

A comparative study of early and late extubation following transoral odontoidectomy and posterior fixation

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Abstract

Background and Aims: Elective ventilation is the usual practice after transoral odontoidectomy (TOO) and posterior fixation. This practice of elective ventilation is not based on any evidence. The primary objective of our study was to find out the difference in oxygenation and ventilation in patients extubated early compared to those extubated late after TOO and posterior fixation. The secondary objectives were to compare the length of Intensive Care Unit (ICU)/hospital stay and pulmonary complications between the two groups.

Material and Methods: After TOO and posterior fixation, patients were either extubated in the operating room (Group E) or extubated next day (Group D). The oxygenation (PaO₂:FiO₂ ratio) and ventilation (PaCO₂) of the two groups before surgery, at 30 min and at 6/12/24 and 48 h after extubation were compared. Complications, durations of ICU and hospital stay were noted.

Results: The base-line PaO₂:FiO₂ and PaCO₂ was comparable between the groups. No significant change in the PaO₂:FiO₂ was noted in the postoperative period in either group as compared to the preoperative values. Except for at 12 h after surgery, there was no significant difference between the two groups at various time intervals. No significant change in the PaCO₂ level was seen during the study period in either group. PaCO₂ measured at 30 min after surgery was more in Group E (37.5 ± 3.2 mmHg in Group E vs. 34.6 ± 2.9 mmHg in Group D), otherwise there was no significant difference between the two groups at various time intervals. One patient in Group E (7.1%) and two patients in Group D (13%) developed postoperative respiratory complication, but the difference was not statistically significant. The mean ICU stay (Group D = 42 ± 25 h vs. Group E = 25.1 ± 16.9 h) and mean hospital stay (Group D = 9.9 ± 4 days vs. Group E = 7.6 ± 2.2 days) were longer in Group D patients.

Conclusion: Ventilation and oxygenation in the postoperative period in patients undergoing TOO and posterior fixation are not different between the two groups. However, the duration of ICU and hospital stay was prolonged in group D.

Key words: Atlanto-axial dislocation, craniovertebral junction, delayed extubation, early extubation, transoral odontoidectomy, ventilation

Introduction

Craniovertebral junction (CVJ) anomalies are disorders involving the skeleton and the enclosed neuraxis at the junction

of cranium and cervical spine. The bony abnormalities associated with CVJ anomalies are basilar invagination, occipitalization of atlas, and atlanto-axial dislocation^[1,2] When the atlanto-axial dislocation is irreducible, transoral odontoidectomy (TOO) followed by posterior fixation of cervical spine is done.^[2,3] The airway management for TOO has evolved from elective tracheostomy and prolonged ventilation to orotracheal or nasotracheal intubation and extubation after 1-5 days.^[2-5] Due to the fixed cervical spine, extension of neck is not possible after surgery and laryngoscopy and tracheal intubation is often difficult. In view of the fixed cervical spine and the oropharyngeal surgery, extubation is usually delayed to avoid the complications of difficult reintubation.^[3-6] However, several complications may occur because of the presence of an endotracheal tube and mechanical ventilation.^[7-11] Early extubation at the end of surgery is practiced in few centers, but there is no data

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on their postoperative outcomes in terms of oxygenation and ventilation and occurrence of respiratory complications in these patients.^[12,13] The primary objective of this study was to find out the difference in oxygenation and ventilation in patients extubated early compared to those extubated late after TOO and posterior fixation. The secondary objectives were to assess the length of Intensive Care Unit (ICU) stay, hospital stay and the incidences of pulmonary complications between the two groups.

