Pattern of airway management in craniomaxillofacial injury patients with fracture mandible: A retrospective analysis

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ABSTRACT

Maxillofacial injuries affect theairway in many ways. Knowing the factors which may lead to airway management other than Macintosh laryngoscopy will help emergency medical team in decision making and thus avoid any fatal situation. The present retrospective observational study was aimed to evaluate fractures and airway management patterns in cranio-maxillofacial injury patients with fracture of the mandible. It was also aimed to assess the clinical findings which predict airway management by other than Macintosh laryngoscopy. Anaesthesia management record, critical care assessment record and surgical team notes were evaluated in all cranio-maxillofacial injury patients with mandible fracture who required anaesthesia, critical care and ENT specialty services. The duration of the study was between 2009-10 to 2013-14 and the collected data was evaluated by using INSTAT software.Fifty nine (64.13%) out of 92 cranio-maxillofacial injury patients (with at least one head and neck or facial bone fracture) presented with mandibular fracture. The mean age was 27.25 years with 94.8% male patients. Laryngoscopy was expected not to be helpful in 38.33% cases. Video laryngoscopy appeared to be better or preferred over Machintosh laryngoscopy. Awake fiberoptic intubation was done in 30%, elective tracheostomy in 6.67% and retrograde intubation in 1.67% cases. Multiple facial bone fractures and mouth opening < 2 cm was independently associated with airway management other than laryngoscopy ($p < 0.0001$). Airway management is deviating towards video laryngoscopy from Macintosh laryngoscopy. Awake Fiberoptic intubation still plays a big role. Submental and blind intubations are becoming less prevalent.

Keywords: Craniomaxillofacial injury, Mandible fracture, Video laryngoscopy, awake fiberoptic intubation, intubating introducer.

INTRODUCTION

Road Traffic Accidents (RTA) are on the rise worldwide.[1] Mandible fracture is relatively common among the cranio-maxillofacial and polytrauma patients due to the prominence of the mandible and its relative lack of support. Conventional Laryngoscopy needs to push the mandible up and away which appears to be easier in mandible fracture patients. However, associated situations in cranio-maxillofacial trauma patients may adversely affect the airway.[2] Pain with swelling leads to intolerance to bag & mask ventilation while edema, bilateral fracturesexaggerate tongue fall leading to loss in airway. Pain also leads to trismus, leading to limited inter-incisor space for laryngoscopy. Associated maxillary fracture further complicates the situation. Conventional laryngoscopy is also associated with substantial amount of neck movement, especially extension, which is dangerous in suspected cervical injury patients. These multiple factors create a unique situation making airway management a challenge and potentially fatal.

Airway management technologies /devices have also evolved over time.[3] Many airway devices help anesthesiologist in the management of difficult airway but yet airway loss leading to major complications including death are still prevalent.[4] Many a time anticipation of difficult airway may not be easy or appropriate instrument and expertise may not be available during odd emergency hours. Knowing the factors which may lead to difficult airway management in mandibular fracture patients will help anaesthesiologists and emergency/ surgical teams in making the correct decision and thus avoiding a fatal situation.

MATERIALS AND METHODS

The present study was conducted retrospectively in our tertiary care hospital of North East India. Informed consent for surgical / airway management / anaesthesia were obtained from all patients. All cranio-maxillofacial injury patients with mandible fracture who required anaesthesia, critical care and Ear, Nose and Throat (ENT) specialty services were taken from the register between 2009-10 to 2013-14 and included for the study. Isolated cranio-maxillofacial injuries like traumatic brain injury (TBI) and cervical spine/cord injury patients or other cranio-maxillofacial bone fracture/s without mandible fracture were not included. Anaesthesia management record, critical

care assessment record sheet and surgical teamnotes, radiological evidences like X-ray and CT scans (Figure 2, 3) of the patients admitted were reviewed to collect complete data. Age, gender, aetiology of fracture, associated injuries, mode of airway management and reason for selecting the mode (where mentioned directly) were noted. Mouth opening was mentioned in finger breadths rather than in centimetres (cm), converted to cm by multiplying 1.5. Severetrismus was taken as mouth opening < 2 cm. The use of muscle relaxants before intubation was also noted. Complications in record sheet were also searched and noted. Site of fracture and number of fracture in the mandible were taken from radiological evidence and surgical records. Frequency distribution for demographics and trauma and airway related data are presented (Table 1 and 2), while statistical significance for risk analysis was calculated by estimating for Odd's ratio using INSTAT software (Table 3).

