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Evaluation of changes in mallampati class in patients undergoing percutaneous nephrolithotomy surgeries in the prone position: A prospective observational study

Shibani Padhy*, Nirmala Jonnavithula, Gopinath Ramachandran

Department of Anaesthesiology and Intensive Care, Nizams Institute of Medical Sciences, Hyderabad, Telangana, India

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ABSTRACT

Objective: To evaluate airway changes in patients undergoing Percutaneous nephrolithotomy (PCNL) surgery in the prone position.
Methods: Modified Mallampati class (MMP) was evaluated preoperatively, and at 4, 12, 24 and 48 h postoperatively in 75 patients undergoing PCNL surgery in the prone position. The duration of surgery, amount of intravenous fluids and irrigation fluids used and estimated blood loss were evaluated for their predictive value.
Results: MMP class increased one class in 73.33% patients and 2 classes in 14.7%.There was no correlation between MMP change and length of surgery, amount of intravenous fluids or irrigation fluids used and surgical blood loss. The MMP reverted back to the preoperative state by 24 h in 92.4% patients and by 48 h in 4.5% patients.
Conclusion: MMP scores increase by at least 1 class in most of the patients after pcnl surgery in the prone position. Change in MMP class reverts back to preoperative state by 24 h in 92.4% patients and is not persistent in majority of patients at 48 h postoperatively. The degree of airway changes is unaffected by the duration of the surgery, amount of IV fluids and irrigation fluids used. Such deterioration of MMP scores in the postoperative period increases the risk of confronting difficult re -intubation, particularly in the presence of other pre-existing factors for difficult airway.

1. Introduction

Encountering a difficult airway for re-intubation after planned tracheal extubation is challenging and associated with significant morbidity and mortality. Review of previous literature reveals re-intubation rates in the postoperative period after elective surgeries to be between 0.17% and 0.45% [1,2]. Airway oedema is a frequently implicated cause of extubation failure requiring re-intubation in the post anaesthesia care unit(PACU) [1,2]. In January 2012, the Difficult Airway Society published a set of guidelines for the management of tracheal extubation [3]. They identified prone position, prolonged surgical duration and fluid overload as possible contributors to airway oedema in the post-operative period [3]. Supraglottic swelling and oedema thus produced, can cause posterior displacement of the epiglottis, typically inspiratory obstruction and may render the postoperative airway more difficult for re-intubation as compared to the preoperative state.

Such airway changes might be of greater concern when re-intubation is required in the postoperative period in a patient with existing difficult airway. The risk is further compounded in conditions such as obesity and obstructive sleep apnoea (OSA).

Most of our awareness in this context is borrowed from presumed similar airway changes occurring during the course of pregnancy and labour. The characteristics of position related postoperative changes in airway dimensions, in normal patients unlike the obstetric population have not been extensively investigated.

To the best of our knowledge, there are no prospective studies evaluating the degree of airway changes that occur during surgeries in the prone position. Similarly, the time required for airway changes to regress back to baseline, though studied in obstetric patients, is not known in the surgical population. Lastly, though it

* Corresponding author.
E-mail addresses: drshibanipadhy@gmail.com (S. Padhy), njonnavithula@gmail.com (N. Jonnavithula), gopi_59@hotmail.com (G. Ramachandran).

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has been suggested that the degree of airway changes may be affected by surgical factors like duration of the procedure and intraoperatively fluid balance, none of these have been thoroughly investigated. The four-point modified Mallampati (MMP) score is a widely used marker of difficult intubation.

Thus, we seeked to investigate the degree of airway changes as quantified by the MMP score, as well as the time required for such changes to revert to the preoperative state after PCNL surgery in the prone position. In addition the effect of surgical variables like duration of surgery, amount of intraoperative intravenous and irrigation fluids used, and the estimated blood loss during surgery, on the airway changes were also evaluated.

2. Methods

The approval of the institute's ethics committee was obtained for this prospective, observational study. After obtaining written, informed consent, we enrolled 75 patients between the ages of 18–65 years scheduled for elective PCNL surgery in the prone position. Exclusion criteria were patient refusal, pregnancy, history of a difficult intubation, Mallampati Class 4 airway, history of difficult mask ventilation, or inability to open the mouth for assessment.

