

Cuff Pressure Change During Anterior Cervical Spine Surgeries and its Effects Postoperatively

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Abstract

Background: Anterior cervical spine surgeries carry significant morbidity postoperatively due to dysphagia, vocal cord palsy, etc. Retraction of tissues of the neck causes a rise in endotracheal cuff pressure, which can be measured using pressure transducer. This prospective and observational study was done to detect the changes in cuff pressure on retraction of soft tissues of the neck and also to assess postoperative morbidity related to the airway. **Materials and Methods:** Forty patients scheduled for anterior cervical spine surgery of American Society of Anesthesiologists (ASA) grades I or II were studied. Continuous cuff pressure measurement was done using a pressure transducer attached to the pilot balloon of the endotracheal tube after induction of anesthesia and endotracheal intubation. Anesthesia was maintained with 50% O₂ in N₂O and isoflurane with intermittent doses of atracurium. Changes in cuff pressure before retraction, during retraction, and after removal of retractors were measured. No adjustment of cuff pressure was done. Postoperatively, the patients were observed for sore throat, dysphagia, and hoarseness of voice for 3 days. Video laryngoscopy was planned in case of prolonged hoarseness of voice for more than 2 days. **Results:** Time-adjusted mean cuff pressure before retraction was 23.10 ± 7.51 mmHg, which increased significantly during retraction (50.69 ± 17.63 mmHg). After removal of retractors, cuff pressure decreased to 37.98 ± 15.04 mmHg. Postoperatively, the average duration of sore throat was 31.65 ± 22.48 h, that of dysphagia was 34.80 ± 20.66 h, and that of hoarseness of voice was 1.96 h. **Conclusion:** Endotracheal cuff pressure rises significantly during neck retraction in anterior cervical spine surgeries. There is consistent postoperative morbidity related to the airway in these patients, which is self-limiting.

Key words: Cervical spine surgery, cuff pressure, vocal cord palsy

INTRODUCTION

Cervical spine surgeries are commonly performed for the management of disc prolapse or trauma to the cervical spine. Anterior approach provides easier access to the spine. Complications related to the airway in anterior approach range from mild sore throat, subclinical vocal cord paresis, and prolonged dysphagia to symptomatic vocal cord palsy.^[1-5] The incidence of tracheal mucosal ischemia after anterior cervical spine surgeries has been reported to be 2-44%.^[6,7] Various mechanisms like compression, stretching, and direct surgical trauma of recurrent laryngeal nerve have been proposed for vocal cord palsy.^[8-11] Cadaveric studies done previously suggest that these complications are due to intralaryngeal compression of the branches of the recurrent laryngeal nerve.^[12,13]

Only a few studies have been done correlating retractor application, endotracheal cuff pressure, and postoperative morbidity related to the airway.^[1,2,10,14-16] Hence, this study was

designed to find out the variations in cuff pressure on retraction of soft tissues of the neck. Secondary objectives included assessment of postoperative morbidity like sore throat, dysphagia, hoarseness of voice, and vocal cord dysfunction.

MATERIALS AND METHODS

This prospective and observational study was conducted in a tertiary care referral hospital after approval was obtained from the ethical review board of the institution. The patients scheduled to undergo anterior cervical spine surgery aged between 18 years and 65 years belonging to the American Society of Anesthesiologists (ASA) grades I or II were selected for the study. Exclusion criteria included short neck, anatomical deformity or history of previous surgery at the neck or cervical spine, and obesity. Written informed consent was obtained from all the subjects.

In the operation theater, general anesthesia was induced with propofol and fentanyl. Atracurium (0.5 mg/kg) was used to facilitate tracheal intubation with flexometallic endotracheal tube (Mallinckrodt) of size 8.5 mm for males and 7.5 mm

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for females. Intubation was done by an anesthetist with more than 2 years of experience. Cases of traumatic intubation were excluded from the study. Endotracheal tube cuff was inflated with air just enough to prevent any leak detected by auscultation in the suprasternal notch. The pilot balloon was connected to an air-filled transducer (Edwards) and baseline pressure was noted. Anesthesia was maintained using 50% O₂ in N₂O and isoflurane with intermittent doses of fentanyl and atracurium. Cuff pressure was continuously monitored and noted every 15 min. Changes in cuff pressure value before retraction of neck tissues, during retraction, and after the removal of retractors were noted. No adjustment of cuff pressure was done during surgery. Patients were extubated at the end of surgery. Patients who were ventilated postoperatively were excluded from the study.

Postoperatively, the patients were observed for sore throat, dysphagia, and hoarseness of voice for 3 days. The patients were assessed hourly for the first 3 h and then once in 12 h till 3 days. Video laryngoscopy was planned in case hoarseness persisted for more than 2 days.

Other data that were collected included patient demographics, surgical duration (skin incision to closure), and retraction time (insertion of retractors to their removal).

Statistical analysis

It was estimated that a sample size of 30 would be sufficient in order to find a cuff pressure change of at least 8 mmHg during retraction for a level of significance of 5% and power of 80% (as per Rakesh Garg *et al.*).^[9]

Data were reported using median (25th percentile and 75th percentile). Repeated measures of analysis of variance (ANOVA) were used to compare the time-adjusted cuff pressures between the three groups (cuff pressure before cervical retraction, during retraction, and after the removal of retractors). Probability value <5% was considered as statistically significant.

RESULTS

The total number of patients in the study was 40, of whom 11 were males and 29 were females. The average age of the patients was 42 ± 10 years. Mean duration of surgery and retraction

were 266.75 ± 79.23 min and 171.50 ± 67.42 min, respectively [Table 1]. Increase in cuff pressure on application of retractors and fall in cuff pressure on removal of retractors were both significant (*P* < 0.001). Time-adjusted mean cuff pressure before retraction was 23.10 ± 7.51 mmHg, which increased to 50.69 ± 17.63 mmHg during retraction and decreased to 37.98 ± 15.04 mmHg after the removal of retractors [Table 2].