Table 1: Age, sex, etiologic and fracture wise distribution of the craniomaxillofacial injury patients presented as number and percentage. n – total number, *74 fracture point in 58 cases

Parameters	Number (%)
Age distribution (n = 58)	
0-6 years	1 (1.72)
7-17 years	4 (6.7)
18-40 years	49 (84.48)
41-65 years	4 (6.7)
>65 years	0
Sex Distribution (n = 58)	
Male	55 (94.82)
Female	3 (5.18)
Etiologies (n = 58)	
RTA	42 (72.42)
Fall from height	7 (12.06)
Assault	8 (13.8)
Sport injury	1 (1.72)
Blast/ missile injury	0
Site of fracture*	
Condyle	11 (18.96)
Ramus	5 (8.62)
Angle	10 (17.24)
Body	17 (29.31)
Parasymphyseal	31 (53.44)
Multiple site (almost all double site)	17 (29.31)
Associated	
craniomaxillofacialfracture	15 (25.86)
Maxillary	6 (10.34)
Cranial bone	6 (10.34)
Nasal bone	4 (6.89)
Zygomatic	3 (5.17)
C spine	18 (31.03)
Multiple bone	9 (15.51)
Other than craniomaxillofacial	25 (43.10)
At least one bone of any body part	

Table 2: Category of airway and technique used to intubate the cranio-maxillofacial trauma patients with fracture mandible presented as number and percentage. (n- total number)

Parameters	Number (%)
Mouth opening (n=60)	
Mild to moderate (> 2 cm)	42 (70)
Severe (< 2 cm)	18 (30)
Impact on airway (n=60)	
Anticipated Difficult ventilation	46 (76.67)
Anticipated Difficult intubation	33 (55)
Anticipated Difficult ventilation & Intubation	23 (38.33)
Unanticipated difficult intubation	Nil/?data incomplete
Unanticipated CVCI	-
Airway management	
Direct Laryngoscopy	20 (33.33)
Without relaxant	11 (18.33)
With relaxant	9 (15)
Video laryngoscopy	17 (28.33)
Without relaxant	16 (26.67)
With relaxant	1 (1.67)
Awake fiberoptic	18 (30)
Elective Tracheostomy	4 (6.67)
Retrograde intubation	1 (1.67)

RESULTS

Fifty-nine (64.13 %) out of 92cranio-maxillofacial injury patients with at least one head and neck or facial bone fracture presented with mandibular fracture during 2010 to 2014. Among 59 patients, 58 required 60 times airway management during perioperative and critical care management. There were 55 (94.8%) male patients with male female ratio of 18.33:1.

The mean age of patients was 27.25±9.55 years. Forty-nine (84.48%) patients were of the age group of 18 to 40 years. RTA was the most common cause (72.41%) of fracture followed by assault (13.79%) and fall from height (12%). Twenty-five (43.1%) patients had at least one bone fracture of any part of the body while 18 (31%) had at least one other maxillofacial bone fracture, among which fracture of the maxilla was the most common. Fifty-four patients (93.1%) required emergency / urgent airway management. Mask ventilation was anticipated to be difficult in 76.66% while difficult intubation was anticipated in 55% cases. Yet, in majority of the cases (61.67%) laryngoscopy was expected to be feasible by either conventional laryngoscope or video laryngoscope. Number of attempts for intubation data was not available

Table 3: Results of Fisher's exact test for the parameter assessed for association with airway management other than laryngoscopy. (OR- odds ratio. *fracture mandible at one site / undisplaced fracture with minimal trismus with/without suspected c-spine injury.)

Parameters (risks)	Other than laryngoscopy N = 23	OR (95% CI)	Two tailed p value
Mouth opening < 2 cm	18 (66.67%)	11.20 (3.23 – 38.84)	< 0.0001
C-spine injury (conf/ suspected)	04 (80%)	7.57 (0.78 – 72.72)	0.0662
Multiple site fracture	10 (58.82%)	3.29 (1.02 – 10.56)	0.0751
Multiple facial bone fracture	14 (77.78%)	12.83 (3.38 – 48.70)	< 0.0001
Reoperation	02 (100%)	8.72 (0.39 – 190.34)	0.1429
Simple mandible fracture*	04 (12.12%)	0.05 (0.01 – 0.22)	< 0.0001
Multiple site + C spine injury	02 (100%)	8.72 (0.39 – 190.34)	0.1429

