Original Article

Evaluation of changes in Mallampati class in patients undergoing lumbar spine surgeries in the prone position: A prospective observational study

ABSTRACT

Background: Positioning of patients during surgery, whether prone or head down, can lead to airway edema which, in turn, may lead to a difficult airway, and enhanced chances for reintubation. We aimed to assess and evaluate modified Mallampati class (MMC) change in patients scheduled for lumbar spine surgery in the prone position.

Materials and Methods: This prospective observational study included 80 patients scheduled for lumbar spine surgery. The MMC was assessed up to 48 h postoperatively. The time taken by the patients in the postoperative period for MMC class to revert to preoperative value and airway complications, if any, was noted. Other parameters observed were surgical duration, intraoperative fluids used, and blood loss to look for any significant correlation with changes in MMC.

Results: MMC increase by one grade was observed in 73 patients (91%). MMC in 54 patients (74%) returned to baseline within 18 h, in 12 patients (16%) it took 24 h, and in the remaining 7 patients (10%) the time taken was 36 h.

Conclusion: It was concluded and established by this study that the MMC declined by one grade and reverted to baseline value within 36 h. This change in MMC necessitates extra caution to be adopted during the postoperative period as surgery in a prone position may predispose to an increased risk of encountering difficult reintubation. The change in MMC was not significantly correlated to intraoperative variables like duration of surgery, amount of intraoperative fluid given, and blood loss.

Key words: Airway changes, lumbar spine surgery, modified Mallampati class, prone position

Introduction

It is emphasized that problems related to the airway extend well into the postoperative period contributing to significant morbidity during emergence and extubation. It is pertinent to mention that postoperative airway complications can lead to reintubation, tracheotomy, and an increase in the hospital stay.[1] Difficult Airway Society (UK) has acknowledged patient positioning (which includes prone or prolonged Trendelenburg) as one of the factors causing airway edema.[2] Other factors like excessive fluid shifting, duration of surgery, anaphylaxis, and giving positive pressure ventilation over a long duration can also contribute to facial and airway edema. All these factors predispose the patient to postoperative

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airway obstruction presenting mostly as postextubation stridor and at times may require postoperative elective ventilation.

Airway changes have been reported during certain surgeries or procedures; however, information available on this occurrence in the surgery done especially in the prone position is sparse. Similarly, the duration required for the airway changes to revert to the preoperative value has not been studied much. Lastly, it has been suggested that there are certain intraoperative variables like fluid balance or duration of surgery that may influence the degree of airway changes but the conclusion drawn from recent studies on the topic have been uncertain.[3-5] Therefore, this study was undertaken on patients undergoing lumbar spine surgery to further explore the consequences of the prone position and intraoperative surgical variables on airway changes taking place perioperatively. Time taken for airway changes to regress to their baseline value was also noted.

Materials and Methods

The research has been performed in a tertiary care hospital and research center for 18 months, starting from 2020 after registering at the Clinical Trials RegistryIndia (CTRI/2020/12/030016). This prospective observational study included 80 American Society of Anesthesiologists Physical Status I or II patients between 18 and 65 years scheduled for lumbar spine surgery. Patients unable to open mouth for assessment of airway, modified Mallampati Class (MMC) grade 4, unstable cervical spine, pregnant patients, and refusal to give consent were not included. In our study, patients in which intubation was difficult involving multiple laryngoscopic attempts and prolonged airway manipulation were also not considered. Institutional Ethics Committee (IEC) Approval : IEC/2019-186 dt. 21/10/19.

