Original Article

Assessment of airway parameters in obstetric patients and comparing them at different phases in the perinatal period: A prospective observational study

Address for correspondence:
Dr. Kiranpreet Kaur,
52/9 J, Medical Campus,
Rohtak - 124 001, Haryana,
India.
E-mail: kiranpreet72@rediffmail.com

Submitted: 03-Aug-2023
Revised: 01-Oct-2023
Accepted: 02-Oct-2023
Published: 21-Nov-2023

Access this article online

Website: https://journals.lww.com/ijaweb

DOI: 10.4103/ija.ija_675_22

Quick response code

Kiranpreet Kaur, Vaishali, Pushpa Dahiya[1], Svareen Kaur[2], Mamta Bhardwaj, Suresh K. Singhal

Departments of Anaesthesiology and Critical Care, [1]Obstetrics and Gynaecology, Pt. B.D. Sharma PGIMS, Rohtak, Haryana, [2]Dr. Baba Saheb Ambedkar Govt. Medical College, Rohini, Delhi, India

ABSTRACT

Background and Aims: Airway changes occur in different stages of pregnancy. We aimed to evaluate the changes in the upper airway in obstetric patients during pregnancy, labour and after delivery using multiple airway indices and identify the predictive factors of these changes. **Methods:** This observational study was conducted on 90 parturients aged >20 years, having monofoetal pregnancy. The patient's weight was noted, airway assessment including Mallampati grading (MPG), and thyromental distance (TMD), sternomental distance (SMD), neck circumference (NC) and Wilson's risk score were measured in the second trimester of pregnancy (T_0), between 32 and 34 weeks of gestation (T_1), at the time of admission for safe confinement, between 38 and 40 weeks of gestation (T_2), 2 h after delivery of baby (T_3) and, 24 h after delivery (T_4). Unpaired *t*-test and analysis of variance test were applied. **Results:** Changes in mean (standard deviation [SD]) weight, recorded from T0 to T2, were from 56.96 (10.77) to 65.322 (11.49) kg ($P = 0.001$). A rise of one or two grades in MPG was detected as the pregnancy progressed, and a decrease of one grade was noted after delivery. A significant decrease in mean (SD) TMD was noted from 6.88 (0.65) to 6.36 (0.62) cm from T0 to T2 ($P = 0.001$). SMD also decreased in a similar manner as TMD. NC increased from T0 to T3 and then decreased at T4 ($P = 0.004$). **Conclusion:** Following the second trimester of pregnancy, MPG increased by either one or two grades, with a decrease in TMD and SMD and an increase in NC.

Keywords: Airway changes, delivery, labour, Mallampati grading, neck circumference, pregnancy, sternomental distance, thyromental distance

INTRODUCTION

The airway oedema and increased fat deposition around the neck during pregnancy and labour result in failed tracheal intubation, eight times higher in the pregnant population than in the non-pregnant population.[1-5] Various screening tools are available to evaluate difficult laryngoscopy and tracheal intubation.[2,6] Most studies have evaluated one or two airway parameters predominantly in preeclamptic parturients.

The present study aimed to assess the changes in upper airway and airway indices in obstetric patients and identify the predictive factors for changes in airway parameters. The study's primary objective was to assess the variation in Mallampati grading (MPG) during pregnancy, labour and after delivery. Secondary

How to cite this article: Kaur K, Vaishali, Dahiya P, Kaur S, Bhardwaj M, Singhal SK. Assessment of airway parameters in obstetric patients and comparing them at different phases in the perinatal period: A prospective observational study. Indian J Anaesth 2023;67:S268-73.

objectives were to evaluate other airway parameters like thyromental distance (TMD) and sternomental distance (SMD) and correlate airway changes with weight gain during pregnancy and duration of labour.

