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ORIGINAL ARTICLE

Airway changes in pregnant women before and after delivery

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Abstract
Aim High incidence of difficult or failed intubation in obstetric patients is still a major problem to challenge anaesthesiologists. Although the probability of difficult intubation is impossible to predict preoperatively, some simple, practical bedside tests may help. This study used five simple tests in an attempt to better evaluate airway changes in pregnant women before and after delivery.
Materials and methods Pregnant women from the ASA I–II group who were planning to undergo a normal vaginal delivery were evaluated as to the possibility of experiencing difficult intubation. Mallampati scores, thyromental distance, sternomental distance, mouth opening, and the degree of neck extension were recorded just before delivery and 24 h after delivery.
Results Significant differences were seen in the pre- and post-delivery measurements ($p < 0.05$). Before delivery, Mallampati scores I, II, III, IV were 35, 24, 2, 0, respectively, and 24 h after delivery became 46, 15, 0, 0, respectively.
Conclusions Within 24 h after delivery, Mallampati scores changed in one-third (*n* 21, 36.6 %) of the patients. Significant differences between the two measurements of thyromental and sternomental distances, mouth opening, and the degree of neck extension confirm difficult airway management in pregnant women.

Keywords Airway changes · Pregnancy · Difficult intubation · Delivery · Anaesthesia · Obstetric

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Introduction

Nowadays, the most popular methods for anaesthetic management of parturient patients are regional anaesthetic techniques since they can provide excellent analgesia and anaesthesia with few maternal side effects and little or no neonatal depression. In some pregnant women, however, general anaesthetic management may be applied, for e.g. when probable difficult intubation could become a major problem. Airway management in pregnant women is more difficult than in the normal patient population and the incidence of failed intubation is higher in this patient group [1, 2].

Possible causes for difficulty in ventilation, laryngeal mask insertion, and intubation in pregnant women are weight gain, enlarged breasts and increased anteroposterior diameter of the chest, increased water retention, and changes of Mallampati scores during pregnancy [3–6]. When intubating a parturient, viewing her oropharyngeal area is more difficult. The risk of traumatizing the oropharynx is higher due to oedema in the upper airway, oedema contributed to by an increased oestrogen level and

increased blood volume. Increased deposition of fat in the body also leads to increased fat around the neck.

In this study, we aimed to evaluate airway changes in pregnant women with five practical bedside tests which can be easily performed both before and after delivery.

Materials and methods

After gaining approval from the ethics committee, we explained the study to the parturients and received their informed written consent. Included in our study were 61 monofetal pregnant women of 37 weeks gestation from the ASA I−II group who were planning vaginal delivery. Their ages ranged from 17 to 39 years. Excluded from our study were patients planning to have a caesarean for any reason, patients from the ASA III−IV group, those with a multifetal pregnancy, and those who were uncooperative.

Our patients were given no obstetric (e.g., spinal or epidural) analgesic management. Just before entering the delivery room, each patient in the early active labour stage with 2−3 cm cervical dilation was asked her age, height, and weight before pregnancy. In standing position, her current weight was measured and noted. As she remained standing, a senior anaesthesiologist (DA) next evaluated her Mallampati scores and mouth opening. In the delivery room, she (DA) measured the now supine patient for thyromental distance (from the thyroid notch to the mental protuberance) and sternomental distance (from the sternal notch to the mental distance). The interincisor gap was used to access mouth opening. Also measured was the degree of neck extension, i.e., the angle between the horizontal plane and a line linking the angle of mouth and the tragus of the ear.

After 24 h, the same anaesthesiologist (DA) again measured, evaluated, and noted the patient's weight, Mallampati score, thyromental and sternomental distances, mouth opening, and the degree of neck extension.

SSPS 15.0 was used to analyse the data. The paired *t* test was used for normally distributed matched groups. The Wilcoxon test was used for the matched groups which were not normally distributed.

For normally distributed data, repeated measures ANOVA was used for repeated measurements. The Friedman test was used for normally distributed data. Determination of statistical significance was set at $p < 0.05$.

Based on a presumed significant difference in difficult intubation criteria between the prepartum and postpartum states, a sample size of 61 pregnant patients is sufficient to satisfy power calculations ($\alpha = 0.05$ and $\beta = 0.20$) and to disprove a null hypothesis that difficult intubation criteria do not differ in the prepartum and postpartum state.