Material and Methods

After approval of the ethics committee, 30 CVJ anomaly patients undergoing TOO and posterior fixations were included in the study. Informed consent was obtained from each patient or the legal guardian. Patients with history of bronchial asthma, chronic obstructive airway disease, frequent chest infections, excessive snoring, morbid obesity, cardiac disease, preoperative respiratory symptom, lower cranial nerve deficit and American Society of Anesthesiologists (ASA) Grade 3 or more were excluded from the study. All patients were premedicated with intramuscular 0.2 mg glycopyrrolate 1 h prior to induction of anesthesia. In the operating room, routine monitors were attached and arterial cannulation was done under local anesthesia. Arterial blood gas (ABG) analysis was done, while the patients were breathing room air. The PaO₂:FiO₂ ratio (ratio between partial pressure of oxygen in patient's arterial blood [PaO₂] and fraction of inhaled oxygen by the patient [FiO₂]) was calculated. Fiberoptic laryngoscopy was done for endotracheal intubation either during awake state or under general anesthesia. Anesthesia was induced with fentanyl (2 µg/kg) and thiopental (3-5 mg/kg). To achieve muscle paralysis rocuronium (1 mg/kg) was given at the time of induction and repeated whenever deemed necessary. Anesthesia was maintained with isoflurane, fentanyl and 60% nitrous oxide. TOO was done in supine position, and then the patients were turned prone for posterior fixation. Continuous monitoring of SpO₂, ETCO₂, electrocardiogram (ECG), axillary temperature, anesthetic agent concentration, invasive blood pressure, spirometry, and neuromuscular activity was done during the intraoperative period. The duration of surgery, duration of anesthesia, amount of blood loss, volume of fluids, blood transfusion, hemodynamic fluctuations, and total dose of fentanyl as well as rocuronium were recorded. Careful laryngoscopy was done at the end of surgery to rule out any gross oropharyngeal swelling. Inhalational anesthetics were discontinued and neuromuscular paralysis was reversed after laryngoscopy. Patients were considered ready for extubation when the following criteria were met: fully awake patient responding well to command, train of four ratio >90%, regular with normal depth respiration,

respiratory rate (RR) <25 breaths/min, adequate cough reflex, stable hemodynamics, and movement of all the limbs and SpO₂ >95%. When the patients were considered fit for extubation, they were randomized into two groups, early extubation group (Group E) and delayed extubation group (Group D). Randomization was done using a computer generated randomization chart. Patients in Group E were extubated in the operating room, while patients in Group D were given fentanyl and midazolam and transferred to ICU for elective ventilation. Patients who remained on mechanical ventilation were ventilated with tidal volume of 8 ml/kg, RR 12 breaths/min, FiO₂ 40%, positive end expiratory pressure of 5 cm of H₂O and pressure support of 10 cm of H₂O in synchronized mandatory ventilation mode. For postoperative analgesia ketorolac 30 mg was given intramuscularly at the time of wound closure and was repeated every 8 h. Those patients, who remained on ventilator, also received sedation in the form of midazolam (1-2 mg/h) and fentanyl (1 mcg/kg/h) to keep them comfortable. Patients were extubated next day after overnight ventilation. Sedation was stopped at least 4 h before extubation. Postoperative monitoring included SpO₂, ETCO₂, ECG, noninvasive blood pressure and RR. ABG was done at 30 min, 6, 12, 24 and 48 h after extubation and the PaO₂:FiO₂ ratio was calculated. Chest X-ray was done on the 3rd postoperative day. Vital hemodynamic parameters were recorded at the time of shifting and after 1, 2, 4, 6, 12, 24 and 48 h of extubation. Patients were observed during their hospital stay for development of any respiratory complication. Postoperative pulmonary complication was defined as occurrence of hypoventilation, hypoxia, hypercarbia, tachypnea, dyspnea, bronchospasm, tracheo-bronchitis, purulent sputum, atelectasis, pneumonia, pneumothorax, emphysema, accidental extubation, endotracheal tube blockade, and the need for reintubation or tracheostomy. Intervention was planned for the possible occurrence of respiratory distress. The criteria for reintubation were: Desaturation (PaO₂ <60), hypoventilation (PaCO₂ >50), tachypnea (RR >35/min), impending respiratory failure, and retention of secretions.

Statistical analysis

Data were analyzed with the help of STATA 9.0 (College Station TX) software and SPSS 10 (categorical variables). Numerical variables were compared with *t*-test and repeated analysis of variance. Categorical variables were compared with Fishers' exact test. *P* < 0.05 was considered as significant.