METHODS

This prospective observational study was conducted on 90 obstetric patients above the age of 20 years, having monofoetal pregnancy and belonging to the American Society of Anesthesiologists physical status II. The study was conducted at a tertiary care teaching hospital from September 2021 to May 2022 after receiving approval from the institutional ethics committee (vide approval number BREC/Th/20/Anaesth02 dated 1 April 2021) and following registration with the Clinical Trials Registry-India (vide registration number CTRI/2021/08/035902, www.ctri.nic.in). The study followed the principles of the Declaration of Helsinki, 2013 and is reported in accordance with the guidelines for reporting observational studies (Strengthening the Reporting of Observational Studies in Epidemiology [STROBE]). Informed consent was obtained from all the participants to participate in the study and use the patient data for research and educational purposes. Patients with a history of hypertensive disorders of pregnancy, multifoetal pregnancy, neck and oral pathology and mouth opening <2.5 cm were excluded from the study. Patients' weight was noted, and airway assessment, including MPG and landmark-guided measurement of TMD and SMD, were done. TMD (measured in cm as the distance from the tip of the thyroid cartilage to the tip of the mentum with the neck fully extended), SMD (measured in cm from the upper border of the manubrium to the tip of the mentum with the neck fully extended), neck circumference (NC) and Wilson's risk score were noted at five time intervals. The first reading (T_0) was taken in the second trimester of pregnancy when the patient was recruited in the outpatient clinic of the obstetrics department. The patient's age and height were also noted on the first visit. Subsequently, the patient's weight measurement and airway assessment were done between 32 and 34 weeks of gestation, when the patient visited the antenatal clinic for follow-up (T_1), at the time of admission for safe confinement, between 38 and 40 weeks of gestation (T_2), 2 h after delivery (T_3) and finally 24 h after delivery (T_4). The duration of the first and second stages of labour and the total amount of fluid administered during labour were also recorded.

The study's primary outcome was to assess the variation in MPG during pregnancy, labour and after delivery. The secondary outcome was to correlate airway changes with weight gain during pregnancy, duration of labour and fluid administered. Based on a previous study, the proportion of patients with MPG changes was 67%.[7] Therefore, assuming the proportion of patients with MPG changes (p) = 67% with a 10% margin of error, the minimum required sample size at a 5% level of significance was 90 patients. Analysis was done using Statistical Package for the Social Sciences version 20 (International Business Machines SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included the computation of percentages, mean and standard deviation (SD). Pearson's correlation test was used for quantitative data (age, weight and height) to assess the correlation between all observed airway parameters. The level of significance was set at $P \leq 0.05$.

RESULTS

Out of 140 patients assessed for eligibility, 10 were excluded due to the development of pregnancy-induced hypertension (PIH). Among the 130 patients enroled, 40 patients could not be followed up due to delivery at a different hospital or due to caesarean section [Figure 1]. The mean (SD) age and height of the patients enroled in the study were 25.44 (4.61)

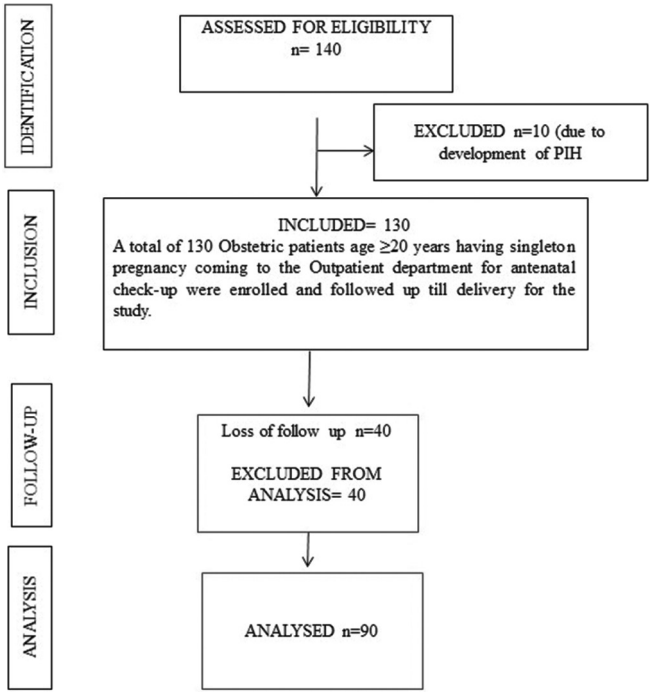

Figure 1: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) flow diagram, PIH:Pregnancy induced hypertension

years and 154.79 (5.85) cm, respectively. Changes in MPG were observed at five different intervals [Table 1]. Changes in mean weight, TMD, SMD and NC were found to be statistically significant [Table 2]. A significant difference in mean weight was observed from T0 to T1 with a mean difference of −6.3 kg (95% confidence interval [CI] −5.9, −6.9); between T0 and T2, this difference was −8.3 kg (95% CI −7.6, −8.9). Maximum increase in weight was observed from T0 to T2 [Table 2]. Outcomes and estimation for the primary and secondary outcomes are shown in Table 3. Wilson's risk sum score was calculated, and a maximum score of 4 was recorded [Table 1]. An increase in score was observed till T2; after that, it started decreasing at T3 and T4, which was statistically non-significant. The first stage of labour lasted for 17.57 (2.42) h (95% CI 16.14, 18.47), while the second stage lasted till 60.1 (12.1) min (95% CI 52.3, 68.7) min. Intravenous (IV) fluid was supplemented in 32 (35.5%) patients. On average, 500 ml of fluid was administered. The rest of the 58 (64.5%) patients were managed on oral fluid, according to the standard protocol being followed at our institute. IV fluids were administered only to the patients who did not accept oral intake.

