Trends in Anaesthesia and Critical Care 24 (2019) 22–25

Contents lists available at ScienceDirect

Trends in Anaesthesia and Critical Care

journal homepage: www.elsevier.com/locate/tacc

New predictors of difficult intubation in obstetric patients: A prospective observational study

Anouar Jarraya [a, *], Doniyes Choura [a], Yosra Mejdoub [b], Manel Kammoun [a], Faiza Grati [a], kamel Kolsi [a]

[a] Anesthesiology Department, Hedi Chaker University Hospital, Sfax, Tunisia
[b] Statistics Department, Hedi Chaker University Hospital, Sfax, Tunisia

ARTICLE INFO

Article history:
Received 20 June 2018
Received in revised form
6 August 2018
Accepted 13 August 2018

1. Introduction

Failed airway management during obstetric anesthesia remains the most important cause of anesthesia related maternal morbidity and mortality [1]. The incidence of failed intubation among the pregnant population is estimated to be up to eight times that of the nonpregnant population [2]. Maintenance of the airway is often difficult to estimate [3] and unpredictable difficult intubation remains so frequent in obstetric anesthesia, which means that usual predictors (Mallampati, mouth opening and thyromental distance) are insufficient [4]. So, looking for new predictors, including the influence of pregnancy-related physiological, anatomical, and pathological changes seem to be essential.

This study was performed to assess the ability of new predictors like chest circumference to sternomental distance, weight gain during pregnancy and neck circumference that might identify women with a potential intubation difficulty prior to cesarean section.

2. Methodology

After Local Research Ethics Committee approval, we enrolled 143 patients in this prospective observational study conducted between March 2016 and June 2017 in the Hedi Chaker University Hospital in Tunisia. Written informed consent was obtained from all patients.

We included 18–40 years old patients, ASA I, II, or III class, undergoing cesarean section delivery under general anesthesia. The reasons of general anesthesia were: the patient refusal or contra-indicated or failed spinal anesthesia. Patients with an upper airway pathology (maxillofacial fractures or tumors), cervical spine fracture, and younger than 18 years, were excluded.

General anesthesia was induced with Propofol 4 mg/kg and succinylcholine 1 mg/kg as part of a crash induction without cricoid pressure.

Prior to tracheal intubation, the age, height, current weight, body mass index, weight gain during pregnancy and Mallampati class were noted.

Mallampati scores were as follows:

Mallampati I: soft palate, fauces, uvula and tonsillar pillars visible.

Mallampati II: soft palate, fauces and uvula visible.

Mallampati III: soft palate and base of uvula visible.

Mallampati IV: soft palate not visible.

Parity and gestation were also recorded. Mouth opening was assessed using the maximal interincisor gap. Sternomental distance and thyromental distance were measured with a graduated tape in sniffing of morning air position. Sternomental distance was from the sternal notch to the mental protuberance. Thyromental distance was from the thyroid notch to the mental protuberance. The chest (the widest at the nipple line) and neck circumference were measured in sitting position with the hands behind the head with a graduated tape.

Laryngoscopy was initially performed by two anaesthetists with more than 2 years of experience with a size 3 Macintosh laryngoscope and the view was graded according to Cormack and Lehane. The anesthesiologist who documented the laryngeal view by the Cormack-Lehane classification was blinded to preoperative airway assessment collected by another anesthesiologist to avoid observer bias.

Cormack and Lehane scores were as follows.

Cormack I: good view of glottis.

Cormack II: only posterior part of glottis seen.

Cormack III: only epiglottis is visible.

Cormack IV: epiglottis is not visible.

* Corresponding author.
E-mail address: dranouarjarraya1983@gmail.com (A. Jarraya).

https://doi.org/10.1016/j.tacc.2018.08.005

In case of failed intubation, anesthesia would be continued and LMA Fastrach® inserted and used as a guide for tracheal intubation. Then, if ventilation was possible, the LMA Fastrach® would be used for the rest of surgery. But in cases of impossible ventilation or vomiting or threatening hypoxia, the patient would be awakened.

