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Prospective Analytic Study of Airway Problems in Elective Vs Emergency Cases with a Difficult Airway

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Abstract

Background: A difficult airway is not only a problem during intubation but also equally a problem post-operatively in controlling the airway and if reintubation is required. A limited research study reports are available on this subject. *Aim*: This present study was aimed to evaluate peri-operative airway problems (ventilation and intubation, post-operative extubation and reintubation) in elective and emergency surgical cases with the difficult airway. *Materials and Methods:* This prospective study was conducted in teaching institute on 145 anticipated and unanticipated difficult intubation cases from January 2016 to December 2016. Both emergency and elective cases were included. The demographic data, problems of difficult ventilation, difficult intubation as well as post–operative ventilation and reintubation data were collected. The data compared, the outcomes and results between these two groups were analyzed by Microsoft excel-SSSA by ANOVA and student t-test. *Results:* There is no statistical difference demographic data. In difficult airway cases frequency of Ventilation and intubation problems were more in emergency cases. Ventilation problems in elective/ emergency problems were 13.79%/ 18.62% and intubation problems in elective/emergency were 23.45%/30.34% respectively. Extubation problems also occurred more in emergency cases (elective/ emergency was 5.52%+8.28%)/(8.97% +11.02% respectively). Reintubation problems were more in emergency cases (2.76%) as compared to elective cases (2.07%). *Conclusion:* Intubation and Extubation of the difficult airway is more problematic. Adequate preparation planning and perform the action. Only awake extubation has to be done in these patients. High-risk patients should be identified early and after following safety guidelines, the difficult airway problems should be tackled.

Keywords: Difficult Airway; Ventilation; Intubation; Extubation; Peri-Operative Period; Re-Intubation.

Introduction

At Present in difficult airway more attention is paid towards intubation than extubation. The successful management of the perioperative difficult airway includes ventilation, intubation, and extubation and postoperative protection of patients' airway. The ASA database analysis shows that no improved outcomes seen at extubation till now [1]. Experts are of the opinion that one-third of major complications do occur in the recovery room with difficult airway and mortality rate is nearly 5% [2]. The most common problems of airway obstruction are incomplete recovery, laryngospasm, airway edema and airway collapse [3]. Not anticipating the risk and poor quality management during and after intubation were the common factors contributing for this [4]. This present study was aimed to evaluate peri-operative airway problems (ventilation and intubation, post-operative extubation and reintubation) in elective and emergency surgical cases with the difficult airway.

Matreial and Methods

This prospective study was done in our teaching institute after obtaining the approval from Intuitional ethics committee from

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January 2016 to December 2016. 145 difficult airway cases both emergency and elective were included in this study.

Inclusion Criteria

All general anaesthesia cases of above 2 years with anticipated and unanticipated difficult intubation cases of ASA grade I, II and III were included. Cases like obese, neck swellings, neck contractures, facial injuries, congenital facial abnormalities, Lemon score III&IV, and Malampatti III & IV and Carmack-Lehane grade III&IV were also included in this study.

Exclusion Criteria

Malampatti I&II, ASA grade IV and all easy intubation cases.

Methods were Used to Secure the Airway

Mask Ventilation: Mask ventilation was done for about 3-5 minutes before and during induction of anesthesia. Head was kept in suitable position during ventilation; mask was held with single hand or both hands as well as sometimes with chin support to make tight seal.

Tracheal Intubation: While the patient was prepared for intubation, head was kept in sniffing position; laryngoscope was introduced to visualize vocal cards. If the vocal cords were not observed during laryngoscopy, different maneuvers tried to visualize the glottis. The following steps were used for adequate exposure to direct visualization of the true vocal cords like; positioning the head into a "sniffing" or "drinking" position, external laryngeal manipulation, (BURP maneuver: backward, upward, rightward pressure), using of larger laryngoscope blade, small handle or alternatively, using a straight blade such as a Miller 2 or 3 to facilitate intubation.