Results

Due to excessive blood loss and surgical complication, one patient was not randomized and was excluded from the study (postinclusion exclusion). Thereby, 29 patients

were randomized into the two groups, 14 patients in early extubation group (Group E) and 15 patients in delayed extubation group (Group D).

The demographic profiles of both the groups were comparable [Table 1]. There was no significant difference in the total duration of surgery or anesthesia, blood loss and the volume of fluids infused between the two groups. There was no significant intraoperative event or major hemodynamic fluctuation. None of the patients received any blood transfusion in perioperative period.

The base-line PaO₂:FiO₂ was comparable (477.6 ± 83.9 in Group E vs. 433.3 ± 42.9 in Group D) between the two

groups. No significant change in the PaO₂:FiO₂ was noted in the postoperative period in either group when compared to the preoperative values. Twelve hours after surgery the PaO₂:FiO₂ ratio was significantly greater in Group E as compared to Group D, otherwise there was no significant difference between the two groups at various time intervals [Table 2]. No significant change in the PaCO₂ level was seen during the study period in either group [Table 2]. PaCO₂ measured at 30 min after surgery was more in Group E (37.5 ± 3.2 mmHg in Group E vs. 34.6 ± 2.9 mmHg in Group D), otherwise there was no significant difference between the two groups at various time intervals.

Heart rate and blood pressure did not show any intragroup or intergroup variability, except at one point at 12 h after surgery when systolic blood pressure was higher in [Table 3].

One patient in Group E (7.1%) and two patients in Group D (13%) developed postoperative respiratory complication, but the difference was not statistically significant [Table 4]. One patient in Group E developed stridor and dyspnea 48 h after extubation. No obvious cause of airway obstruction was detected on direct laryngoscopy. The patient was intubated and kept on mechanical ventilation for next 18 h and was extubated successfully. The rest of his hospital stay was uneventful. One patient in Group D developed purulent sputum on second day of surgery, and his chest X-ray showed infiltrates, he improved with antibiotic therapy. The other

Table 1: Preoperative and intraoperative data (mean±SD or number (percentage))

Parameter	Group E (n = 14)	Group D (n = 15)	P value
Age (years)	31.1±14.3	29.7±12.3	0.38
Weight (kg)	52.5±12	50.7±8.4	0.64
Male sex	9 (64.3)	12 (75)	0.43
Duration of surgery (min)	395±71	408±125	0.73
Duration of anesthesia (min)	511±78	528±85	0.58
Blood loss (ml)	328±208	313±146	0.59
Intravenous fluids (ml)	3214±699	3500±613	0.25
Total rocuronium used (mg)	156.4±47.6	139.3±31.2	0.26
Total fentanyl used (µg)	300±95.6	306.7±67.8	0.83
Awake fiberoptic intubation	11 (78.6)	10 (66.7)	0.68

SD = Standard deviation

Table 2: PaO₂:FiO₂ and PaCO₂ at various time intervals after surgery (mean±SD)

	Base line	30 min	6 h	12 h	24 h	48 h
PaO ₂ :FiO ₂ (mmHg)						
Group E	477.6±83.9	390.4±66.3	393.1±55.2	411.9±29.9	419.8±42.5	423.1±21.2
Group D	433.3±42.9	411.8±70	385.3±66.8	377.6±54.4*	406.8±68.5	412.4±52.9
PaCO ₂ (mmHg)						
Group E	38.3±3.3	37.5±3.9	36±3.2	41.9±14.2	37.2±3.4	37.5±2.6
Group D	38.5±3.6	34.6±2.9*	33.3±5.1	35.3±4.3	37.6±3.05	38.3±3.2

*P < 0.05 (between group comparison). SD = Standard deviation

Table 3: Hemodynamic parameters at various time intervals after surgery (mean±SD)