DISCUSSION

MPG noted in the present study increased as the pregnancy progressed, then began to fall after delivery. Most patients (55%) had MPG I in the second trimester, and as the pregnancy progressed, MPG changed to II and III till delivery. MPG increased to the next level in most individuals after 38–40 weeks. The highest variation in MPG was observed just before term or during active labour. The increase in MPG can be attributed to increased soft tissue volume, presumably due to pharyngeal oedema, fluid retention and weight gain in pregnancy.[3,7]

The findings of Das *et al*.,[7] Aydas *et al*.,[8] Boutonnet *et al*.[9] and Shivashankar *et al*.[10] were similar to the current study regarding MPG change. However, there is variation among authors regarding the regression of MPG. In the present study, one-fourth of patients regressing to grade I were seen within 24 h following delivery. Aydas *et al*.[8] also noted statistically significant regression in MPG 24 h after delivery, but Boutonnet *et al*.[9] reported a decrease from 20 min to 48 h postdelivery. Das *et al*.[7] observed regression of MPG after 72 h. Contrasting observations of rising MPG after the first 24 h of delivery were made by Shivashankar *et al*.[10] compared to the present study.

A favourable association between the weight and MPG change was noted in the current study. A positive correlation indicates that weight gain may be a considerable factor causing airway oedema and changing MPG. Similar to the present study, a substantial correlation between pregnancy-related weight gain and airway alteration was reported by Shivashankar *et al*. [10] who found an increase in MPG of 1.4 times for every 1 kg of weight gain. Besides MPG, other airway assessment methods, TMD, SMD and NC, evaluated in our study, are important parameters in predicting airway changes in pregnancy.

The current study observed statistically significant changes in TMD, SMD and NC with advancing pregnancy. In contrast to the current investigation, Das *et al*.[7] reported no change in TMD. The present study and researchers extrapolated that TMD decreases as the pregnancy advances and increases

Table 1: Comparison of Mallampati grading and Wilson's risk sum score at different stages of pregnancy

Parameter	Time point	Mallampati grading				*P*
		1	2	3	4	
Time points	T0	50 (55.6)	33 (36.7)	7 (7.8)	0 (0.0)	0.001
	T1	9 (10.0)	56 (62.2)	25 (27.8)	0 (0.0)	
	T2	1 (1.1)	62 (68.9)	25 (27.8)	2 (2.2)	
	T3	6 (6.7)	65 (72.2)	19 (21.1)	0 (0.0)	
	T4	21 (23.3)	59 (65.6)	10 (11.1)	0 (0.0)	
Parameter	**Time point**	**Wilson's risk sum score**				***P***
		0	**1.0**	**2.0**	**3.0**	**4.0**	
	T0	38 (42.2)	25 (27.8)	19 (21.1)	4 (4.4)	4 (4.4)	0.530
	T1	28 (31.1)	24 (26.7)	21 (23.3)	13 (14.4)	4 (4.4)	
	T2	24 (26.7)	24 (26.7)	25 (27.8)	12 (13.3)	5 (5.6)	
	T3	30 (33.3)	24 (26.7)	24 (26.7)	7 (7.8)	5 (5.6)	
	T4	36 (40.0)	25 (27.8)	21 (23.3)	4 (4.4)	4 (4.4)	

T0 - second trimester of pregnancy; T1 - between 32 and 34 weeks of gestation; T2 - between 38 and 40 weeks of gestation; T3-2 h after delivery; T4 - 24 h after delivery

Table 2: Comparison of weight, thyromental distance, sternomental distance and neck circumference