Before induction of anesthesia, the Mallampati test was assessed by using Samsoon and Young's modification of Mallampati class.[6,7] MMC was performed with the patient inclined to keep the head in a neutral position, fully open mouth, and tongue protruding out. To remove bias resulting from the position in the postoperative period arising due to pain, all the MMC evaluations during the preoperative and postoperative periods were performed by raising the head end of the operation theater (OT) table by 45° and keeping the examiner's eye parallel to the patient's mouth. This evaluation was done at the interval of ½, 1, 2, 4, 8, 12, 24, 36, and 48 h after surgery with preoperative assessment taken as baseline. Two senior anesthesiologists did the preoperative and postoperative assessments for airway changes independently and no variations were noticed. On arrival in the OT, five lead electrocardiography, non-invasive blood pressure (NIBP), SpO_2, and temperature probes were attached. Induction of anesthesia was done with propofol 2 mg kg^{-1}, fentanyl 2 μg kg^{-1}, and flexometallic tube was used for tracheal intubation, facilitated by using 0.1 mg kg^{-1} vecuronium. Thereafter 0.5–1% isoflurane with 60% nitrous oxide (N_2O) in oxygen was used to maintain anesthesia with end-tidal carbon dioxide pressure ($ETCO_2$) kept in a range of 30–35 mm Hg. The intraoperative fluid replacement was done with Ringer's lactate.

Surgical duration, the quantity of intraoperative fluids given, and blood loss were also monitored. The primary outcome included postoperative change in MMC in patients posted for lumbar spine surgery performed in the prone position. Secondary outcomes comprised time required for the change in MMC to regress to baseline value and the correlation of any of various intraoperative variables concerning changes observed in MMC.

Statistical methods include the Chi-square test and the Student's *t*-test. Spearman correlation coefficient was used to find out any correlation between intraoperative variables and MMC changes observed. Keeping in mind possible inter-observer variability that can occur during the evaluation of MMC ensued to the requirement of one grade mean MMC change, a sample size of 80 patients was determined. Standard values adopted were 0.05 for alpha error, 0.8 for power, and a sigma of 1.5. This was done by a study conducted by Padhy *et al*.[3] in which 75 patients were registered.

Results

A total of 83 patients were screened for inclusion, and 3 were excluded due to non-fulfillment of inclusion criteria with airway being classified as MMC 4 as shown in Figure 1. Baseline characteristics of the included patients along with airway parameters are depicted in Table 1. The amount of intraoperative fluid given and blood loss in relation to the duration of surgery is shown in Figure 2. During the postoperative period, MMC increased by one grade in 73 patients (91%) who completed the study. Time taken for a one grade point increase in the MMC score over the preoperative score was 1 h in 2 patients (2.8%), 2 h in 8 patients (11%), 4 h in 10 patients (13.6%), and 8 h in 53 patient (72.6%), so by 8 h all 73 patients showed a change in MMC by grade 1. The details are summarized in Table 2.

Duration for MMC to regress to preoperative baseline value after lumbar spine surgery done in the prone position was

also assessed. MMC in 54 patients (74%) returned to baseline within 18 h, in 12 patients (16%) time required was 24 h, and in 7 patients (10%) it was 36 h. It was observed that it took 36 h for the changes in MMC to relapse back to the preoperative baseline value in all 73 patients [Figure 3]. The intravenous fluids given, surgical duration, blood loss, and weight of the patient did not show any significant correlation with changes in MMC [Table 3]. In our study, none of the patients had airway-related complications, no patients required reintubation, and no blood transfusion was given.

Discussion

The Mallampatti score used for airway assessment is invaluable in predicting a difficult airway and is a reliable tool for assessing the shape and size of a patient's tongue concerning other oral structures.[7] Over the years, it has proved to be an easy, consistent, reproducible, and standardized method to evaluate airways and can be used for identifying patients at risk for difficult tracheal intubation.[7-10] Mallampatti score of grade 3 or 4 in patients has been associated with impaired glottis exposure (Cormack–Lehane score, 3 or 4).[11] Mallampatti scoring system still holds

Table 1: Demographic and airway parameters

Parameters	Data
Gender no. (%)	M 49 (61.3%); F 31 (38.7%)
Age, yrs (mean±SD)	43.4±13.38
Weight, kg (mean±SD)	M 62.04±5.23; F 53.91±3.54
MMC 1	33 patients
MMC 2	31 patients
MMC 3	16 patients

SD=Standard deviation, M/F=Male/female, MMC=Modified Mallampati class

Table 2: Time taken in a number of patients during the postoperative period for an increase in MMC in comparison to preoperative level while undergoing lumbar spine surgery in the prone position