	Before shifting to ICU	1 h	2 h	4 h	6 h	12 h	24 h	48 h
Systolic blood pressure (mmHg)								
Group E	127.9±14.5	128.3±11.3	125.3±9.6	121.9±10.5	121.6±9.02	119±10.2	118±14.3	117.4±15.4
Group D	128±18.1	127.4±19	130±19.7	130.9±20.3	128.0±15.4	128.9±12.3	120.5±10.8	120.1±10.9
Diastolic blood pressure (mmHg)								
Group E	78.4±13.4	77±11.6	75.2±13.2	75.1±12	73.1±11	72±12.1	70±10.2	70.7±10.8
Group D	78.7±18.6	81.5±15.6	82.3±17	83.1±7.5	79.4±6.5	79.7±13.8	73.2±9.4	72±8.9
Heart rate (beat/min)								
Early extubation	102.5±23.3	96.6±21.9	93.6±22.9	89.4±25.2	87.7±25	84.8±18.3	82.1±14.3	79.6±11.9
Delayed extubation	107.3±14.4	103.2±15.9	96.4±18.3	92.3±16	92.3±17.9	88.3±17.2	88.1±15.4	84.9±14.2

*P < 0.05 (between group comparison). ICU = Intensive care unit, SD = Standard deviation

patient in Group D developed paralytic ileus and severe abdominal distension leading to atelectasis and tachypnea. He improved with antibiotics and chest physiotherapy.

There was no wound related problem in patients of Group E. However, two patients in Group D developed delayed wound healing of the oropharyngeal wound. In one patient, nasogastric tube was removed following wound dehiscence and a feeding jejunostomy was done for enteral feeding. Both the patients recovered well. The mean duration of postoperative ventilation of Group D was 19.8 ± 5.9 h [range: 15-40 h, Table 5]. The mean ICU stay (Group D = 42 ± 25.1 h vs. Group E = 25 ± 16.9 h) and mean hospital stay (Group D = 9.9 ± 4 days vs. Group E = 7.6 ± 2.2 days) were longer in Group D patients [Table 5].

Discussion

Our results show that ventilation and oxygenation in patients undergoing TOO and posterior fixation are not different in the postoperative period between the group extubated early when compared to those extubated late. We took $\text{PaO}_2:\text{FiO}_2$ ratio and PaCO_2 levels as markers of oxygenation and ventilation respectively. It has been shown that $\text{PaO}_2:\text{FiO}_2$ ratio and PaCO_2 levels represent the oxygenation and alveolar ventilation well.^[14] In the intragroup comparison, the $\text{PaO}_2:\text{FiO}_2$ ratio and PaCO_2 did not change significantly during the monitoring period in either group. In the between group comparison, though a significant difference of $\text{PaO}_2:\text{FiO}_2$ ratio was seen at 12 h after surgery, such difference was not found at 24 and 48 h after surgery. Similarly, though there was a significant difference of PaCO_2 measured 30 min after surgery between the two groups, it was not different in the subsequent period. The duration of ICU stay and hospital stay was less in patients who were extubated at the end of surgery.

We did not find any difference in the incidence of postoperative respiratory complications between the two groups. Only one patient in the early extubation group developed respiratory complication. The respiratory problem in the above patient surfaced only 48 h after extubation. There was no oropharyngeal swelling in this patient. The occurrence of respiratory distress and the need for reintubation in that patient would not have been influenced by the choice of early or late extubation. In the postoperative period, 2 patients in the delayed extubation group developed respiratory symptoms but neither of them required reintubation. Though the incidence of postoperative respiratory complications was low in our study, we attribute our statistically insignificant findings to the small sample size. Occurrence of significant postoperative respiratory compromise in any of the group would have resulted in a

Table 4: Postoperative complications

Complication	Group E (n = 14)	Group D (n = 15)
Respiratory complication	1	2
Reintubation	1	0
Wound complication	0	2

Table 5: Duration of ventilation, ICU and hospital stay (mean \pm SD)

Course of hospital stay	Group E (n = 14)	Group D (n = 15)	P value
Duration of ventilation (h)	0	19.8 ± 5.9	—
ICU stay (h)	25.1 ± 16.9	42 ± 25	0.02
Hospital stay (days)	7.6 ± 2.2	9.9 ± 4	0.04

ICU = Intensive Care Unit, SD = Standard deviation

significant and sustained change in the PaO_2 ; FiO_2 ratio and PaCO_2 in both intragroup and intergroup comparison. But, since no such change was observed, we exclude any possibility of a significant compromise of respiratory function in either group.