Other adjuvants used were malleable metal stylet, gum elastic bougie, Fiberoptic intubation equipment, laryngeal mask airway (LMA) esophageal-tracheal double-lumen airway and the difficult airways cart was always available in the operation rooms. We were prepared to do crico-thyriodtomy in case above methods failed. Difficult airway protocols A, B, C and D were followed whenever necessary.

Extubation and Reintubation [5]: Prior to extubation, the usual criteria of extubation was met (these including hemodynamic stability, satisfactory oxygen carrying capacity, normothermia, adequate respiratory rate and tidal volume, good oxygen saturation, and an alert patient who was able to clear secretions, protected his airway, and maintain airway patency)and tested for regain of full muscle power). Patients at high risk for failed extubation were (with any potential for hypoventilation, ventilation/ perfusion mismatch, failure of the pulmonary toilet, or expected airway obstruction) kept on the ventilator. Our main goal of extubation of the difficult airway was to avoid reintubation

At the time of reintubation, the emergent situations such as poor oxygenation and/or ventilation in an uncooperative patient with a compromised airway tackled by oxygenation and reintubation after giving muscle relaxant.

Results and Statistical Analysis

The data of difficult ventilation and intubation from elective verses anticipated and unanticipated was collected. The post–operative ventilation and reintubation problems data was also collected. This data between elective and emergency cases results were analyzed by using Microsoft excel, Social science statistics calculator ANOVA and t-test calculator.

Out of 145 cases, 52 were elective and 93 were emergency (Table 1). Face mask and bag ventilation problems occurred in 47 cases 32.41% (20-13.79% in elective cases and 27-18.62% in emergency cases). Intubation problems occurred in 53.79% (34-23.45% elective/44-30.34% emergency) 78 cases. Ventilation and intubation combined problem occurred in 13.80% (8-5.52% elective/12-8.28% emergency) 20 cases (Table 2). Extubation problems seen in elective/ emergency cases 14.49% the figures were 8-5.52%/ 13-8.97% total 21 cases and reintubation problems were 4.83% (3-2.07%/4-2.76%) 7 cases. Cases which were not recovered completely and selected elective cases were directly kept on the ventilator till their complete recovery, 19.31% (12-8.28%/16-11.02%) 28 cases. Cases recovered completely in the operation room transferred to post- operative surgical ward were 61.38 %(39-26.90%/50-34.48%) (Table 2).

Haemodynamics& peripheral oxygen saturations: Vitals including heart rate(HR), Electrocardiogram (ECG) Non invasive blood pressure (NIBP), peripheral oxygen saturation (SpO_2), and End tidal carbandioxide ($EtCO_2$) were recorded before and after the ventilation and intubation as well as post extubation and reintubation(in required) cases. Only average readings plotted in the table without standard

deviation due too many columns. Raise of vitals, Etco2 and fall of SpO_2 observed during intubation. During reintubation fall SpO_2 was observed and sometimes to a critical level (Table 3). The shooting of heart rate, blood pressures observed whenever repeated attempts were made for intubation and reintubation (Table 3).

Table 1: Demographic particulars

S. No	Particulars	Elective(n=52)	Emergency(n=93)	p- value
1	Age in years	48.27±19.11	49.82±19.52	0.85
2	Sex	29:23	48:45	
3	Height in cms	160.27±6.44	159.27±5.1	0.94
4	Weight in kgs	57.73±12.24	58.09±9.34	0.69
5	Operation time in minutes	136.73±20.69	154.91±15.77	0.03

There is no statistical significance except duration of operations.