Mean value	T0	T1	T2	T3	T4	*P*
Weight (kg)	56.96 (10.77) (54.70–59.22)	63.29 (11.32) (60.92–65.66)	65.32 (11.49) (62.91–67.73)	61.48 (10.98) (59.18–63.78)	61.48 (10.98) (59.18–53.78)	0.001
Thyromental distance (cm)	6.88 (0.65) (6.75–7.02)	6.64 (0.62) (6.509–6.77)	6.36 (0.6221) (6.23–6.49)	6.36 (0.61) (6.23–6.49)	6.70 (0.64) (6.57–6.84)	0.001
Sternomental distance (cm)	14.83 (1.63) (14.49–15.18)	14.51 (1.61) (14.17–14.85)	13.95 (1.38) (13.86–14.52)	14.24 (1.59) (13.86–14.52)	14.25 (1.62) (14.14–14.81)	0.003
Neck circumference (cm)	31.25 (2.59) (30.71–31.79)	31.31 (3.09) (31.11–32.36)	32.43 (2.70) (31.66–32.78)	32.43 (2.83) (31.66–32.78)	31.86 (2.69) (28.703–41.38)	0.004

Data are expressed as mean (standard deviation) (95% confidence interval). T0 - Second trimester of pregnancy; T1 - Between 32 and 34 weeks of gestation; T2 - Between 38 and 40 weeks of gestation; T3 - 2 h after delivery; T4 - 24 h after delivery

Table 3: Outcomes and estimation for primary and secondary outcomes

	Odds ratio (95% confidence interval)	*P*
(Constant)	1.440 (−0.384, 3.265)	0.120
Weight	0.015 (0.002, 0.029)	0.020
Thyromental distance	−0.145(−0.397, 0.107)	0.256
Sternomental distance	0.017 (−0.096, 0.130)	0.765
Neck circumference	0.020 (−0.037, 0.077)	0.484
Score	0.006 (−0.09, 0.101)	0.900

following delivery.[8,10] Water retention and weight gain could contribute to a decrease in TMD.[8] Aydas *et al*.[8] determined a substantial change in SMD before and after delivery, consistent with the current investigation ($P < 0.01$). Similar to the current study, a highly significant correlation between NC and changes in the airways was noted by Shivashankar *et al*.[10] They observed that an increase in NC/cm affects MPG and increases the likelihood of getting an MP score of 3–4 by 1.55 times. Das *et al.*,[7] in contrast to the findings of the present investigation, found no significant change in NC during pregnancy. The present study and other authors concluded that weight gain was the most important factor causing changes in airway parameters like MPG, TMD, SMD and NC.[8]

In the current study, Wilson's score showed non-significant changes with advancing pregnancy. Gupta *et al*.[11] compared MPG and Wilson's risk sum in obstetric patients. They observed that the combined Wilson's score and MPG tests were 100% sensitive predictors for difficult airways.

We observed no significant relation between IV fluid administration and duration of labour with airway changes. Numerous authors claimed that the straining during labour, as well as IV fluids, worsen airway oedema. Das *et al*.[7] observed that cases in active labour had a change of MPG by two grades (43.4%), in contrast to those without active labour (16.6%). They cited a linear relationship between active labour and the extent of changes in MPG.[3,7,9] In contrast, Kodali *et al*.[3] and Das *et al*.[7] found that IV fluid administration resulting in fluid retention contributes to changes in MPG.

Weight and other airway measures, such as MPG, TMD, SMD and NC, were significantly correlated at different intervals [Table 4]. In addition, TMD and SMD had a strong association. Weight gain, water retention and pharyngeal oedema are the major factors contributing to airway changes in pregnancy.

Table 4: Correlation between the airway parameters

	Weight (kg)	Mallampati grading	Thyromental distance (cm)	Sternomental distance (cm)	Neck circumference (cm)
T2					
Weight (kg)					
Pearson correlation	1	0.395	0.202	0.279	0.656
P	-	<0.001	0.056	0.008	<0.001
Mallampati grading					
Pearson correlation	0.395	1	−0.072	0.154	0.293
P	<0.001	-	0.498	0.149	0.005
Thyromental distance (cm)					
Pearson correlation	0.202	−0.072	1	0.527	0.072
P	0.056	0.498	-	<0.001	0.502
Sternomental distance (cm)					
Pearson correlation	0.279	0.154	0.527	1	0.192
P	0.008	0.149	<0.001	-	0.070
Neck circumference (cm)					
Pearson correlation	0.656	0.293	0.072	0.192	1
P	<0.001	0.005	0.502	0.070	-
T3					
Weight (kg)					
Pearson correlation	1	0.521	0.202	0.199	0.611
P	-	<0.001	0.056	0.060	<0.001
Mallampati grading					
Pearson correlation	0.521	1	−0.049	0.012	0.447
P	<0.001	-	0.645	0.911	<0.001
Thyromental distance (cm)					
Pearson correlation	0.202	−0.049	1	0.668	0.031
P	0.056	0.645	-	<0.001	0.769
Sternomental distance (cm)					
Pearson correlation	0.199	0.012	0.668	1	0.083
P	0.060	0.911	<0.001	-	0.438
Neck circumference (cm)					
Pearson correlation	0.611	0.447	0.031	0.083	1
P	<0.001	<0.001	0.769	0.438	-
T4					
Weight (kg)					
Pearson correlation	1	0.272	0.225	0.361	0.657
P	-	0.009	0.030	<0.001	<0.001
Mallampati grading					
Pearson correlation	0.272	1	0.009	0.110	0.163
P	0.009	-	0.933	0.302	0.125
Thyromental distance (cm)					
Pearson correlation	0.225	0.009	1	0.609	0.094
P	0.030	0.933	-	<0.001	0.377
Sternomental distance (cm)					
Pearson correlation	0.361	0.110	0.609	1	0.268
P	<0.001	0.302	<0.001	-	0.010
Neck circumference (cm)					
Pearson correlation	0.657	0.163	0.094	0.268	1
P	<0.001	0.125	0.377	0.010	-