Then, Patients were divided into two groups according to their Cormack laryngoscopic view.

- Group E (easy intubation/control group): for Cormack I or II.
- Group D (difficult intubation/case study group): for Cormack III or IV.

Sample size calculation was determined after a pilot study including 74 patients. The incidence of patients having a chest circumference to sternomental distance over 7 was 18% in group E versus 54% in group D. A sample of 30 patients in each group provides a study power of 85% and a 5% margin of error ($\alpha = 0.05$, $\beta = 0.15$) according to clinical Sample Size Calculator.

Data were analyzed using SPSS software (version 20.0, SPSS Inc., USA). The measured variables are expressed as median. Differences between the difficult and easy groups were analyzed using a binary univariate logistic regression model to determine the significant risk factors for difficult intubation. Then, all the significant variables from the previous step were entered into a binary multivariate logistic regression (forward-Wald) model to determine the independent risk factors for difficult intubation. The diagnostic performance of the significant risk factors was also assessed using the receiver-operating characteristic (ROC) curves. Then, we identified the adequate cut-off points by selecting the maximum specificity while sensitivity $\geq$70%. Variables which were significantly associated on univariate analysis were included in a stratified multivariate model to identify significant independent predictors of difficult intubation. A value of $p < 0.05$ was considered as significant.

3. Results

In this study, 143 women were recruited (31 cases in group D versus 112 in group E). None of the patients had a history of difficult intubation. No patient was excluded and none of the patients in the study had failed tracheal intubation. Binary univariate logistic regression comparing the two groups was presented in Table 1. The Mallampati score, the chest circumference to the sternomental distance, the weight gain during pregnancy and the neck circumference were independently associated with a difficult intubation revealed by Multivariate analysis (Odds ratio in Table 1). Fig. 1 shows the ROC curves for Thyromental distance, sternomental distance, mouth opening, Neck circumference, Chest circumference to sternomental distance and the Weight gain.

The cutoff points for difficult intubation were the Mallampati score of III or IV, the sternomental distance <13.8 cm, the neck circumference >39.5 cm, the chest circumference >97 cm, a ratio of chest circumference to sternomental distance >7.1 and weight gain during pregnancy >11.7 kg. Table 2 provides information on the accuracy of risk factors (sensitivity and specificity of each parameter).

4. Discussion

Our study showed that chest circumference to sternomental distance, weight gain during pregnancy and neck circumference may be good predictors of difficult intubation in the obstetric population as well as the Mallampati score. The assessment of these new predictors before anesthesia induction may allow us to avoid potential consequences of unpredictable difficult intubation [5]. It was reported that the incidence of failed obstetric intubation is widely higher than the non obstetric population [6,7]. This may be due to performance under stress that can be avoided by predicting difficult airway before anesthesia induction [8,9].

In our study, we looked for new predictors. We thought that physiological and anatomical pregnancy-related changes [10] like enlarged breasts, weight gain during pregnancy, airway oedema due to increased total body water [11] and changing Mallampati during labor [12], are on the basis of Poor view at laryngoscopy and so intubation difficulties [13]. The other parameters were taken from literature like Body mass index, thyromental distance [14], sternomental distance [15] and neck circumference [16,17].

Our results were comparable with previous studies concerning thyromental distance [14], sternomental distance [15] and neck circumference [17]. Concerning the Mallampati score that may increase more significantly in vaginal delivery than in cesarean section [18], it remains a good predictor for difficult intubation. It was also a predictor for failed intubation in obstetric patients, according to a British survey [8]. However, there is no previous study that used chest circumference or weight gain during pregnancy as predictors for difficult intubation in obstetrics which is the main benefit of our study.

The first limit of our study was the sample size which was limited because spinal anesthesia is actually the technique of choice for cesarean section delivery in our department [19]. The second

Table 1
Predictors for difficult intubation.