Table 2: All operations both elective and emergency cases with airway problems particulars

S. No	Particulars of difficult airway problems n=145		Particulars of various department cases									
			GS	*OBG*	*ENT*	*Ortho*	*Dental*	*Neuro*	*Pea*	*Others*	*Total*	*%*
1	Ventilation; n=47 32.41%	*Elective*	6	4			5	3		2	20	13.79
		Emergency	10	9	2			1	1	4	27	18.62
2	Intubation n=78 53.79%	*Elective*	11	10	8	1	2	1		1	34	23.45
		Emergency	14	15	6			4	1	4	44	30.34
3	Ventilation & Intubation n=20; 13.80%	*Elective*	2	2	1	2				2	8	5.52
		Emergency	3	4			1	1	1	1	12	8.28
4	Total=145 percentage		46 31.72%	44 30.34%	17 11.72%	3 2.07%	8 5.52%	10 6.9%	3 2.07%	14 9.67%	145 100%	100%
5	Extubation problems n=21	*Elective*	2	1	4		1				8	5.52
		Emergency	4	5				2	1	1	13	8.97
6	Reintubation n=7	*Elective*	1		1				1		3	2.07
		Emergency	1	1		1				1	4	2.76
7	Kept on ventilator Post operatively n=28	*Elective*	3	2	1	1		3		2	12	8.28
		Emergency	6	2		1		4		3	16	11.02
8	No extubation problems n=89	*Elective*	15	13	3	1	6			1	39	26.90
		Emergency	14	18	8		1		2	7	50	34.48
9	Total percentage		46 31.72%	42 28.97%	17 11.72%	4 2.76%	8 5.52%	9 6.21%	4 2.76%	15 10.34%	145 100%	100%

*GS=General surgery, OBG= Obstetrics& gynecology, ENT= Ear, Nose and Throat surgery, Ortho= Orthopedics, Dental= dental including Faecio-maxillary surgery, Neuro= Neurosurgery Pae= Paediatric surgery other= Plastic, Onco-surgery, Urology etc. Difficult airway problems are more in emergency cases when compared to elective cases; more emergency cases needed post-operative ventilatory management

Table 3: Vitals, Spo_2 and $ETco_2$ before and after intubation

Particulars of difficult airway problems n=145		Particulars of vitals before (1) and after intubation (2) average standard deviation not included because of many readings space problem.							
		Heart rate		*MBP*		*SPO2*		*Etco2*	
		1	*2*	*1*	*2*	*1*	*2*	*1*	*2*
Ventilation	*Elective*	82.03±8.14	94.1±4.01	93.8±3.22	98.3±3.37	100	95.7±1.89	32.33±3.57	45.89±1.97
n=47	*Emergency*	93.9±3.14	102.3±3.8	101.7±4.64	106.2±5.07	100	93.9±2.81	32.89±3.18	52.22±4.18
Intubation	*Elective*	83.88±3.14	112±6.16	101.67±3.16	116.02±3.81	100	94±2.79	35.89±1.76	53.56±3.05
n=78	*Emergency*	103.8±4.87	124.9±6.87	103.77±3.87	118.79±5.43	100	94.3±2.45	38.66±1.01	55.22±2.45
Ventilation &	*Elective*	84.7±4.47	116±4.62	105.1±6.06	117.9±4.75	100	94.9±1.79	37.89±2.52	54.89±1.9
Intubation	*Emergency*	105.6±4.9	131.52±6.54	97.9±5.59	112.3±4.69	100	95.1±1.66	35.89±2.26	53.67±3.04
n=20									

Extubation before(1) *after*(2)		*1*	*2*	*1*	*2*	*1*	*2*	*1*	*2*
Extubation	*Elective*	90.02±6.15	103.52±4.67	95.6±4.55	108.1±3.68	100	96.7±1.34	35.78±1.39	43.67±4.09
n=21	*Emergency*	115.8±4.42	124.2±4.05	93.8±5.94	104.1±5.11	100	94.8±1.69	35.89±1.76	45.78±2.73
Reintubation before (1) after (2)									
Reintubation&	*Elective*	128.11±7.8	114.67±2.87	109.54±7.58	98.02±4.87	86±4.79	100	57.67±3.2	36.11±1.45
ventilation	*Emergency*	141.89±4.62	124.11±2.21	118.1±9.45	101.78±6.85	84.37±3.3	100	62±1.73	34.78±1.64
n=7									

*DBP= diastolic blood pressure; MBP= Mean blood pressure SBP= systolic blood pressure SP02 =Oxygen saturation; Etco2=End tidal carbandioxide level.