Time (h)	Total no. of patients with MMC increased by grade 1	Percentage of patients whose MMC increased by grade 1	No. of patients with MMC increased by grades 2 and 3 or more	Percentage of patients whose MMC increased by grades 2 and 3 or more
1/2	0	0	0	0
1	2	2.8%	0	0
2	8	11%	0	0
4	10	13.6%	0	0
8	53	72.6%	0	0

MMC=Modified Mallampati class

Table 3: Correlation analysis of change in MMC with weight, height, duration of surgery, amount of intravenous (IV) fluids, and estimated blood loss

Variable	Correlation coefficient (r)	*P*
Weight	0.121	0.104
Duration of surgery	0.015	0.536
Amount of IV fluids	0.098	0.131
Estimated blood loss	0.051	0.261

Rho (r) is the Spearman correlation coefficient. Correlation is significant at the $P<0.05$ level (two-tailed)

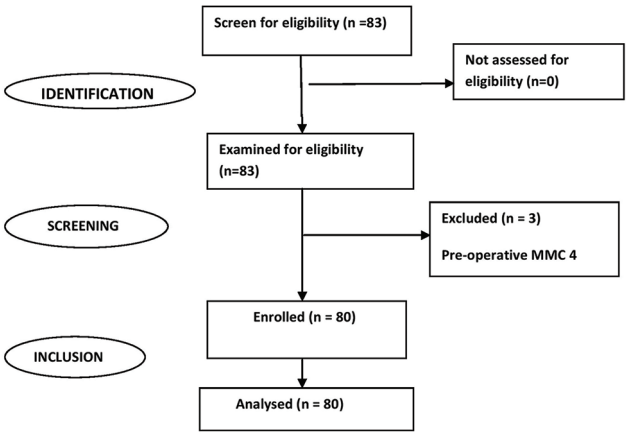

Figure 1: Consort diagram detailing the patient flow

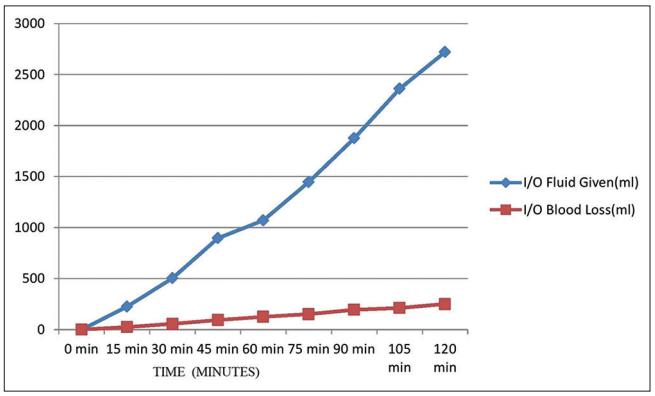

Figure 2: The amount of intraoperative fluid given and blood loss in relation to the duration of surgery

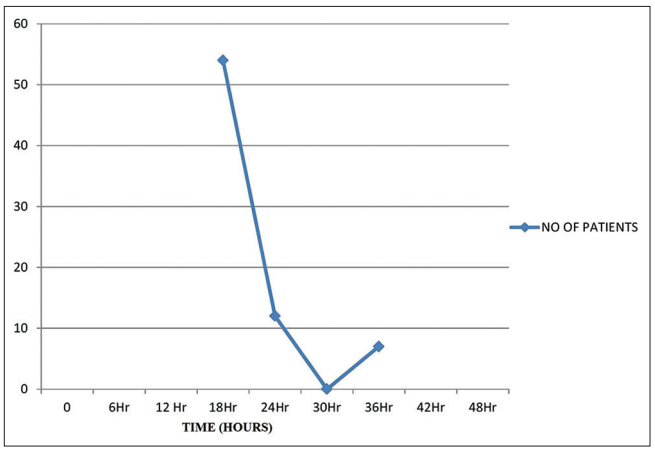

Figure 3: Time required for postoperative MMC to revert back to preoperative grade in patients undergoing lumbar spine surgery in the prone position

reasonable clinical utility as has been demonstrated in a meta-analysis that involved over 34,000 patients by Lee *et al*.[12] This scoring system is practiced by anesthesiologists worldwide and was used as a method to evaluate the airway in our study.