T2 - between 38 and 40 weeks of gestation; T3 - 2 h after delivery; T4 - 24 h after delivery

The patients in the study had a normal delivery, so the association with Cormack Lehane grading was not done in the research. Regression of the airway parameter to the basal level could not be noticed because most patients who had uneventful deliveries were discharged after 24 h.

CONCLUSION

A substantial shift in MPG to one or two higher grades was noted following airway assessment with advancing pregnancy. On evaluating other airway parameters, a decrease in TMD and SMD and an increase in NC were

observed. These alterations could be attributed to fluid retention and weight gain. To conclude, the airway parameters deteriorate as the pregnancy advances, necessitating more frequent airway assessments by anaesthesiologists before any intervention.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval as per the authors' institution policy.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

ORCID:

Kiranpreet Kaur: https://orcid.org/0000-0003-3592-0061

Pushpa Dahiya: https://orcid.org/0000-0003-4523-3310

Svareen Kaur: https://orcid.org/0000-0001-9154-7439

Mamta Bhardwaj: https://orcid.org/0000-0002-3942-3268

Suresh K. Singhal: https://orcid.org/0000-0002-8993-9924

REFERENCES

1. Raza D, Ismail S. Change in Mallampati class during labour: Hypertensive versus normotensive parturients. Acta Anaesthesiol Scand 2018;62:1086-91.
2. Ahuja P, Jain D, Bhardwaj N, Jain K, Gainder S, Kang M. Airway changes following labor and delivery in preeclamptic parturients: A prospective case control study. Int J Obstet Anaesth 2018;33:17-22.
3. Kodali BS, Chandrasekhar S, Bulich LN, Topulos GP, Datta S. Airway changes during labor and delivery. Anesthesiology 2008;108:357-62.
4. Khan FA. Airway and obstetric anesthesia: A review. Anaesth Pain Intensive Care 2014;18:397-404.
5. Bhatia P, Chhabra S. Physiological and anatomical changes of pregnancy: Implications for anaesthesia. Indian J Anaesth 2018;62:651-7.
6. Li Y, Li Y, Chen Q, Hua H, Jiao J Zhang L, *et al*. The effect of first trimester body mass index on the changes in the upper lip bite test classification before and after delivery: A prospective observational study. Front Med 2022;9:969862.
7. Das AK, Sabharwal N, Kumar M. Airway changes before and after delivery-does labour has any effect on the modified mallampati score? J Obstet Anaesth Crit Care 2021;11:90-5.
8. Aydas AD, Basaranoglu G, Ozdemir H, Dooply SL, Muhammedoglu N, Kucuk S, *et al*. Airway changes in pregnant women before and after delivery. Ir J Med Sci 2015;184:431-3.
9. Boutonnet M, Faitot V, Katz A, Salomon L, Keita H. Mallampati class changes during pregnancy, labour and after delivery: Can these be predicted? Br J Anaesth 2010;104:67-70.
10. Shivashankar A, Rajappa GC, Rath P, Deepak KS. Change in mallampati score during pregnancy, labour and post labour: An observational study. Sri Lankan J Anaesthesiol 2021;29:13-7.
11. Gupta S, Pareek S, Dulara SC. Comparison of two methods for predicting difficult intubation in obstetric patients. Middle East J Anaesthesiol 2003;17:275-85.