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OBSTETRICS

Mallampati class changes during pregnancy, labour, and after delivery: can these be predicted?

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Background. An increase in Mallampati class is associated with difficult laryngoscopy in obstetrics. The goal of our study was to determine the changes in Mallampati class before, during, and after labour, and to identify predictive factors of the changes.

Methods. Mallampati class was evaluated at four time intervals in 87 pregnant patients: during the 8th month of pregnancy (T_1), placement of epidural catheter (T_2), 20 min after delivery (T_3), and 48 h after delivery (T_4). Factors such as gestational weight gain, duration of first and second stages of labour, and i.v. fluids administered during labour were evaluated for their predictive value. Mallampati classes 3 and 4 were compared for each time interval. Logistic regression was used to test the association between each factor and Mallampati class evolution.

Results. Mallampati class did not change for 37% of patients. The proportion of patients falling into Mallampati classes 3 and 4 at the various times of assessment were: T_1, 10.3%; T_2, 36.8%; T_3, 51.7%; and T_4, 20.7%. The differences in percentages were all significant ($P<0.01$). None of the evaluated factors was predictive.

Conclusions. The incidence of Mallampati classes 3 and 4 increases during labour compared with the pre-labour period, and these changes are not fully reversed by 48 h after delivery. This work confirms the absolute necessity of examining the airway before anaesthetic management in obstetric patients.

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The Mallampati classification is a valuable estimate of the tongue size relative to the oral cavity.[1] The use of the Mallampati class alone has limited discriminative power for difficult laryngoscopy, defined as the impossibility for an experienced clinician to visualize the larynx in an appropriately positioned patient, with optimal external laryngeal manipulation, blade type, and blade size. However, when performed properly, Mallampati classification is a simple, reproducible, and reliable pre-anaesthetic airway assessment. In obstetric patients, Mallampati classes 3 and 4 are strongly associated with difficult laryngoscopy, with an increased relative risk of 7.6 and 11.3, respectively.[2] Pilkington and colleagues[3] reported an increase in the Mallampati class during the course of pregnancy. Two recent studies conducted by Kodali and colleagues[4] identified airway changes during labour and delivery, confirming previous anecdotal observations.[5] However, no study has reported the evolution of the Mallampati class in the same population of obstetric patients during pregnancy, labour, and after delivery. The goal of our study was to evaluate upper airway changes at each time point and to identify any predictive factors.

Methods

The approval of the Institutional Review Board (IRB) of Paris North Hospitals (Paris 7 University, AP-HP) was obtained for this prospective, observational study. Informed verbal consent was obtained from every parturient who participated in the study.

Pregnant women were recruited during a 4 month period in the labour suite of a teaching hospital where

2300 deliveries are performed each year. Informed consent was obtained from every patient before initiation of epidural analgesia. Inclusion criteria were age $\geq$18 yr, monofetal pregnancy at $\geq$37 weeks gestation, and epidural analgesia for childbirth. Exclusion criteria were non-French-speaking women, the absence of consent, multiple pregnancy, and anaesthesia consultation in which Mallampati class was not recorded. The Mallampati class was evaluated in the semisitting position, with the head in a neutral position, mouth opened as wide as possible, and without phonation, at four time points: during consultation for anaesthesia during the 8th month of pregnancy (T_1), placement of epidural catheter (T_2), 20 min after delivery (T_3), and 48 h after delivery (T_4). All patients were evaluated for Mallampati class by the same two practitioners. All evaluations at T_1 were performed by the same anaesthesiologist, while all T_2, T_3, and T_4 evaluations were performed by the second practitioner. The variables evaluated as potential predictive factors of Mallampati class evolution were:

(i) between T_1 and T_2: gain in body weight;
(ii) between T_2 and T_3: duration of first and second stages of labour, volume of i.v. fluids administered during labour;
(iii) between T_1 and T_4: duration of second stage of labour and volume of i.v. fluids administered during labour.

Data on parturients' characteristics, labour, and delivery were also collected either from parturients' medical files or by in-person interviews.

No modifications in the normal procedure for epidural placement or analgesic management were imposed by our study protocol. After establishing i.v. access, the heart rate, pulse oximetry, and non-invasive pressure were measured non-invasively throughout labour and delivery. The procedure for epidural placement was explained to the parturient, and a multi-orifice epidural catheter was inserted with the patient in a sitting position, using a 17 G Tuohy needle and the loss-of-resistance technique. Induction and maintenance of analgesia were managed according to institutional clinical protocols, using either continuous infusion of ropivacaine (2 mg ml^{-1})+ sufentanil (0.4 μg ml^{-1}) or parturient-controlled epidural analgesia with levobupivacaine (0.125 mg ml^{-1})+ sufentanil (0.5 μg ml^{-1}).

All data and statistical analyses were managed with SAS software (SAS v8.0, Cary, NC, USA).

Descriptive statistics are presented as mean (SD).

