Change in Mallampati Score during Pregnancy, Labour and Post Labour: An Observational Study

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Background
Mallampati (MP) score is used to predict the ease of endotracheal intubation. Pregnancy is often associated with failed intubation during anaesthesia for caesarean delivery and contributes majorly to maternal complications that are related to anaesthesia. This study aimed to determine the change in MP grade over the course of pregnancy (first trimester, during labour and post-delivery)

Methods
The study was conducted on 389 pregnant women in the first trimester. Demographic data, airway characteristics and MP score of the patients were recorded at different stages of pregnancy. Change in MP grade was assessed for those patients, who have delivered vaginally.

Results
The mean age of the study subjects was 25.77±3.64 years. There was a significant association of MP score with weight gain (P<0.0001) and change in neck circumference (P<0.0001). There was a significant change in the number of patients with MP grade 3 and 4 was noted from first trimester (n=14; 2.26%) to 48 hours post-delivery (n=78; 24.6%) (P<0.01), showing a strong association between change in MP score and pregnancy.

Conclusion
There was a significant increase in the MP score over the course of pregnancy that may be attributed to gestational weight gain along with variations in the neck circumference in pregnant women. Hence, assessment of MP score is important for proper management of difficult intubation, especially in parturient.

Keywords: intubation, labour, pregnancy, weight gain

Introduction

The management of parturients poses complex challenges to anesthesiologists, including risk factors like pulmonary aspiration, emergency caesarean-section and balancing the conflicting needs of both the mother and fetus. For obstetric patients, endotracheal intubation is known to be the standard care for airway management.[1] Pregnant women pose a high risk of failed intubation, constituting a challenge for the anesthesiologist.[2] Mallampati (MP) grading has proven to be a primordial predictor of difficult tracheal intubation in parturients.[3] The MP score gives a rough estimate of the size of tongue relative to the oral cavity.[3]

The incidence of failed intubation in obstetrics is higher when compared to general surgery and has not been well explained so far.[4] Increase in MP score in parturients gives an insight into

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understanding the mechanisms involved in difficult intubation, majorly in parturients and immediately post labor.[5]

The MP classification allows for instantaneous identification of an increase in the tongue volume without the help of sophisticated devices.[6] MP score may also change over the course of hours during the labor process and needs to be assessed prior to instrumentation.[5] There are only few Indian studies on MP score in pregnant women. The score is not static, and it is important to evaluate the score frequently in obstetric patients to reduce the morbidity and mortality due to endotracheal intubation.[1] This study aimed to determine the change in MP grade over the course of pregnancy (first trimester, during labor and post-delivery).

Methods

Five hundred pregnant women in the first trimester, aged >18 years, were enrolled and this study was conducted over a period of three years. Informed consent was procured from the patients and the study was approved by the institutional ethical committee (MSRMC/EC/2016), with CTRI registration number CTRI/2018/02/011944. Patients with multiple pregnancy, previous head and neck surgeries and temporomandibular disease were excluded. Women with initial MP grade 4 were excluded from enrollment because there is no description of a grade greater than 4 in MP classification. Demographics, mode of delivery, gravidity, and co-morbid disease of all the patients were noted. Figure 1 shows the consort flow diagram of recruitment of study participants.

The modified MP grade was assessed in all patients by the same anesthesiologist.[7] The MP score was measured in a seated position, with head in neutral position, mouth opened widely with absence of phonation at five different time points, i.e. at first trimester**,** at the commencement/ induction of labor, during labor, after 24 h and 48 h of delivery. MP grade during labor was assessed after induction of labor, in the first stage of labor before giving labor analgesia, but before full cervical dilatation. Change in MP grade over different time points (first trimester to 48 h post-delivery) was assessed for those patients who delivered vaginally. Variables such as age, height, gravidity, mode of delivery, weight gain, change in thyromental distance (TMD) and neck circumference from first trimester to third trimester**,** volume of intravenous fluids infused during labor, and comorbid conditions associated with pregnancy (hypertensive disorders of pregnancy, hypothyroidism and gestational diabetes) were collected from patient's medical files or by in-person interviews.