Table 1 Significant differences seen in parturients' weights before and after delivery

	Mean ± SD	*P*
Age (years)	25.54 ± 7.8	>0.05
Height (cm)	161.41 ± 11.06	>0.05
Weight (kg, before pregnancy)	59.82 ± 11.32	<0.01
Weight (kg, before birth)	72.95 ± 8.2	<0.01
Weight (kg, after birth)	66.56 ± 6.3	<0.01

Table 2 The relationship between the measurements before delivery and the measurements of 24 h after delivery

	Before birth (mean ± SD)	After birth (mean ± SD)	*P*
Thyromental distance (cm)	9.86 ± 1.57	10.18 ± 1.61	<0.01
Sternomental distance (cm)	17.26 ± 2.21	17.62 ± 2.08	<0.01
Mouth opening (cm)	5.74 ± 0.78	6.10 ± 0.75	<0.01
The degree of neck extension	83.82 ± 10.87	90.00 ± 8.80	<0.05
Mallampati (I, II, III, IV)	(35, 24, 2, 0)	(46, 15, 0, 0)	<0.05

Results

Each participant's age, height, and weight before and after pregnancy are shown in Table 1. Measurements of mouth opening, sternomental distance, thyromental distance, and the degree of neck extension before and after delivery were all found to differ to a statistically significantly degree (Table 2, $p < 0.05$). Measurements of weight before and after delivery were also significantly different ($p < 0.05$).

Conclusions

At two different times in this study, we evaluated airway changes in pregnant women who underwent vaginal deliveries. In the early active labour stage (cervical dilatation 2−3 cm) and 24 h after birth, we recorded changes in their Mallampati scores as well as thyromental and sternomental distances, mouth opening, and the degree of neck extension. We found statistically significant regression in all measurements taken 24 h after delivery, particularly in Mallampati scores. Sternomental and thyromental distances, mouth opening, and the degree of head extension significantly increased by the time of the second measurements 24 h after birth. Our study confirms a resolution of airway oedema after delivery.

In the past 12 years, Hawkins and his colleagues studied 129 cases of maternal deaths. The subjects had been under

general anaesthesia management for caesarean delivery. The vast majority of those deaths was caused by unsuccessful airway management, such as inability to adequately ventilate, difficulty in intubation, and aspiration problems [7].

Airway management of obstetric patients is relatively difficult for various reasons. For example, soft tissue changes during pregnancy may lead to difficult intubation. Also, weight gain during pregnancy and increased fat deposition around the neck decreases the degree of neck extension. In addition, enlarged breasts sometimes lead to improper positioning of a laryngoscope.

Upper airway oedema and fragility are among the other factors which can lead to difficult intubation, because viewing the oropharynx becomes more difficult and the risk of traumatizing the oropharyngeal mucosa is relatively higher. Some studies show a gradual reduction of colloid osmotic pressure during pregnancy [8]. Moreover, oestrogen reduces the escape of albumin from capillary endothelium, which leads to an expansion of the plasma volume of upto 21 % [9]. Increase of maternal blood volume caused by sodium retention from the effect of the renin–angiotensin–aldosterone system, plus water retention of upto 8.5 L, leads to reduction in colloid osmotic pressure and increased hydrostatic pressure leading to airway oedema [10].

With decreased osmotic pressure, pushing and straining during delivery can increase intracapillary pressure which may also lead to airway oedema [4]. It is, however, difficult to verify whether pushing and straining during delivery increases airway oedema or not [4].

Guru et al. [11] found that changes of Mallampati scores were not affected by epidural analgesia during labour. In our study, we did not apply any techniques of obstetric analgesia to our patients.

Kodali et al. [4] showed that labour and delivery decreases pharyngeal volume probably due to airway oedema. Our findings support theirs.

Difficult intubation is impossible to verify. We can only predict difficult intubation. For this purpose, upper airway anatomy should be examined carefully before determining a specific anaesthetic management. Sometimes alternative tests are necessary to compare to routinely used techniques. One measuring instrument used for this purpose is an acoustic reflectometre. Kodali et al. studied pregnant women at the stage when their cervical dilatation was 2–3 cm. In the first group, they used modified Mallampati scores [4]. Immediately after birth, an increase in Mallampati score I occurred in 33 % of the patients and II in 5 % of the patients. In the second group, they used an acoustic reflectometre to measure the volume of the oral cavity and thereby identified significant reduction in oral volume immediately after birth.

Studies revealed that during pregnancy Mallampati scores change in one-third of parturients. Boutonnet et al. [5] recorded airway changes of 87 pregnant women at four different times: at the eighth month of pregnancy (T1), after epidural catheterization (T2), 20 min after delivery (T3), and 48 h after delivery (T4). They evaluated Mallampati score changes and found increases between T1−T2 and T2−T3; however, Mallampati scores decreased between T3 and T4.

One limitation of our study was that, not being a blinded study, it was open to observer bias. In addition, we did not have any laryngoscope view. We used five simple bedside tests which can be easily performed within a few minutes. Further studies could, with photographic imaging, evaluate the laryngeal view changes in pregnant women immediately before and after the delivery period.

In conclusion, special attention should be given to airway changes in the pregnant population. This study should heighten awareness of the need to evaluate the airway fully before deciding upon an anaesthetic intervention. In addition, a rapid improvement in airway conditions following delivery has been verified.

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