The McNemar test was used to compare Mallampati classes 3 and 4 at each time point. Logistic regression was used to test the association between each factor and Mallampati class evolution. The level of significance was set at $P<0.05$.

Results

Ninety women were offered enrolment; two refused to participate and one was not eligible because the Mallampati class at consultation with the anaesthesiologist was unavailable. Overall, 87 pregnant women were included in the study.

The mean age of the patients was 31.2 (5.2) yr, and the mean BMI before pregnancy was 23.9 (4.7) kg m^{-2}. Eight women (9.2%) were diagnosed with obesity before pregnancy and 21 (24.1%) were overweight. The patient characteristics are shown in Table 1.

Thirty-two (36.8%) women were nulliparous. Only three (3.4%) were diagnosed with pre-eclampsia; their Mallampati designations worsened from class 2 at T_1 to class 3 at T_2 and T_3, but returned to Mallampati class 2 at T_4. Nine patients (10.3%) underwent Caesarean delivery, two of them under general anaesthesia (both were grade 1 by Cormack and Lehane classification).[6] Obstetrical data are shown in Table 2.

The Mallampati class did not change for 32 women (36.8%), nine of the 26 Mallampati 1 patients (34.6%), 20 of the 52 Mallampati 2 patients (38.5%), and three of the nine Mallampati 3 patients (33.3%). For the remaining parturients, Mallampati class increased between T_1–T_2 and T_2–T_3 and decreased between T_3 and T_4.

The percentages of Mallampati classes 3 and 4 (grouped together here) were 10.3, 36.8, 51.7, and 20.7 at T_1, T_2, T_3, and T_4, respectively, and showed statistically significantly differences (T_1 *vs* T_2, P=0.0000; T_2 *vs* T_3, P=0.0005; T_3 *vs* T_4, P=0.0000; T_4 *vs* T_1, P=0.0062) (Fig. 1).

Discussion

This study has demonstrated an increase in the incidence of Mallampati classes 3 and 4 from the 8th month of pregnancy to the beginning of labour and during labour. These changes were not fully reversed up to 48 h after delivery.

Table 1 Patient characteristics. All values are presented as means (SD) or counts (%)

Patient characteristics (n=87)	
Age (yr)	31.2 (5.2)
Ethnicity	
Caucasian (%)	71 (81.6)
African (%)	8 (9.2)
Asian (%)	5 (5.7)
Caribbean (%)	2 (2.3)
Other (%)	1 (1.1)
Pre-pregnancy weight (kg)	64.2 (13.2)
Height (cm)	164.0 (6.3)
BMI (kg m^{-2})	23.9 (4.7)
<20 (%)	15 (17.2)
20–25 (%)	43 (49.4)
25–30 (%)	21 (24.1)
>30 (%)	8 (9.2)

These changes also occurred irrespective of any increase in body weight, duration of first and second stages of labour, or volume of i.v. fluid.

In a previous study, Pilkington and colleagues showed a substantial increase in the Mallampati class between 12 and 38 weeks gestation. The incidence of class 4 at 38 weeks averaged 34%. The investigators highlighted an association between airway change and gain in body weight during pregnancy.[3] We observed a 3.5-fold increase in patients with Mallampati class 3 or 4 at T_2 evaluation compared with T_1 ($P<0.05$), but we did not find that increased body weight was predictive for airway changes. The mean gain in body weight in the study by Pilkington and colleagues was about 11 kg, compared with 12.3 (5.8) kg in our study. The lack of correlation between gain in body weight and change in Mallampati class seen in our cohort may be explained by the fact that the first evaluation was performed at 12 weeks in the study by Pilkington and colleagues, but at 33.0 (2.2) weeks in our study. Thus, it is possible that the increases in Mallampati class related to increased body weight occur before 33 weeks of gestation.

In a recent study, Kodali and colleagues[4] reported rapid changes in Mallampati classification during labour and identified a 1.7-fold increase in Mallampati classes 3 and 4 in the post- *vs* pre-labour evaluation. The findings from our cohort agree well with these results, with a 1.4-fold higher frequency in Mallampati classes 3 and 4 when evaluated after delivery *vs* at the beginning of labour. Consistent with Kodali and colleagues' findings, we failed to identify any predictive factors for the increase in airway class. Because airway oedema can be augmented by fluid overload and prolonged Valsalva efforts, as described in previous case reports,[7] we hypothesized that the volume of i.v. fluids administered and durations of first and second stages of labour might be potential factors. However, none of these potential factors was predictive of Mallampati class changes in our study.

Lastly, we evaluated whether the Mallampati class changes reversed in the 48 h after delivery and whether the duration of second stage of labour and the volume of i.v. fluids administered during labour were predictive. Our results showed a trend towards decrease in Mallampati class in parturients with a Mallampati class 3 or 4 during labour, but the changes were not fully reversed even at 48 h post-labour; of patients who eventually reached Mallampati class 4, 21% were still ranked as such at 48 h post-labour, compared with 0% at their first evaluation (T_1). We could not identify any factor that predicted the absence of improvement in Mallampati class at 48 h after delivery.