Based on previous study, the change in MP grade during pregnancy, labor and post-delivery was reported to be 50%.[5] Hence, with a relative precision of 5.5% and desired CI of 95%, sample size of 318 was required.

R v 3.6.0 was used to analyze the data. Continuous variables were represented by mean± SD while categorical variables were represented by frequency. Quade test was used to assess the change in MP score at two time points. Paired comparison was done with Wilcoxon signed rank test with Benjamini-Hochberg adjustment whereas paired categorical variables using McNemar's test. $P \leq 0.05$ considered as statistically significant.

Results

Of 500 pregnant patients, only 389 were studied, as remaining were lost to follow-up. The mean age of participants was 25.77±3.64 years and mean height was 155.3 ± 4.0 cms. Characteristics of the participants are presented in Table 1.

Around 318 (81.75%) patients underwent vaginal delivery. The distribution of MP grade during different stages of pregnancy and labor is shown in Figure 2. There was a significant relation between weight, neck circumference and TMD (P <0.0001; Table 2) with MP score.

The MP score post-delivery was recorded for 318 patients who had vaginal delivery and assessed for change in MP score at different time points. In the first trimester, the number of patients (n=304) with MP score of 1 and 2 (complete visualization of the soft palate, complete visualization of uvula) were greater than the number of patients with MP 1 and 2 during labor (n=235), 24 h post-delivery (n=232) and 48 h post-delivery (n=240), signifying a change in MP grade from first trimester to 48 h post-delivery, P<0.0001 (Table 3). A significant change in MP grade was noted

Table 1
Demographics of study participants

parameters		Number of Participants (n=389)	
		Count (n)	Percent (%)
Age	<20	5	1.29
	20-25	203	52.19
	26-30	141	36.25
	≥30	40	10.28
Gravidity	Primi	201	51.67
	G2	139	35.73
	G3	41	10.54
	G4	7	1.8
	G5	1	0.26
Co-morbid disease	Nil	254	65.3
	Pregnancy induced hypertension	48	12.34
	Gestational diabetes mellitus	8	2.06
	Hypothyroid	67	17.22
	Pregnancy induced hypertension and Hypothyroid	1	0.26
	Tuberculosis	1	0.26
	Anemia	10	2.57
Mode of delivery	Vaginal	318	81.75
	Lower segment caesarean section	71	18.25
Height (cm)	155.3 ± 4.0		
Intravenous Fluid	1021.54 ± 408.24		

Table 2
Correlation of different parameters with Mallampati score

Parameters	OR [95% CI]	P-value
Weight (kg)	1.03[1.02,1.04]	<0.0001**
Neck Circumference (cm)	1.55[1.43,1.68]	<0.0001**
Thyromental Distance (cm)	0.66[0.58,0.74]	<0.0001**
***indicates statistically significant*		

at different time points from first trimester to pre labor (P < 0.0001). The number of pregnant women who had MP grade 3 in the first trimester was only 14 (2.24%), which increased to 83 (26.1%) during the pre-labor period.

The distribution of MP score at pre-labor, during labor, 24 h and post 48 h post-delivery was significantly different from first trimester (P<0.0001). Distribution of MP score at 48 h post-delivery was significantly different from MP score at pre-labor (P=0.0120), during labor (P=0.0004) and 24 h post-delivery (P=0.0060). Participants with MP grade 3 and 4 were 85 (26.8%) and 78 (24.6%) at 24 h and 48 h. post delivery, respectively, compared to only 14 (2.24%) participants in the first trimester, which was statistically significant (P < 0.01).

Discussion

The MP score is derived from a simple airway-classification system and is used to recognize the risk of difficult tracheal intubation.[7] The MP classification includes four grades (1, 2, 3 and 4) depending on the soft palate visibility,[8] with grade 4 being the worst.

