Influence of approach laterality to outcome of one to two level primary anterior cervical discectomy and fusion

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Introduction

The laterality of approach to anterior cervical discectomy and fusion (ACDF) surgery is a source of controversy. Surgeons have used both right and left-sided approaches since the development of the ACDF procedure during the 1950s. Smith and Robinson were the first to describe the procedure in 1955 adopting a left-sided approach. This was closely followed three years later by Cloward who described a similar procedure with a right-sided approach. Multiple factors have been implicated in the decision-making process including historical elements and anatomic considerations including the course of the recurrent laryngeal nerve (RLN) and the presence of the thoracic duct on the left-side.

RLN palsy is a recognised complication following anterior cervical surgery and can be both transient and permanent. Rates of RLN injury vary between 0.9%-24%. The most common clinical symptoms of RLN palsy include postoperative dysphonia and dysphagia but may also be clinically asymptomatic. The course of the RLN varies on the right compared to the left. The RLN is formed from the sixth pharyngeal arch on both sides however on the left side its position is dictated by the ligametum arteriosum and the absence of this structure on the right side leads to a more supero-lateral position with a less predictable course. This difference has been suggested as a factor in post-operative rates of RLN palsy however few studies have directly compared the rates between left-sided and right-sided approaches and current data is inconclusive. In two independent series, both Beutler et al. and Kilburg et al. showed that the rate of RLN palsy in anterior cervical spine surgery was the same regardless of laterality of approach whereas Jung and Schramm found that a right-sided approach generated higher rates of RLN palsy than the left-sided however this should be interpreted with caution due to this risk of confounding bias as half of the left-sided approaches were performed with lower endotracheal tube cuff pressures which is known to be an independent variable in generation of RLN palsy. Further to this, no studies have compared right-sided vs left-sided approaches at individual cervical levels to determine whether the risk of injury to the RLN varies at particular cervical levels.

Injury to other anatomical structures in the vicinity of the surgical field are also described although rare phenomena but may have catastrophic consequences. Oesophageal perforation is seen in between 0.3-0.9% of cases but is associated with mortality rates of 33%. Rates of post-operative Horner's syndrome caused by injury to the sympathetic chain vary from 0.06-1.1% and are noted to be more frequent in further caudal surgery due to the divergence of the longus colli muscles. Carotid artery injury is a theoretical risk however Härtl et al. found no instances of intraoperative injury in their review. Likewise, injury to the thoracic duct is exceptionally rare with a 0.02% risk of iatrogenic injury. Additionally, there are no reported cases of internal jugular vein injury intraoperatively. No studies have directly compared the risk of iatrogenic injury to these structures with a right-sided vs left-sided approach (excluding the unilateral thoracic duct).

AIMS

The primary aim of this study is to evaluate the incidence of complications following ACDF surgery and whether this changes with laterality of anterior approach to the cervical spine. Secondary aims include whether the incidence of complications varies with different targeted cervical levels.

Methodology

A retrospective cohort study was performed evaluating consecutive patients undergoing primary, one or two level ACDF surgery under the care of two orthopaedic spinal surgeons at our institution between May 2016 and March 2020. Revision surgery and anterior approaches to the cervical spine for other procedures were excluded. The laterality of incision was determined by preference of the operating surgeon.

Anonomysed data was collected via evaluation of contemporaneous clinical notes, post-operative clinic letters along with review of the Spine Tango register and Core Outcomes Measures Index (COMI) patient reported information. The patient-specific dataset included the age, body mass index (BMI), American Society of Anesthesiologists physical classification score (ASA) and smoking status. Surgical data included the laterality of approach, number of levels fused, surgical level, whether a supplementary plate was used and the development of peri or post-operative complications.

The primary outcome was determined to be development of dysphonia or dysphagia in the post-operative period extending at least two weeks post-operatively or confirmed vocal fold paralysis via direct observation following review in the ear, nose and throat (ENT) clinic. Secondary outcomes included the development of other complications including thoracic duct, oseophageal or vascular injury and return to theatre.

Statistical analysis was performed on the data set using the SPSS software (IBM, Armonk, New York, USA). The Fisher exact test and independent T-test were used for categorical and continuous data respectively. A P value of <0.05 was taken to be statistically significant.