After surgery, the number of patients who complained of sore throat for 48 h were 14 and for 72 h were 5. The average duration of sore throat was 31.65 ± 22.48 h. The number of patients who complained of dysphagia for 48 h were 16 and for 72 h were 3. The average duration of dysphagia was 34.80 ± 20.66 h. Nine patients complained of hoarseness of voice after surgery but it persisted for 24 h in only one of them. The average duration of hoarseness of voice was 1.96 h [Table 1]. Because no patient in our study had hoarseness of voice for more than 2 days, video laryngoscopy was not conducted on any of them.

DISCUSSION

Few prospective and retrospective studies have been conducted for anterior cervical spine surgeries to identify the causes of postoperative morbidity related to tracheal mucosal ischemia. We monitored intraoperative cuff pressures continuously using a transducer and attempted to identify postoperative morbidity using clinical criteria (presence of sore throat, dysphagia, and hoarseness of voice) and had planned for video laryngoscopy in case hoarseness of voice persisted for more than 2 days.

Table 2: Cuff pressure values

	Cuff pressure before cervical retraction (mmHg)	Cuff pressure during retraction (mmHg)	Cuff pressure after removal of retractors (mmHg)
Mean	23.10	50.69 (<i>P</i> <0.001)	37.98
Std. Deviation	7.519	17.633	15.046
Minimum	7	23	13
Maximum	44	108	67
Percentile			
25	17.45	37.38	30.25
50	23.31	48.52	36.00
75	27.52	63.42	48.00

Table 1: Relation between duration of surgery, retraction time and morbidity

	Duration of surgery (mins)	Duration of retraction (mins)	Duration of sore throat (hrs)	Duration of dysphagia (hrs)	Duration of hoarseness (hrs)
Mean	266.75	171.50	31.65	34.80	1.963
Std. Deviation	79.231	67.427	22.481	20.660	4.7128
Minimum	75	30	0	0	0
Maximum	405	330	84	96	24.0
Percentile					
25	225.00	120.00	12.00	24.00	0
50	280.00	165.00	24.00	36.00	0
75	310.00	221.25	48.00	48.00	0.375

It was noted that there is a significant increase in endotracheal tube cuff pressure on application of cervical retractors and a significant fall in cuff pressure on removal of retractors during anterior cervical spine surgeries. Because the duration of surgery and retraction varied, we considered time-averaged mean cuff pressure to be superior in assessing the effects of retraction. Unlike Rakesh Garg *et al.* who did single-point estimation of cuff pressures, we used air-filled pressure transducer to monitor the trends in cuff pressure and find out time-averaged mean cuff pressure.^[14] The mean baseline cuff pressure (23.10 ± 7.51 mmHg) increased by more than 200% after retraction (50.69 ± 17.63 mmHg). There was a significant fall in cuff pressure on the removal of retractors.

Endotracheal tube cuff insufflation was done using minimal leak technique where graded inflation of cuff was done with just enough air to prevent any leak detected by auscultation over suprasternal area. This was done to prevent overinflation of the cuff at the start of the case. Many studies have emphasized the importance of such practice.^[14,15] It has been suggested that the endotracheal tube cuff pressure should be maintained at 20-30 cm H₂O to prevent ischemia of the tracheal mucosa.^[17] Measuring actual cuff pressure should be preferred to injecting a given volume of air in regular practice.^[18]

N₂O was used as it was decided not to deviate from our institutional practice. Also, we wanted to assess the rise in cuff pressure in such a scenario. It is interesting to note that the cuff pressure change due to N₂O even at the end of surgery was from baseline of 23.10 ± 7.51 mmHg to 37.98 ± 15.04 mmHg (after the removal of retractor). Retractor application further contributed significantly to cuff pressure rise (50.69 ± 17.63 mmHg). The incidence of morbidity is directly related to increase in cuff pressure and hence, this is a very significant finding.

Krischovich *et al.* noted that cuff pressure increases to 40-52 mmHg during retraction.^[2] Kim *et al.* also noted that cuff pressure rises from 20 mmHg up to 33 mmHg.^[11] We found similar findings in our study.

Kim *et al.* noted that among 25 control cases, at 1 week after surgery, the number of patients who complained of sore throat was one, those who complained of dysphagia were three, and those who complained of hoarseness of voice was one.^[11] We found that out of 40 cases, even at 72 h post surgery, five patients continued to have sore throat, three patients continued to have dysphagia, and none of them had persistence in hoarseness of voice. Grading of the symptoms and follow-up of these patients for a longer period of time would have yielded better results but was not done because of practical considerations.

Our study was limited as we did not perform routine postoperative video laryngoscopy in all patients because of which we might have missed a few cases of vocal cord dysfunction. However, there was no case with symptoms of vocal cord palsy lasting for more than 2 days. On the contrary, Krischovich *et al.* have found about 6.8% incidence of vocal cord palsy in cases without adjustment of cuff pressure.^[2] Also,

Rakesh Garg *et al.* found about 2.7% incidence of vocal cord palsy.^[14] Hoarseness of voice and vocal cord palsies, however, resolve in most cases without any intervention.^[2,11,14,19]

CONCLUSION

In conclusion, endotracheal cuff pressure increased significantly after the application of cervical retractors during anterior cervical spine surgery. There is consistent postoperative morbidity like sore throat, dysphagia, and hoarseness of voice in these patients. Continuous measurement of cuff pressure using transducer can help in monitoring trends and assist further adjustments in cuff pressure with resultant reduction in morbidity.

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