During pregnancy there are multiple changes observed in the airway due to various factors, not all of them clearly defined.[9] The physiological changes coherent with pregnancy and labor remarkably affect the respiratory system by decreasing lung volume and thoracic compliance and narrowing the upper airway. Anatomically, the upper airway is enveloped by soft tissues such as tongue and soft palate, which are encompassed by bony structures like the mandible and spine. Size of the airway space is determined by the balance between the size of the bony enclosure and the soft tissue volume.[6] There is no obvious bone or joint deformity during pregnancy and labor. However, the soft tissue volume is increased, presumably due to pharyngeal edema and weight gain that occurs

during pregnancy,[5] which accounts for increasing grade of MP score during pregnancy and labor.

Similar to other study, we observed a significant increase in MP score from first trimester to pre-labor and delivery[5] in which there was a significant increase in MP score in patients from pre-labor to post labor (17 vs. 30; $P < 0.001$), who had reached an MP score of 3-4.

In a previous study,[10] the authors emphasized an association between airway change and weight gain during pregnancy. In the present study, using logistic regression, it was concluded that change in weight and change in neck circumference were significant factors affecting MP score change. For one unit increase in weight gain (per kg), the odds of change in MP score increase by 1.04 times. In contrast, the study conducted by Boutonnet et al.[11] did not find increased body weight to be predictive for airway changes, and this absence of correlation between weight gain and change in MP score may be explained by the fact that their first evaluation was done at 32 weeks of gestation.

Variation in neck circumference was also found to influence the MP grade. With one-unit increase (per cm) in neck circumference, the odds of having an MP score of 3-4 was 1.55 times higher, akin to Lebouanlger et al.[12] Lebouanlger et al.[12] in their study using acoustic reflection method, have shown a significant diminution in the cross-sectional area of pharynx and subsequent increase in MP grade during normal pregnancy, with no change in the cross-sectional area of the trachea. Our data were in agreement with these findings, which suggest that increase in neck circumference and weight gain during pregnancy lead to decrease in cross sectional area of the pharynx due to pharyngeal edema, increase in local fatty tissue volume and other features like generalized weight gain suggesting potential intubation.[5] From the first trimester to other stages of pregnancy (pre delivery, during labor and post labor), the incidence of reduction in the number of patients with MP score 1-2 was 9.3%.

This study has certain limitations. We did not use any form of airway imaging technique like reflectometry or photography to assess the MP classification. It was a subjective assessment performed by a single observer and the MP score of the patient in the previous stage of pregnancy were not blinded to the observer. Since it was a subjective measurement, the reliability of the assessment of MP score is questionable. Authors attempted to preclude this by instructing the participant thoroughly regarding maximum mouth opening and tongue protrusion without phonation before assessment.

Conclusions

Overall there is a significant increase in the MP score over the course of pregnancy. The changes in MP score can be seen due to various factors like weight gain, variations in the neck circumference and TMD. As several indications

Table 3
Mallampati score at different stages of pregnancy

Mallampati score	Number of Patients (n=318)				
	1st Trimester	Pre-labor	During labor	24 h Post–Delivery	48 h Post–Delivery
Grade 1	161	104	103	103	107
Grade 2	143	131	129	130	133
Grade 3	14	65	68	67	62
Grade 4	–	18	18	18	16
P-values		$<0.0001^{\dagger, ***}$	$<0.0001^{\dagger, ***}$ $0.0898^{\ddagger}$	$<0.0001^{\dagger, ***}$ $0.1655^{\ddagger}$ $1^{\S}$	$<0.0001^{\dagger, ***}$ $0.0120^{\ddagger, *}$ $0.0004^{\S, ***}$ $0.0060^{\dagger\dagger, **}$

, ** and * significant; † indicates comparison of 1st trimester with pre-labor, during labor, 24 h post-delivery and 48 h post-delivery; ‡ indicates comparison of pre-labor with during labor, 24 h post-delivery and 48 h post-delivery; § indicates comparison of during labor with 24 h and 48 h post-delivery and †† indicates comparison between 24 h post-delivery and 48 h post-delivery.*

for general anesthesia still prevail in the obstetric population, the incidence of failed intubation remains high. Hence, it is important to evaluate the MP score especially prior to induction of anesthesia to avoid failed intubation. Assessment of MP score aids the anesthesiologist in identifying plausible risk of difficult intubation. This information is important to the anesthetic team during set up for a case and will influence the choice of equipment prepared for airway management.

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