Table 4: Various causes for difficult airway

S. No	**Particulars of difficult airway problems n=145**		**Particulars of various difficult airway group problems**							
			Pre-0perative				***post-operative***			
			Anatomical	**Pathological**	***Total***			**Anaesthesia**	**Surgical**	***Total***
1	Ventilation n=47	*Elective*	9	12	21	Extubation n=21; 14.48%	*Elective*	12	3	21
2		*Emergency*	10	16	26		*Emergency*	5	1	
3	Intubation n=78	*Elective*	11	15	26	Total		17; 11.72%	4 2.76	21 14.48%
4		*Emergency*	24	28	52					
5	Ventilation& Intubation n=20	*Elective*	3	2	5	Reintubation n=7	*Elective*	2	1	3
6		*Emergency*	6	9	15		*Emergency*	3	1	4
7	Total=145		63 43.45%	82 56.55%	145	Total		5 3.45%	2 1.38%	7 4.83%

More pathological problem than anatomical are seen in difficult airway

Table 5: Particulars of various major difficult airway problems

S. No	**Particulars of various difficult airway group problems**							
	Pre-0perative-ventilation and intubation problem/ major primary cause				***post-operative incomplete recovery, extubation and reintubation due to***			
	Anatomical	**Pathological**	***Others***	***Total***	**Anaesthesia**	**Surgical**	***Patient***	***Total***
1	Obesity n=14	Restricted mouth opening n=5	*Equipment failure*	*19*	Multiple attempts oedema N=3/1	Neck surgeries N=1	COPD 4/1	*8/2*
2	Beard N=4	Large tongue N=2	*Incomplete equipment*	*6*	Incomplete recovery (muscle) N=2	Faecio-maxillary surgeries	ASA Grade-4,5	*2*
5	Aged N=12	Tumors in and around oral cavity n=5	*Inexperience*	*17*	Excess sedation N=4/2	Nerve damage	OP poisoning	*4/2*
4	Snoring N=9	Immobile epiglottis n=15	*No trained assistants*	*24*	Hypoglycemia	Hematomas N=2	Myopathies N=3/2	*5/2*
5	Edentulous N=8	Neck burns contractures N=4	*Experienced help not available*	*12*	Electrolyte imbalance N=2	Prolonged surgeries N=4/1	Hepatic & renal failure	*6/1*
6	Congenital abnormalities N=5	Restricted neck movement N=4	*Over confidence*	*9*	Hypothermia N=1	Heavy blood loss N=3	Hypothyroidism N=4	*8*
7	Mallampati G4 N=8	Faecio-maxillary injuries n=6	*Ego*	*14*	Hypoxia	Incomplete preparation N=2	Drugs used by patient	*2*

8.	receding jaw n=11	Neck injury N=6	*Incomplete relaxation=4*	*21*	Deep extubation			
9	Acromagaly N=3	Congenital myopathies n=4	*Insufficient head support N=5*	*12*				
10	Pregnancy N=5	Others n=6		*11*				
Total	79	57	*9*	*145*	15	13	14	*42*
%	54.48%	39.31%	*6.21%*	*100*	10.34%	8.97%	9.66	*28.97%*

More pathological problem than anatomical are seen in difficult airway. All three anaesthesia, surgical and patient factors are equally important for patient recovery

Table 6: Showing number of attempts in elective and emergency cases, postponed and requiring surgical airway

S. No	*Type of cases*	Technique used	3 attempts	>3 attempts	postponed	Emergency surgical airway	Total	%
1	Elective	Change of adjuvants	23	12	3		38	26.21
		Change of person	8	6			14	09.66
	Total							35.87%
2	Emergency	Change of adjuvants	43	21		1	65	44.82
		Change of person	15	13			28	19.31
								64.13%
3	Total		89	52	3	1	145	
	%		61.38%	35.86%	2.07%	0.69%		100 %