The patient's airway was evaluated by the Samsoon and Young modified Mallampati test [4,5]. The evaluations were done with the patient in the semi sitting position, head in a neutral position, mouth opened as wide as possible, tongue maximally protruded and without phonation at five time points: preoperatively, and at,4 h,12 h, 24 h and 48 h postoperatively. All the preoperative and postoperative MMP evaluations were done with the head end of the table raised to 45° in order to obviate positional bias due to pain in the postoperative period. However it is unlikely that positioning affects the MMP score [6–8]. All evaluations for Mallampati class were performed by the same two senior practitioners with 15 years experience in the field. All subjects received general anaesthesia with American Society of Anaesthesiologists (ASA) standard monitoring. Duration of surgery, amount of intraoperative fluids, blood loss, amount of irrigation fluids used and postoperative haemoglobin were also monitored. Crystalloids in the form of a balanced salt solution (plasmalyte) were used for intraoperative fluid administration in all patients.

2.1. Statistical analysis

Sample size determination was difficult to compute as there is a paucity of similar studies in the literature. Taking into consideration the wide intraobserver variability in assessing the MMP class and mean MMP grade having to increase by one grade with a sigma of 1.5 and in order to have standard values of 0.05 for α and 0.8 for power, a sample size of 75 was calculated. This was similar to the 72 patients enrolled by Elrond et al. in his study [9].

Marginal homogeneity tests were applied to baseline and postsurgical mallampati scores. As the matrix was not a full 4×4 set, Kappa statistics were not calculated. The Mean baseline and post surgical mallampati scores were analyzed using repeated-measures analysis of variance (ANOVA) and Freidman two-way ANOVA. Effect of duration of surgery and the amount of IV and irrigation fluids administered on MMP was calculated using a multiple linear regression model. The a priori primary outcome was a change in Mallampati class found between pre and post blinded observer. Changes in MMP scores are shown in Table 3 and 4. Sixty-six patients (88%) increased their MMP score, of whom 55 (73.3%) changed MMP by one class and 11 (14.7%) by two classes. No subject decreased their MMP score. All statistical tests (marginal homogeneity, ANOVA, and Freidman two-way analysis) showed significance between baseline and post MMP scores with a $p < 0.001$.

The Kaplan-Meier **analysis** was done to determine the time taken for maximum change in MMP scores and the time taken for the MMP scores to return back to the baseline.

3. Results

The demographic data are shown in Table 1, and the surgical variables are represented in Table 2.

Table 3 shows the degree of changes in mallampati scores after surgery in the prone position. Sixty-six patients (88%) increased their MMP score, of whom 55 (73.3%) changed MMP by one class and 11 (14.7%) by two classes. No subject decreased their MMP score.

There was no significant correlation of changes in airway class with duration of surgery, amount of IV fluids and irrigation fluids administered and amount of estimated blood loss during surgery (Table 4). None of the patients required blood transfusion in our study.

We also evaluated the time duration required for the mallampati class changes to revert back to the preoperative state after surgery in the prone position. We found that the deterioration of mallampati class was seen by 4 h postoperatively in 86.4% of patients and at 8 h evaluation all of the 66 patients exhibited an increased mallampati class (Fig. 1).

Table 1
Demographics.

Gender, n (%)	M: 36 (48%) F: 39 (52%)
Age,yrs(mean ± SD)	44 ± 12
Weight, kgs (mean ± SD)	71 ± 7
Thyromental distance,cms(mean ± SD)	9.4 ± 1.6
Sternomental distance, cms (mean ± SD)	16 ± 2.2
Neck circumference,cms(mean ± SD)	35 ± 4.4

Table 2
Surgical variables.

Duration of surgery, min (mean ± SD)	120.6 ± 22.83
Intravenous fluids, ml (mean ± SD)	1464.29 ± 301
Irrigation fluids, L (mean ± SD)	20.39 ± 7.3
Estimated blood loss, ml (mean ± SD)	150 ± 80

Table 3
Changes in modified Mallampati scores.

MMP cha nge	Number (%)	Degree of change in MMP class		
No change	9(12)	–	–	–
Changed n(%)	66(88)	1	2	3
		55(73.3)	11(14.7)	0(0)

Table 4
Correlation Analysis of Change in MMP scores with Weight, Height, Duration of surgery, amount of IV fluids, amount of irrigation Fluids, change in haemoglobin conc. and estimated blood loss.(n _ 75).

Variable	Change in Airway Class ρ* (*P* Value)
Weight	-0.15(0.898)
Age	-0.53(0.647)
Intravenous fluids	0.174(0.132)
Irrigation fluids	0.144(0.213)
Duration of surgery	0.027(0.817)
Difference in pre- and post- operative Hb	0.125(0.280)
Estimated blood loss	0.165(0.124)

*Rho (ρ) is the Spearman correlation coefficient.
*Correlation is significant at the 0.05 level (2-tailed).

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