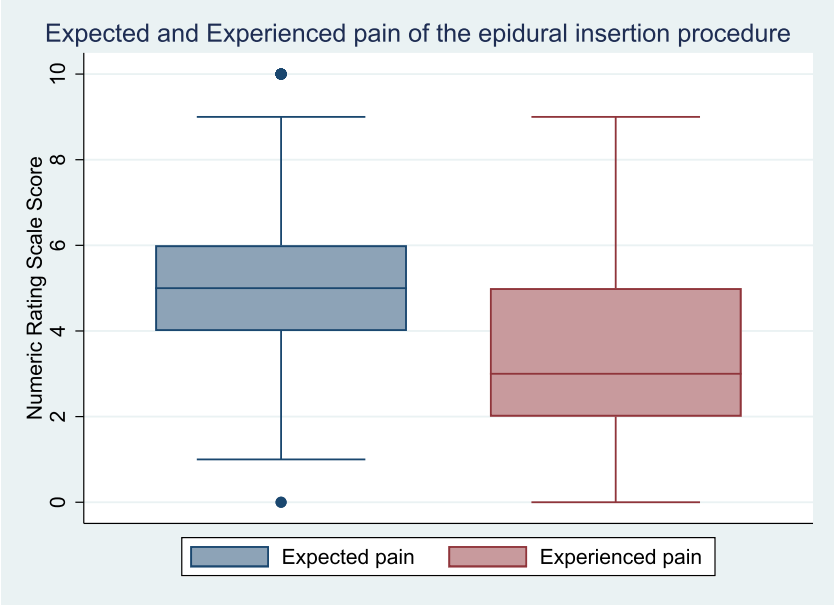

Fig 2. Expected and experienced procedural pain. Expected and experienced epidural catheter insertion procedural pain in the study population (n = 161). Boxes are medians and 25th/75th percentile, and whiskers represent 1.5th/98.5th percentile. Dots represent outliers. The patients' experienced pain (mean = 3.5, SD = 2.0) was statistically significant less than expected pain (mean = 4.9, SD = 2.0), t(160) = 7.57, $p < 0.0001$.

procedure. Because both patients' *a priori* expectations and physicians' wording about the impending procedure may influence experienced procedural pain, this approach may introduce some potential bias.[7,22] Third, the authors did not use a validated questionnaire to examine postoperative side effects because no such questionnaire exists. The questions are complex, and interviewer-facilitated questioning might be required to get the full picture. The correlation between the EDC procedure and long-term side effects needs to be established using a control group to better distinguish it from sequelae related to the surgical procedure. Finally, the possible long-term adverse effects of the epidural procedure may be associated with reporting and recall biases. However, studies still have not reached a consensus on whether a potential nonresponse bias results in over- or underestimating symptoms.[23] The authors believe the results are equally applicable in other settings because the procedures were performed by an heterogeneous group of physicians ranging from anesthesiologists in training to attending physicians with years of clinical experience with this procedure. Future studies are needed on both the nocebo effects related to the procedure and the long-term side effects of epidural analgesia to obtain a complete picture of the risks and benefits of epidural analgesia beyond merely discussing hematomas and abscesses. Specifically, the influence of the wording used while providing preprocedural information, and the correlation between the EDC procedure and long-term side effects deserve additional attention.

Table 3
Regression Analyses of Experienced Procedural Pain

Procedural Pain	Coeff.	S.E.	95% CI		P value
			Lower	Upper	
Age	0.124	0.019	-0.024	0.049	0.503
Male sex	0.178	0.305	-0.426	0.782	0.561
Previous EDC	-0.002	0.371	-0.735	0.731	0.995
Expected pain	0.268	0.075	0.119	0.417	**0.001**
Procedural medication	0.728	0.425	-0.113	1.568	0.089
Attempts placing EDC					
1-2 attempts (base)					
3-4 attempts	1.392	0.391	0.619	2.165	**0.001**
> 4 attempts	1.677	0.547	0.595	2.759	**0.003**
Physician's charge					
Resident (base)					
Fellow	-0.06	0.355	-0.762	0.642	0.865
Attending physician	0.044	0.419	-0.783	0.872	0.916
Procedural approach					
Median approach (base)					
Paramedian approach	0.802	0.348	0.114	1.491	**0.023**

NOTE. Regression analysis of experienced pain for the EDC procedure including covariates. Statistically significant covariates ($p < 0.05$) are highlighted in bold.
Abbreviations: Coeff., EDC, epidural catheter; SE, standard error.

Conclusions

Epidural catheter insertion for epidural analgesia can be performed rapidly, and is associated with only mild pain in most cases. The actual procedure-related pain was significantly less than that expected by the patients, but was significantly related to these expectations. The number of procedural attempts required for insertion influenced the experienced pain, but the physician's clinical experience did not. Long-term sequelae were observed in 4%-to-6% of patients. This information needs to be a part of the discussion when assessing whether epidural analgesia should be included in the pain management plan after surgery.

Table 4
Results From Postoperative Questionnaires

	6 mo (n = 136)			24 mo (n = 50)		
	n	Proportions		n	Proportions	
Pain after EDC insertion	41	41/136	30.1%	n/a	n/a	n/a
Temporary pain	26	26/136	18.4%	n/a	n/a	n/a
Days, up to and including 1 wk	15	15/136	11.0%	n/a	n/a	n/a
Weeks, up to and including 1 mo	8	8/136	5.9%	n/a	n/a	n/a
Months, >1 mo	3	3/136	2.2%	n/a	n/a	n/a
Persisting pain	15	15/136	11.0%	3	3/50	6.0%
Sensory disturbances after EDC insertion	26	26/136	19.1%	n/a	n/a	n/a
Temporary sensory disturbances	21	21/136	15.4%	n/a	n/a	n/a
Days, up to and including 1 wk	12	12/136	8.8%	n/a	n/a	n/a
Weeks, up to and including 1 mo	4	4/136	2.9%	n/a	n/a	n/a
Months, >1 mo	5	5/136	3.7%	n/a	n/a	n/a
Persisting sensory disturbances	5	5/136	3.7%	2	2/50	4.0%

NOTE. Registration of pain and sensory disturbances using questionnaires at 6 and 24 months postoperatively. Persisting pain/sensory disturbances are defined as symptoms still present at 6 months postoperatively.

Conflict of Interest

The study's funders had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.jvca.2022.08.003.

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