in those cases but 2 of them were intubated by rail road technique over Frova Intubating Introducer with Rapi-Fit adapter and Luer lock connector. Among patients intubated by direct laryngoscopy, video laryngoscopy appeared to be better over normal laryngoscopy, as it was chosen in patients with confirmed or suspected C spine injury and in patients having moderate to severe trismus. Both difficult ventilation and intubationwas anticipated in 33.8% of the patients. Airway in these cases was secured using awake fiberoptic in 30%, elective tracheostomy in 6.67% and retrograde intubation in 1.67% cases. Reason for choosing retrograde intubation over fiberoptic was not mentioned.

Multiple facial bone fractures and mouth opening < 2 cm was independently associated with anticipated difficult airway. Multiple facial bone fractures were strongly associated with airway management techniques other than laryngoscopy with an odd's ratio (OR) of 12.83 and $p < 0.0001$, while mouth opening < 2 cm with an OR of 11.20 and $p < 0.0001$. Simple mandibular fracture was not associated with difficult airway and deviation away from laryngoscopy (OR 0.05, $p < 0.0001$). Multiple site mandibular fracture, C spine injury alone or both together were also not associated with deviation away from laryngoscopy ($p > 0.05$).

DISCUSSION

Significant number of trauma patients suffer from cranio-maxillofacial injuries. Mandible is the most common bone to be fractured among facial bones.[5,6] Multiple site fractures and associated injuries and oedema may lead to airway obstruction and loss of life.[2] Though over the last decade there have been improvements in the airway management devices and techniques, it has not yet taken away the apprehension and difficulties in the management of such airway during perioperative period and critical care set up especially during emergency time. The present study found that mandible was the most common (64.13%) facial bone in trauma patients with cranio-maxillofacial fracture. Road traffic accidents were the commonest cause of such injuries and fractures accounting for 72.41% of cases which is similar to previous findings given by Kar*et al* (80.31%), Raval*et al* (67%) and Anyanechi*et al* (79.9%).[6,7,8] Gunshot or blast injury was found to be the aetiology of maxillofacial trauma in 7% cases in a study done by Saraswat V.[9] The difference in population served in the study hospitals probably explains the difference.

Most of the patients were young belonging to the second to fourth decade of life and these findings are also consistent with previous findings.[5,6,8] Though findings of males being commonly affected are consistent to other studies, the present study has a very high male: female ratio (18.33:1 Vs. 4.4:1) as compared to other studies.[8] This could be attributed to geographical, population and social life style variations.

The commonest site of mandibular fracture was symphyseal/parasymphyseal (53.44%) followed by body (29.31%) in the present study while Anyanechi*et al* found nearly opposite findings in their retrospective analysis (body was the commonest while sympyseal+parasymphysealwere the second most common).[8] Multiple site fractures (all most all double) of the mandible were seen in 29.31% of the patients in the present study which is consistent (29.31% vs. 31.6%) with Anyanechi*et al* findings.[8]

Advanced Trauma Life Support (ATLS) of the American College of Surgeons gives airway management the first priority in its protocol.[10] Though majority of facial injuries are stable, complicated nature of fracture, oedema in the route of intubation makes airway

management challenging and many a time surgical help is also required. Careful airway assessment is a routine practiced by all Anaesthesiologists and Emergency Department (ED) physician before decision making on airway management. The Eastern Association for the Surgery of Trauma (EAST) in their practice management guideline for emergency tracheal intubation immediately following trauma recommends application of structured assessment tool (Look externally, Evaluate the 3-3-2 rule, Mallampati, Obstruction, Neck mobility, namely the LEMON Law) for the purpose.[11] LEMON law has been shown to well predict difficult airway in ED.[12] Maxillofacial fracture will affect almost all parameters of LEMON law and has the possibility of overestimating difficulty (may turn out good sometimes). Therefore, it appears to be a good tool for such patients, yet, possibilities to mislead relatively inexperienced or overenthusiastic anesthesiologists or ED physician in such patients cannot be denied.