	Group E N = 112 (78%)	Group D N = 31 (21%)	P value	Odds Ratio 95% CI.
Age	30,02	31,74	0,166	–
Weight (Kg)	75 (54–110)	94 (56–110)	0.001	1.09 (1.05–1.13)
Size (cm)	166 (152–182)	166 (154–180)	0.453	
BMI (kg/m^2)	26 (19–41)	33 (23–43)	0.001	1.25 (1.14–1.38)
Thyromental distance (cm)	7 (4–12)	6,6 (4–9)	0.088	–
Sternomental distance (cm)	14,0 (11–19)	12.9 (9–19)	0.004	0.98 (0.96–1.02)
Mouth opening (cm)	4.1 (2,5–7)	4.0 (3–6)	0.029	0.94 (0.89–0.99)
Mallampati I-II/III-IV	94/18	11/21	0.001	9.49 (3.89–23.1)
Neck circumference (cm)	35 (16–53)	40.5 (30–47)	0.001	1.3 (1.16–1.46)
Chest circumference (cm)	93 (70–142)	108 (72–143)	0.001	1.06 (1.02–1.09)
CC/SMD	6.53 (4–11)	8.37 (5–13)	0.001	1.69 (1.27–2.23)
Weight gain (kg)	9 (2–20)	13 (2–19)	0.001	1.51 (1.25–1.81)

Data are presented as median (limits) and count as appropriate.
Effect sizes are presented as odds ratios with 95% Confidence interval.
P values are estimated using binary univariate logistic regression with categories pooled for presentation.
Odds ratio are estimated using binary multivariate (forward-Wald) to determine the independent risk factors for difficult intubation.
CC/SMD: chest circumference to the sternomental distance.