Taking senior help during intubation is more important in difficult airway management, otherwise adverse result may occur

Difficult Airway Conditions

Grouped into Anatomical, Pathological and others causes. Various anatomical were 43.45 %(63 cases) and pathological were 56.55% (82) conditions making ventilation and intubation more difficult were also recorded (Table 4). Post-operative problematic extubations 14.48%(17/4=21) and reintubation 4.83% (5/2=7) with various major anaesthetic, surgical causes and patient conditions were also recorded (Table 4).

Ventilation& Intubation

Difficult airway Problem patient were classified into three groups; 1. Anatomical problems like Obesity, beard, and aged, short neck, edentulous, etc, 2. Pathological problems like Restricted mouth opening, large tongue, Pharyngeal masses, receding jaw, pregnancy, neck tumors, neck contractures and Cormack-Lehan score-4 etc and 3. Man and machinery problems (Table 5).

Three or more attempts at intubation were made 35.87% in elective cases and 64.13%in emergency cases. Three (2.07%) cases postponed due too many attempts and resorted for surgical airway in one (0.69%) case. Change of technique or adjunct were used in 99 (68.28%) cases and change of person from senior resident or post graduate to senior faculty in 42 cases (28.97%) (Table 6).

Discussion

A difficult airway is defined as "the clinical situation in which a trained anesthesiologist experiences difficulty with mask ventilation, intubation, or both" [6].

The management of difficult airway during intubation includes adequate pre-oxygenation, limiting the number of attempts to three for intubation and maintaining SpO_2 >94% [7]. Tracheal placement of the endotracheal tube should be confirmed by five point auscultation and capnography. The surgical airway is the option when you can't ventilate or intunbate. Sedation pre-operatively should be used with caution in patients with an anticipated risky airway or compromised airway. We have used all the above method whenever necessary keeping in mind SpO_2. In pregnant patients airway edema and breast enlargement pose problems as they having less reserve volume; eclampsia can pose additional airway-related issues.

Of the three cases postponed temporarily; two cases were postponed due falling saturations and number of attempt exceeds four. They were successfully intubated on the next operation day as they were

elective cases under senior care with more vigilance. In one case which had a large poly cystic neck tumor; awake intubation was planned but not achieved because it extended into oropharynx and ruptured during attempts of intubation; caused a lot of bleeding. In this case, patient coughed lot of blood; through suctioning was done and case postponed for next operation day care taken while passing the laryngoscope and endotracheal tube. In the next operation day successfully intubated with all safety precautions and surgery completed successfully. In one emergency ENT case, we resorted to the surgical airway (tracheostomy) because a large mass below the vocal cards obstructing the airway and passing of tube was not possible and we could ventilate the patient with difficulty before tracheostomy. After the successful introduction of ET tube through surgical airway mass was removed with an uneventful post-operative course.

Extubation failure refers to the condition "when airway obstruction occurs after extubation" [8]. This should be differentiated from a failure to wean from ventilatory support. Patients who fail to meet extubation criteria during spontaneous breathing trials should not be extubated [8].

Extubations failure in majority cases is due to airway trauma as a result of multiple attempts during intubation. Other causes are surgery in and around the head and neck, excess sedation, incomplete recovery, electrolyte imbalance and metabolic disorders [9]. Attention to be paid to prevent hypovolemia, hypoxia, acidosis, hypo or hyperglycemia and higher dose or unnecessary drugs. Plan includes considering of clinical factors which adversely affect ventilation after extubation, failed airway management plan [10].

Reintubation poses a great problem and danger because it may lead to morbidity and mortality if reintubation is not quickly achieved. Whenever a difficult ventilation and intubation occur an attention should be paid at the time of extubation also and reintubation if needed [11].