A large number of patients in the present study anticipated difficult mask ventilation, which was probably due to displaced mandibular fracture, maxillary fracture, severe pain and oedema along suspected or confirmed C spine injury. Though pre-oxygenation can be done by placing the face mask gently after good analgesic coverage and assurance in adults but it is troublesome in children and there is always fear of losing airway even with moderate sedation. This fear is more after injecting muscle relaxants which further exacerbate the fall of tongue especially in bilateral mandibular fractures. EAST practice management guideline recommends that when significant difficulty is anticipated, neuromuscular blockade should be used with caution, and airway rescue devices, including surgical airway equipment, should be immediately available.[11] In the present study similarities with the recommended practice were seen where neuromuscular blocking drugs were only used in 10 out of 37 cases intubated by laryngoscopy (16.67% of total cases). Difficult airway cart was kept ready in all cases.

Machintosh laryngoscopy was tried in patients who had simple mandibular fracture associated with minimal trismus. Video laryngoscopy was preferred over Machintosh laryngoscopy in patients with simple mandible fractures associated with/in suspected C-spine injury, multiple site mandible fracture and moderate to severe trismus. The challenge in performing intubation with conventional direct laryngoscopy arises mainly due to limited mouth opening, difficulty in visualizing the vocal cords and confirmed or suspected C spine injury.[13] These problems are less with video laryngoscopy and probably that is why video laryngoscope has an upper hand in airway management of such patients. Moreover, it has been found that intubation by video laryngoscopy is equally efficacious as with awake fiberoptic intubation which is regarded as the gold standard for anticipated difficult airway management.[14] Recently video intubating stylets have been used for anticipated difficult intubation.[15,16] However, these newer systems have limitations like not having an integrated suction port, which necessitates preparations to prevent oral secretion, and the assistants help to clear the secretion or bleeding as required.[17] Fiber optic is flexible and having integrated suction ports in most of them which makes them more suitable and still widely used. In the present study also awake fiberoptic intubation was used in 30% of the cases, which is nearly similar to findings by Rava*let al* findings (26%), which is significantly higher than the report of Saraswat in his study.[7,9]

Blind awake nasal intubation was used in 20% of cases in the study of Saraswat V while in the present study as well as in the study by Rava*let al*itsuse has not been discussed.[7,9] Blind nasal intubation though is an excellent simple alternative in the absence of fiberscope, has major drawbacks of infrequent success on the first pass and increased trauma with repeated attempts, precipitating complete airway obstruction that necessitates emergency cricothyrotomy.[18] More availability and training on fiber optic and other video assisted devices for intubation probably is the reason behind its declining use.

Awake fiber optic intubation also has its drawbacks like inability to use in situations of active oozing of blood, by untrained personnel and in uncooperative patients.[19] The cost also is relatively higher, which makes its availability relatively less. It also requires airway preparation and sedation. Manyna time, these situations are inevitable in cranio-maxillofacial trauma patients and in such situation elective tracheostomy under local anesthesia appears as the best decision. Elective tracheostomy is also done in pan facial trauma patients. Submental intubation is an alternative to tracheostomy, especially when short-term postoperative control of airway is desirable.[20] In a study by Mittal *et al*, submental intubation was used in 2.46% of the patients for securing airway in maxillofacial injuries while elective tracheostomy was done in 6.16% of cases.[21] Saraswat also have found elective tracheostomy rates at 5.5% which are similar to that of the present study.[9] However no submental intubation record was found in the present study as well as in the study by Rava*let al*.[7]

The present study has limitations of being retrospective in nature. Though we have tried to cover every possible source of data, it is possible that a few cranio-maxillofacial injuries with bony fracture have been left

out, which might have affected the incidence of mandible fracture among these patients. However, it is less likely to have a significant variation in the results obtained on demographic profile of fracture mandible and its impact on airway. Anticipation of difficult mask ventilation, intubation or both were decided from the decision of using muscle relaxant while doing laryngoscopy, selection of mode of intubation, extent of trauma etc, which though appears to be appropriate is not fool proof except in cases with direct notes. Mandible is the commonest facial bone to be fractured in trauma and RTA is the commonest cause. Males are most commonly affected. Simple mandibular fracture is not a major risk for difficult airway. Associated other facial bone fractures, pain with swelling / oedema leading to trismus are the factors which lead to anticipated difficult airway and management deviating away from conventional laryngoscopy. Advanced airway management instruments like videolaryngoscope, fiberoptic bronchoscope, intubating introducers are very helpful and probably a must for airway management in cranio-maxillofacial injury patients.

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