Table 2 Obstetrical data. All values are presented as means (SD) or counts (%). T_2 refers to the time of epidural catheter placement

Obstetrical data (n=87)	
Gestational age (week)	39.8 (1.2)
Parity	
0 (%)	32 (36.8)
1 (%)	34 (39.1)
2 (%)	14 (16.1)
>2 (%)	7 (8.0)
Gestational age at consultation (week)	33.0 (2.2)
Gestational weight gain (kg)	12.3 (5.8)
Gestational pathology (%)	13 (14.9)
Hypertension	5 (5.7)
Diabetes	10 (11.5)
Pre-eclampsia	3 (3.4)
Cervical dilatation at T_2 (cm)	3.9 (1.6)
Average pain during labour (0–10)	2.4 (2.2)
Average pain during expulsion (0–10)	2.4 (2.9)
Oxytocin consumption (UI)	9 (4.9)
Fluids administered during labour (ml)	1864.9 (709.0)
Duration of first stage of labour (min)	409.3 (197.2)
Duration of second stage of labour (min)	17.8 (15.0)
Spontaneous vaginal delivery (%)	58 (66.7)
Instrumental vaginal delivery (%)	20 (23.0)
Caesarean (%)	9 (10.3)

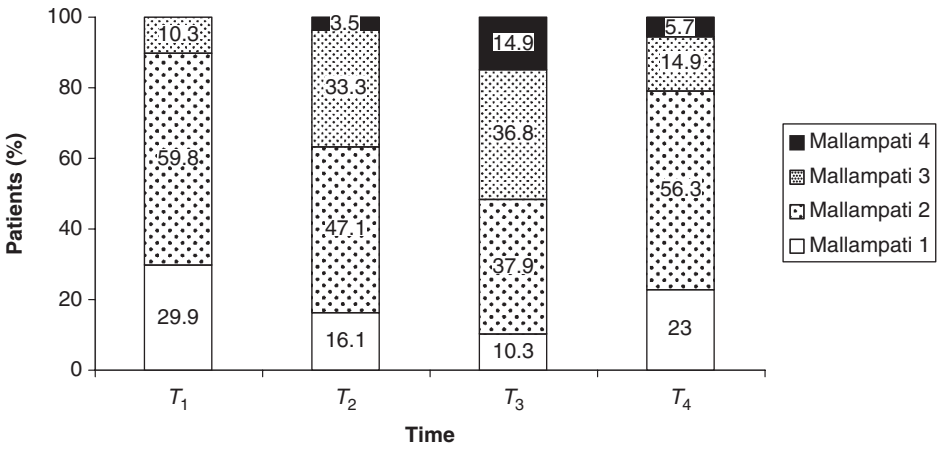

Fig 1 The Mallampati classes at different time points. T_1, 8 months of pregnancy; T_2, during labour; T_3, 20 min after delivery; T_4, 48 h after delivery. The percentages of patients with Mallampati class 3 or 4 changed significantly: T_1 *vs* T_2, P=0.0000; T_2 *vs* T_3, P=0.0005; T_3 *vs* T_4, P=0.0000; T_4 *vs* T_1, P=0.0062.

The very low incidence of pre-eclampsia (3/87) in our sample prevents us from analysing this subgroup. However, fluid retention is a cardinal feature of pre-eclampsia and may be an underlying contributor to airway oedema. Several earlier publications have stressed the possible association between airway oedema and pre-eclampsia.[8–10] The Mallampati classes in our three pre-eclamptic patients worsened from class 2 at T_1 to class 3 at T_2 and T_3 and returned to class 2 at T_4. Further studies are required to evaluate airway changes in this particular population.

In order to minimize inter-observer bias,[11] the three later evaluations were all performed by a single evaluator, whereas all the consultations were performed by a single anaesthetist. Therefore, the second evaluator was not blinded to previous Mallampati class and time of assessment; this is admittedly a study limitation. On the other hand, the use of photographs in order to blind the evaluator, as proposed in several studies,[3 4] would introduce unwarranted and excessive bias, because providing just one view of the airway (not necessarily the best view) would prevent the anaesthesiologist from selecting the best view of the airway and could falsely increase the Mallampati class.

We also chose a neutral position for the head because our aim was to maximize the reproducibility of the Mallampati evaluation. Since the ability to extend the neck varies, a consistent neutral position seemed preferable.

In conclusion, our study confirms the frequent increase in Mallampati class during the course of pregnancy and labour. These changes may potentially occur in every pregnant woman, since no predictive factor could be identified. To our knowledge, this is the first publication that specifically documents the occurrence of these changes during the last weeks of gestation and demonstrates that they are not fully reversed by 48 h after delivery. These findings suggest that it is imperative for anaesthetists to re-evaluate the airway just before anaesthetic management in obstetric patients and up to 48 h after delivery.

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