Many studies have reported worsening of the MMC during labor and these changes have persisted up to 48 h after delivery,[13-15] but very few studies are available on the evaluation of airway changes after surgeries done in the prone position. It was observed in our study that 73 patients (91%) showed deterioration of MMC following surgery done in the prone position, higher than that noticed in the parturient population.[13-17]

Reviewing the literature available does throw some light on worsening MMC after prone surgery. Surgeries performed in the prone position are more predisposed to developing oropharyngeal edema, including macroglossia, sublingual hematoma, and salivary gland swelling; more commonly if the head and neck are kept fully flexed.[17] To add to this extreme, head rotation or flexion can cause increased pressure on blood vessels leading to compression, hence affecting the venous and lymphatic drainage of the oral cavity and leading to airway edema.[18,19] The aforementioned factors can result in ischemia of the oropharynx with increased capillary leak contributing to the airway edema commonly witnessed in the surgeries performed in a prolonged prone position. Prone positioning and gravity can also lead to free water redistribution to the dependent interstitial spaces present in the airway. All the above-mentioned mechanisms, in addition to water retention because of surgical trauma caused by high vascular permeability due to the release of cytokines, can explain the worsening of MMC and airway edema in our patients.[20,21]

Our study demonstrated that there was a change in MMC by one grade as compared to preoperative score in 91% of patients within 8 h postoperatively and MMC returned to baseline in 24 h in 90% of patients and in all by 36 h. As observed in our study, change in MMC was not significantly correlated to surgical duration, the intraoperative fluid used, and blood loss occurred. Padhy *et al*.[3] demonstrated an increase in MMC postoperatively in 88% following percutaneous nephrolithotomy (PCNL) surgery in the prone position and the change persisted up to 48 h in 21% of patients. A possible explanation for this can be that 14% of patients in their study experienced an MMC change by two grades and thus took a long time to return to baseline as compared to the MMC change observed by one grade in our study. Similarly, Teo *et al*.[4] showed worsening of MMC in 78% of spine surgeries done in the prone position through the time to achieve it and return to baseline level was not evaluated by them.

In contrast, a study done by Mishra *et al*.[5] observed a change in MMC postoperatively in 23.9% of patients after PCNL surgery. It is emphasized that the duration of surgery (120.6 ± 22.83 min) and amount of fluid given (1194.12 ± 343.80 ml) in their study were less compared to our study (164.1 ± 27 min) and (1353 ± 193.80 ml).

There is a probability that an increase in oropharyngeal edema as is evident by the worsening of MMC could pose difficult intubation in the immediate postoperative period that requires utmost care to be exercised during extubation following surgery after the prone position. The deterioration of MMC is unpredictable and may not seem to have any correlation to the surgical duration or the amount of fluids given. Likewise, many patients presenting with a difficult airway, obesity, and a history of obstructive sleep apnea are being dealt with for surgery in the prone position can very well result in an increased risk of coming across difficult reintubation. Henceforth, more caution needs to be taken during extubation in such cases.

Whether the deterioration of MMC will correlate with difficulty of intubation is a matter of research as there are studies that show the poor correlation of MMC with Cormack–Lehane grading or in the prediction of the difficult airway.[12,22] More researches involving large trials are required to investigate airway changes in patients with major fluid shifts and surgeries involving prolonged prone positions. Similarly, airway changes during surgeries performed with the patient in a supine position also need to be ascertained.

Conclusion

The study has been able to establish that in most of the patients after undergoing lumbar spine surgery done in the prone position, an increase in MMC by at least one class is found. Any modification in MMC regresses to the preoperative state by 24 h in 90% of patients but is not persistent after 36 h postoperatively. No correlation was found between airway changes associated with the surgical duration, blood loss, and the intravenous fluids given which necessitates further studies with a large sample size. Worsening of MMC, especially during the postoperative period predisposes to increase chances of encountering a difficult airway, specifically if a risk factor for the same is already present.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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