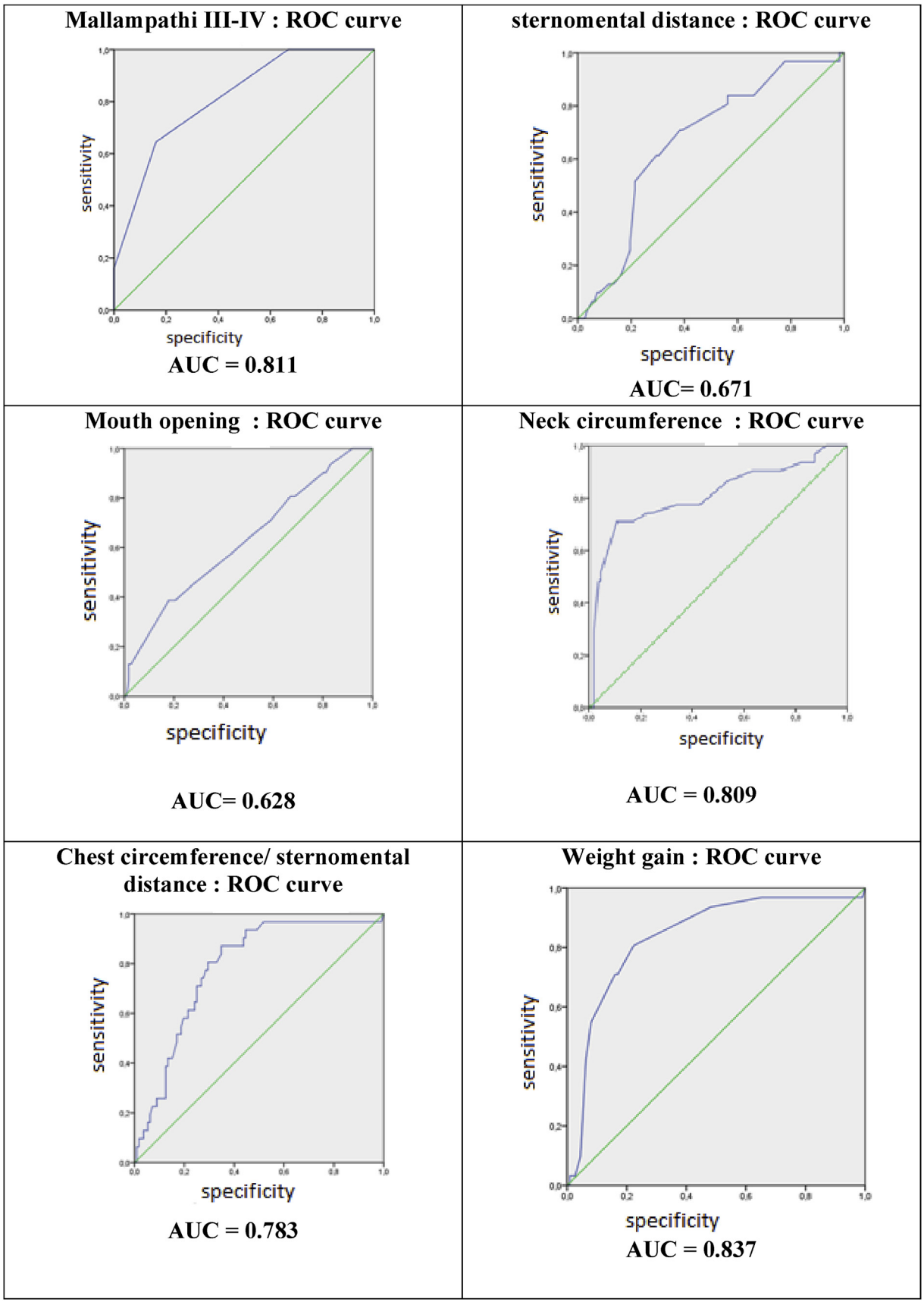

Fig. 1. ROC curve analysis of six different bedside screening tests for difficult intubation. Each receiver characteristic curve is expressed as a solid line. AUC: area under the curve.

Table 2
Tests for difficult intubation. Values expressed as percentages.

Variables	AUC	p	Cut-off	Sensitivity (%)	Specificity (%)
Thyromental distance (mm)	0.599	0.088	–	–	–
Sternomental distance (cm)	0.671	0.004	13.8	71	61
Mouth opening (mm)	0.628	0.029	3.9	45	72.3
Neck circumference (cm)	0.809	$<10^{-3}$	39.5	71	89.3
Chest circumference (cm)	0.761	$<10^{-3}$	97.7	80.6	60
CC/SMD	0.783	$<10^{-3}$	7.1	80.6	70.5
Weight gain (kg)	0.837	$<10^{-3}$	11.7	71	83.9
Mallampathi score	0.811	$<10^{-3}$	III-IV	99%	64%

CC/SMD: chest circumference to sternomental distance.

limit is that we used crash induction without cricoid pressure because this might be a confounding factor in the outcome of our study and there is no scientific proof that this technique can reduce the risk of aspiration in the obstetric population [20]. Another limit of our study is that we included all cesarean section deliveries under general anesthesia and we did not specify the degree of emergency [21].

5. Conclusion

In the obstetric population the use of new predictors of difficult airway with the Mallampati score seems to be mandatory to reduce the incidence of unpredictable difficult intubation as well as its consequences. According to our study, chest circumference to sternomental distance ratio is a new method for predicting difficult intubation in obstetric patients when it exceeds to 7.1 and weight gain during pregnancy may lead to difficult laryngoscopic view when it exceeds to 11.7 Kg. The neck circumference can also predict difficult intubation when it exceeds to 39.5 cm.

Conflicts of interest

None.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.tacc.2018.08.005.