Fear of a difficult airway due to oral surgery compounded with a fixed upper cervical spine is the major reason of delayed extubation after TOO and PF.^[5,6,15-18] The practice of keeping the endotracheal tube and overnight ventilation is not based on scientific evidence but rather due to the apprehension of a difficult intubation in the event of a respiratory failure.

Early extubation of patients following TOO and posterior fixation and early transfer to the general wards may have both medical as well as economic benefit. Complications related to endotracheal intubation like barotrauma, nosocomial infections and ventilator associated pneumonia can be reduced to a great extent. Patients can be mobilized early, which may reduce the occurrence of complications such as deep vein thrombosis and pulmonary thromboembolism. Early extubation also allows early initiation of nutrition, which may help in early mobilization and recovery. The adverse effects associated with the use of analgesia and sedation in ventilated patients can be reduced. Early extubation has also been shown to improve lung functions by reducing intrapulmonary shunts and atelectasis.^[19,20] Early extubation also allows an early discharge from ICU, which can substantially reduce the nursing requirements and the associated cost. On the other hand prolonged intubation and mechanical ventilation has been reported to lead to several complications and prolonged ICU stay.^[7-11]

The surgical technique as well as the airway management of TOO has evolved over the years. During earlier days, splitting of soft palate was a common practice.^[5] With further expertise and modification of the technique, the division of soft palate

was replaced with its retraction into a nasopharyngeal space with a nasal catheter.^[5] TOO in recent times is done through a small incision on the upper part of the posterior pharyngeal wall under the microscope and does not involve any extensive tissue damage.^[5] Previously, preoperative tracheostomy was the norm for TOO.^[3,4] Tracheostomy was done to allow uninterrupted surgical field, faster operative wound healing and comfortable breathing for the patient. In recent times tracheostomy is no longer recommended.^[17] However, many surgeons and anesthesiologists prefer to keep the patient intubated in the postoperative period for few days to allow oropharyngeal swelling to subside.^[5,6,15,16]

The results of our series suggest that selected patients, who are otherwise healthy and have no swelling of the oropharyngeal structures, can be extubated immediately after surgery. The sample size of our study is too small to establish the safety of early extubation in patients undergoing TOO and posterior fixation. These results cannot be applied ASA III & IV patients, patients with other airway difficulty or in difficult surgery involving extensive tissue damage where delayed extubation may be safer. Use of spirometry could have better reflected respiratory functions in the postoperative period. Since the PaO₂ FiO₂ ratio and PaCO₂ changes were not clinically significant, a clinically significant difference of the spirometric data would have been a very unlikely possibility.

Conclusion

Ventilation and oxygenation and the incidence of respiratory complications in patients undergoing TOO and posterior fixation were not different in the postoperative period but the duration of ICU and hospital stay was more in the delayed extubation group as compared to the early extubation group. Further studies with larger sample size would be required to test the safety of early extubation in TOO patients.

References

1. Chamberlain WE. Basilar impression (Platybasia): A bizarre developmental anomaly of the occipital bone and upper cervical spine with striking and misleading neurologic manifestations. *Yale J Biol Med* 1939;11:487-96.
2. Menezes AH. Congenital and acquired abnormalities of the craniovertebral junction. In: Youmans JR, editor. *Neurological Surgery*. Philadelphia: W.B. Saunders Company; 1996. p. 1035-89.
3. Menezes AH, VanGilder JC. Transoral-transpharyngeal approach to the anterior craniocervical junction. Ten-year experience with 72 patients. *J Neurosurg* 1988;69:895-903.
4. Marks RJ, Forrester PC, Calder I, Crockard HA. Anaesthesia for transoral craniocervical surgery. *Anaesthesia* 1986;41:1049-52.