Bag and mask Ventilation problems were less when compared to tracheal intubation problem. Out of 145 cases, bag and mask ventilation problems occurred in 47 cases 32.41% (20 in elective cases and 27 in emergency cases). Intubation problems were more in emergency cases when compared to elective cases 53.79% (34/44=78). Ventilation and intubation combined problem occurred in 8/12 =20 cases 13.80%. More intubation problems seen in emergency cases were due to unanticipated and incomplete preparedness [Table 1]

Difficult ventilation problems: Difficult ventilation problems were like obesity, beard, aged, short neck, edentulous, reduced thyro-mental distance etc

Difficult intubation problems: Difficult intubation problems faced were restricted mouth opening, large tongue, Pharyngeal masses, receding jaw, pregnancy, neck tumors, neck contractures and stiff larynx etc.

Difficult Extubation and reintubation problems: Repeated attempts of intubation edema, Dental, head and neck surgeries, hematomas, collapse of the trachea, laryngospasm, bronchospasm, COPD excess sedation, incomplete recovery, unconscious persons etc; along with difficult ventilation and intubation problems.

The ventilation and intubation problems solved by careful pre-op examination and by following difficult airway algorithm plans like plan-A, plan-B, plan-C and Plan-D.

Assessment of the criteria for extubation: Extubation of the patient was done after fully meeting the extubation criteria like-adequate oxygenation >94%, adequate ventilation VT > 5 ml/kg, spontaneous RR > 7 bpm, ETCO2 < 50 mm Hg, haemodynamically stable, full reversal of muscle relaxation, sustained 5-second head lift or hand grasp, neurologically intact following verbal commands and intact cough/gag reflex. These patients sent to the recovery unit with extra oxygenation and monitoring the patient continuously till safe period achieved.

The extubation problems occurred in surgical procedures like thyroidectomy, large neck tumors, anterior cervical spine procedures, and maxillofacial surgery involving postoperative bleeding, direct tissue trauma or collapse of the trachea.

Particular attention paid to patients with cervical collars, maxillo-mandibular fixation, or with large dressings on the head or neck. Special attention also paid in cases like rheumatoid arthritis, obstructive sleep apnea (OSA), and depressed levels of consciousness cases [11].

Two common methods often performed to determining the feasibility of extubation were; direct laryngoscopy prior to extubation for checking any edema, bleeding, secretions, vocal cords paralysis and the second maneuver performed was the "cuff-leak test" for neck tumors and where more than three attempts taken for intubation .

Once the decision was made that the difficult airway patient can be weaned from ventilatory support and to be extubated, strategies for a safe extubation was formulated by using endo-tracheal tube (ETT) exchangers on full awake persons whenever necessary.

Most of the extubation problems occurred in obese patients and prolonged surgery cases more than three hours, due to multiple causes particularly in emergency cases 13 vs 8. Post-operative reintubation was done in 7 cases out of which 3 cases were elective and 4 cases emergency.

The results are very significant. Of the three elective cases one was a paediatric mentally challenged case with a large thyroid mass, not holding the neck post-operatively. In other two cases one was surgical case of colorectal pathology underwent resection of ASA grade III of compromised cardio-respiratory system.

Other case was posted for vocal cord biopsy repeated attempts done by the surgeon to view the anterior commissions of vocal cards to get the biopsy, after extubation laryngeal spasm occurred due to secretion and bleeding. In emergency cases problem due to compromised cardio-respiratory systems.

Monitoring after extubation: Extubation failure may not occur immediately; so the patients were closely monitored during transport and in the recovery area to prevent airway obstruction which may go undetected until a severe adverse outcome occur. So continuous monitoring was done in all difficult airway cases.

Conclusions

Intubation and Extubation of difficult airway is more problematic in emergency and are associated with morbidity and mortality. Only awake extubation has to be done in these patients. High-risk patients should be identified early and after following safety guidelines, the difficult airway problems should be tackled.

Key Message

In difficult airway both Intubation and extubation are equally important to prevent morbidity and mortality.

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