Table 1

	Left-sided	Right-sided
No.	81	64
Age	53.2 (32-84)	52.2 (26-86)
BMI	29.1 (16.33-45.0)	28.6 (20.3-43.41)
ASA	1.90 (1-3)	1.95 (1-3)
Smoker	19/81 23.5%	17/64 26.5%
Single level %	50/81 61.7%	40/64 62.5%
Double level %	31/81 38.3%	24/64 37.5%
Plate?	51/81 63.0%	33/64 51.6%

Results

A total of 145 procedures were observed over the study period. 81 (56%) underwent a left-sided approach whereas 64 (44%) underwent a right-sided approach. The patient demographics are summarized in table 1. Notably there is no statistical difference in age (p=0.3), BMI (p=0.3), ASA grade or smoking status (p=0.67) between the left-sided and right-sided groups. There were 90 (62%) single-level procedures and 55 (38%) double-level procedures. 84 (58%) ACDFs were supplemented by plate fixation and 61 (42%) were not. One surgeon performed only left-sided approaches whereas the second surgeon performed both right and left-sided procedure.

There was a total of 16 patients (10.5%) who had dysphonia or dysphagia post-operatively and were therefore diagnosed with RLN palsy. 8 (12.5%) patients who underwent right-sided approaches and 8 (9.8%) patient who had left-sided approach (table 3). There was no statistically significant difference in incidence of RLN palsy between the left-sided and right-sided groups (p=0.62).

The breakdown of procedures based on spinal level is explained in table 2. There was no difference in rate of injury to the RLN whether the procedure was done from the right or the left side. Furthermore, no individual surgical level was associated with an increased rate of RLN palsy compared to other surgical levels.

8 (9.2%) of the 87 single-level ACDFs developed RLN palsy compared with 8 (13.8%) of the 60 double-level ACDFs. This was not statistically significant (p=0.39). Likewise, there was no significant difference in rate of RLN injury in the group of ACDFs that also underwent plating (9/85) and those that did not (7/60 p=0.84).

There was one instance of injury to the jugular vein and another one instance of a pharyngeal tear both of which were via left-sided approaches and were identified intraoperatively and repaired with no further consequences. There were no instances of injury to the carotid artery, thoracic duct or oesophagus in this series.

Table 2

Surgical level	RLN palsy
C3-4	2/12 (17%)
C4-5	1/17 (5.9%)
C5-6	2/35 (5.7%)
C6-7	3/22 (13.6%)
C3-5	0/10 (0%)
C4-6	2/14 (14.3%)
C5-7	6/35 (17.1%)

Conclusion

This study set out to assess whether right-sided anterior approaches to the cervical spine for ACDF was associated with higher rates of RLN palsy than left-sided approaches. We found that there was no difference in the rate of injury based on the laterality of the approach used.

Injury to the RLN is a well-recognised phenomenon in anterior neck surgery. Spinal surgeons do not usually explore the RLN, in contrast to the head and neck surgeons who will routinely expose the nerve during surgery on the thyroid gland. Many etiologies of injury have been described, including direct and indirect injury patterns. Direct laceration has been acknowledged along with indirect traction and the snaring of the nerve between retractor blades and the endotracheal tube.

Very few previous studies have set out to answer the question as to whether laterality of approach to the anterior cervical spine has implications on the rate of development of RLN palsy, however, results of these studies are inconclusive. Beutler et al. and Kilburg et al. found no difference in RLN palsy rates whether the spine was approached from the left or the right side whereas Jung and Schramm found that a left-sided approach was less likely to generate a RLN palsy than a right-sided approach. Our study contributes to the evidence base suggesting that, despite the theoretical increased risk of injury via a right-sided approach due to the anatomical factors, this does not lead to an increased risk of postoperative RLN palsy.

The limitations of this study include the indirect diagnosis of RLN palsy via clinical symptoms rather than direct observation of the vocal folds. This could lead to underreporting of RLN palsy due to asymptomatic cases however we were satisfied that there was unlikely to be a difference in that rate of production of symptoms between a right and left-sided RLN palsy and so there would be no difference in rates of reported RLN palsy based on laterality of approach.

Conclusion

We found no difference in the rates of RLN palsy at all other spinal levels for both single and double-level ACDF. This data suggests that surgeons should be free to choose their preferred side of approach.

References

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