5. Mummaneni PV, Haid RW. Transoral odontoidectomy. *Neurosurgery* 2005;56:1045-50.
6. Rath GP, Bithal PK, Guleria R, Chaturvedi A, Kale SS, Gupta V, et al. A comparative study between preoperative and postoperative pulmonary functions and diaphragmatic movements in congenital craniovertebral junction anomalies. *J Neurosurg Anesthesiol* 2006;18:256-61.
7. Terao Y, Matsumoto S, Yamashita K, Takada M, Inadomi C, Fukusaki M, et al. Increased incidence of emergency airway management after combined anterior-posterior cervical spine surgery. *J Neurosurg Anesthesiol* 2004;16:282-6.
8. Tobin MJ. Mechanical ventilation. *N Engl J Med* 1994; 330:1056-61.
9. Pinsky MR. The effects of mechanical ventilation on the cardiovascular system. *Crit Care Clin* 1990;6:663-78.
10. Fagon JY, Chastre J, Domart Y, Trouillet JL, Pierre J, Darne C, et al. Nosocomial pneumonia in patients receiving continuous mechanical ventilation. Prospective analysis of 52 episodes with use of a protected specimen brush and quantitative culture techniques. *Am Rev Respir Dis* 1989;139:877-84.
11. Anzueto A, Frutos-Vivar F, Esteban A, Alía I, Brochard L, Stewart T, et al. Incidence, risk factors and outcome of barotrauma in mechanically ventilated patients. *Intensive Care Med* 2004;30:612-9.
12. Reddy KR, Rao GS, Devi BI, Prasad PV, Ramesh VJ. Pulmonary function after surgery for congenital atlantoaxial dislocation: A comparison with surgery for compressive cervical myelopathy and craniotomy. *J Neurosurg Anesthesiol* 2009;21:196-201.
13. Pandey CK, Azim A, Matreja P, Raza M, Navkar DV, Singh RB, et al. Effect of preoperative dexamethasone on edema of oral and extra-oral structures following trans-oral decompression and posterior fusion. *J Neurosurg Anesthesiol* 2004;16:267-70.
14. Almeida-Junior AA, da Silva MT, Almeida CC, Ribeiro JD. Relationship between physiologic deadspace/ tidal volume ratio and gas exchange in infants with acute bronchiolitis on invasive mechanical ventilation. *Pediatr Crit Care Med* 2007;8:372-7.
15. Petroza PH, Prough DS. Postoperative and intensive care. In: Cottrell J, Smith DS, editors. *Anaesthesia and Neurosurgery*. St. Louis: Mosby Inc.; 2011. p. 623-61.
16. Mahale E, Horlocker TT. Vertebral column and spinal cord surgery. In: Cucchiara RE, Black S, Michenfelder JD, editors. *Clinical Neuroanaesthesia*. New York: ChurchillLivingstone; 1998. p. 403-48.
17. Hadley MN, Spetzler RF, Sonntag VK. The transoral approach to the superior cervical spine. A review of 53 cases of extradural cervicomedullary compression. *J Neurosurg* 1989;71:16-23.
18. Menezes AH. Surgical approaches: Postoperative care and complications "transoral-transpalatopharyngeal approach to the craniocervical junction". *Childs Nerv Syst* 2008;24:1187-93.
19. Johnson D, Thomson D, Mycyk T, Burbridge B, Mayers I. Respiratory outcomes with early extubation after coronary artery bypass surgery. *J Cardiothorac Vasc Anesth* 1997; 11:474-80.
20. Cheng DC, Karski J, Peniston C, Asokumar B, Raveendran G, Carroll J, et al. Morbidity outcome in early versus conventional tracheal extubation after coronary artery bypass grafting: A prospective randomized controlled trial. *J Thorac Cardiovasc Surg* 1996;112:755-64.

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