References

[1] U. Munnur, B. de Boisblanc, M.S. Suresh, Airway problems in pregnancy, Crit. Care Med. 33 (10) (2005) 259–268.
[2] E. Goldszmidt, Principles and practices of obstetric airway management, Anesthesiol. Clin. 26 (1) (2008) 109–125.
[3] K. Saravanakumar, G.M. Cooper, Failed intubation in obstetrics: has the incidence changed recently? Br. J. Anaesth. 94 (5) (2005) 690.
[4] A. Honarmand, M.R. Safavi, Prediction of difficult laryngoscopy in obstetric patients scheduled for caesarean delivery, Eur. J. Anaesthesiol. 25 (9) (2008) 714–720.
[5] R. Pollard, M. Wagner, K. Grichnik, B.C. Clyne, A.S. Habib, Prevalence of difficult intubation and failed intubation in a diverse obstetric community-based population, Curr. Med. Res. Opin. 33 (12) (2017) 2167–2171.
[6] E.A. Djabatey, P.M. Barclay, Difficult and failed intubation in 3430 obstetric general anaesthetics, Anaesthesia 64 (11) (2009) 1168–1171.
[7] J.L. Hawkins, J. Chang, S.K. Palmer, C.P. Gibbs, W.M. Callaghan, Anesthesia-related maternal mortality in the United States: 1979-2002, Obstet. Gynecol. 117 (1) (2011) 69–74.
[8] A.C. Quinn, D. Milne, M. Columb, H. Gorton, M. Knight, Failed tracheal intubation in obstetric anaesthesia: 2 yr. national case-control study in the UK, Br. J. Anaesth. 110 (1) (2013) 74–80.
[9] V. Ramkumar, E. Dinesh, S.R. Shetty, A. Shah, P. Kundra, S. Das, et al., All India Difficult Airway Association 2016 guidelines for the management of unanticipated difficult tracheal intubation in obstetrics, Indian J. Anaesth. 60 (12) (2016) 899–905.
[10] D. Thorin, P. Ravussin, P. De Grandi, Difficult intubation in obstetrics, Rev. Med. Suisse Romande 114 (7) (1994) 617–621.
[11] P. Ahuja, D. Jain, N. Bhardwaj, K. Jain, S. Gainder, M. Kang, Airway changes following labor and delivery in preeclamptic parturients: a prospective case control study, Int. J. Obstet. Anesth. 33 (2018) 17–22.
[12] M. Boutonnet, V. Faitot, A. Katz, L. Salomon, H. Keita, Mallampati class changes during pregnancy, labour, and after delivery: can these be predicted? Br. J. Anaesth. 104 (1) (2010) 67–70.
[13] M. Boutonnet, V. Faitot, H. Keïta, Airway management in obstetrics, Ann. Fr. Anesth. Reanim. 30 (9) (2011) 651–664.
[14] M. Safavi, A. Honarmand, N. Zare, A comparison of the ratio of patient's height to thyromental distance with the modified Mallampati and the upper lip bite test in predicting difficult laryngoscopy, Saudi J. Anaesth. 5 (3) (2011) 258–263.
[15] S. Prakash, P. Mullick, S. Bhandari, A. Kumar, A.R. Gogia, R. Singh, Sternomental distance and sternomental displacement as predictors of difficult laryngoscopy and intubation in adult patients, Saudi J. Anaesth. 11 (3) (2017) 273–278.
[16] W.H. Kim, H.J. Ahn, C.J. Lee, B.S. Shin, J.S. Ko, S.J. Choi, et al., Neck circumference to thyromental distance ratio:a new predictor of difficult intubation in obese patients, Br. J. Anaesth. 106 (5) (2011) 743–748.
[17] W. Riad, T. Ansari, N. Shetty, Does neck circumference help to predict difficult intubation in obstetric patients? A prospective observational study, Saudi J. Anaesth. 12 (1) (2018) 77–81.
[18] J. Hu, S. Huang, F. Tian, S. Sun, N. Li, Y. Xie, A comparison of upper airway parameters in postpartum patients: vaginal delivery vs. caesarean section, Int. J. Clin. Exp. Med. 7 (12) (2014) 5491–5497.
[19] A. Jarraya, J. Zghal, S. Abidi, M. Smaoui, K. Kolsi, Subarachnoid morphine versus TAP blocks for enhanced recovery after caesarean section delivery: a randomized controlled trial, Anaesth Crit Care Pain Med 35 (6) (2016) 391–393.
[20] H.J. Priebe, Obstetric tracheal intubation guidelines and cricoid pressure, Anaesthesia 71 (3) (2016) 345–346.
[21] G. Basaranoglu, M. Columb, G. Lyons, Failure to predict difficult tracheal intubation for emergency caesarean section, Eur. J. Anaesthesiol. 27 (11) (2010) 947–949.