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ORIGINAL ARTICLE

The performance of neck circumference and other airway assessment tests for the prediction of difficult intubation in obese parturients undergoing cesarean delivery [☆],[☆☆]

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ABSTRACT

Background: Pregnancy and obesity each increase the chance of difficult tracheal intubation. This study assessed the performance of the neck circumference and other bedside tests for predicting difficult intubation, and aimed to identify the optimal cutoff point of the test(s) with the highest performance.

Methods: Parturients with a body mass index ≥ 30 kg/m^2, undergoing a cesarean delivery employing conventional tracheal intubation, were enrolled. Preoperative neck circumference, sternomental distance and modified Mallampati test were examined. Difficult intubation was defined as intubation difficulty scale score ≥ 5.

Results: Five hundred and seventy parturients of mean body mass index 34.1 ($\pm$SD 3.8) kg/m^2 were recruited. The incidence of difficult intubation was 3.5%. The performance of the neck circumference test, conducted with the patient sitting or supine, and using the area under the receiver operating characteristic (ROC) curves, was 0.6 (95% CI 0.5 to 0.7) and 0.6 (95% CI 0.4 to 0.7) respectively. The area under the ROC for the modified Mallampati test was 0.6 (95% CI 0.5 to 0.7) and for the sternomental distance test was 0.7 (95% CI 0.6 to 0.8). A sternomental distance less than 14.5 cm, and a ratio of neck circumference in the sitting position to sternomental distance of greater than or equal to 2.7, were optimal cutoff points to identify difficult intubation.

Conclusion: The neck circumference, the sternomental distance, the modified Mallampati test and the ratio of neck circumference to the sternomental distance show limited performance as screening tests to predict difficult intubation among obese parturients.
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Keywords: Obese parturients; Difficult intubation; Clinical prediction

Introduction

Obese parturients are at increased risk of difficult airway management. Previous studies have shown the incidence of difficult laryngoscopy (laryngeal view grades 3 and 4) in both obese patients and obese parturients to lie in the range 3.4–8.75%.[1,2] Quinn et al. found that there was a 7% increase in the risk of failed intubation for every 1 kg/m^2 increase in body mass index (BMI).[3] The engorgement of the oropharyngeal mucosa leads to an increase in the Mallampati score.[4] The limitation of mouth opening, restricted neck movement and increased breast size[5] places the parturient at increased risk of difficult airway management. Furthermore, when obese parturients lie supine there is a significant reduction in the functional residual capacity, because the abdominal contents limit diaphragmatic movement.[6,7] Accordingly, obese parturients have an increased chance of rapid oxygen desaturation and as a result, a significant

increase in morbidity and mortality compared to non-obese parturients.[5] Regional anesthesia is the most common method used for cesarean delivery. This approach reduces the risk of difficult airway management, even though difficulties in palpation and placing a needle for neuraxial block are challenging among obese parturients. General anesthesia is indicated in the case of urgency, inadequate regional block, maternal refusal or contraindications to regional techniques,[6] but should be used with caution because airway management problems have been the major reason for maternal mortality in previous reports.[8]

Several airway assessment tests can be made to anticipate difficult intubation in obese patients and parturients. Modified Mallampati scores of 3 and 4[9] and neck circumference (NC) >43 cm[10] have been associated with difficult intubation in obese patients. The modified Mallampati test (MMT), the ratio of height to thyromental distance (TMD) and the Upper-Lip-Bite test have limited usefulness in screening for difficult intubation in parturients, owing to the tests' sensitivity being less than 72%.[2] A sternomental distance (SMD) of ≤ 13.5 cm[11] and the ratio of the NC to TMD[12] may be predictors of difficult intubation in parturients.

We assumed that NC/SMD ratio was a good predictor of difficult intubation among parturients, because obese parturients have a large amount of neck and chest wall fat deposition and limited neck movement, which can be represented by NC and SMD. The subjects in the study by Kim et al.[12] were obese patients of BMI ≥ 27.5 kg/m^2 and that study instead focused on NC/TM ratio. No previous study has compared NC with other bedside tests for predicting difficult intubation in obese parturients. Therefore, the objectives of this study were to determine the performance of NC and bedside measurements of SMD and MMT for predicting difficult intubation, and to identify the optimal cutoff point(s) of the test(s) which showed the highest performance.

Methods

This prospective observational study was a multi-center study involving a university hospital (Siriraj Hospital) and two tertiary hospitals (Maharat Nakhon Ratchasima Hospital and Suratthani Hospital). The study was approved by the Institutional Review Board. Informed consent was obtained from each parturient. Inclusion criteria were parturients of age >18 years; body mass index ≥ 30 kg/m^2; and undergoing a cesarean section employing general anesthesia with a conventional endotracheal intubation. Exclusion criteria were: parturients who presented with overt signs of difficult intubation, such as facial fracture, facial tumor or cervical spine fracture; who had a history of difficult intubation; for whom a special technique for intubation was

planned; and who were overweight due to pathology such as ascites or a tumor.

Preoperative airway tests, including NC, SMD and MMT, were performed by trained research assistants. Neck circumference was measured with a tape measure at the level of the cricoid cartilage, in both the sitting and supine positions. Patients who are in a sitting position have a significantly smaller neck circumference compared with those lying supine.[13] The SMD was measured with the head in full extension and the mouth closed, using a ruler along the straight distance from the upper border of the manubrium sterni to the bony mentum. The MMT was assessed in a sitting posture.

In the operating room, parturients were monitored routinely with an electrocardiogram, noninvasive arterial blood pressure, and pulse oximetry. They were arranged in the ramped or sniffing position. Preoxygenation with 100% oxygen at 6 L/min through a facemask was given for three to five minutes. Anesthesia was induced with either thiopental 4–8 mg/kg ideal body weight or propofol 2–3 mg/kg ideal body weight and suxamethonium 1–2 mg/kg total body weight, standardized for the rapid sequence intubation protocol. The Sellick maneuver was performed by an experienced nurse anaesthetist by applying a cricoid force of 30 N (equivalent to 3 kg) during loss of consciousness.[14] A Macintosh laryngoscope blade size 3 was used for the first laryngoscopy. All tracheal intubations were performed by an anesthesiologist or a nurse anesthetist with at least two years' experience in anesthesia. The performers were blinded from the preoperative airway measurement by research assistants. Successful intubation was confirmed by bilateral auscultation of the lungs and capnography.

The difficulty of intubation was assessed using the intubation difficulty scale (IDS, seven variables N1 to N7, score ranged from 0 to infinity), as rated by the anesthesiologist or the nurse anesthetist who performed the tracheal intubation and recorded by a research assistant. N1 represents the number of additional intubation attempts (score = 0 for the first attempt). N2 represents the number of additional operators (score = 0 if successful intubation is obtained by the first operator). N3 is the number of alternative intubation techniques used (score = 0 if there are no alternative intubation techniques, and score = 1 if one alternative intubation technique is used). N4 represents the laryngoscopic view, as defined by Cormack and Lehane (grade 1 = score 0, grade 2 = score 1, grade 3 = score 2, grade 4 = score 3). N5 is the lifting force applied during laryngoscopy (score = 0 if inconsiderable, and score = 1 if considerable). N6 is the necessity to apply external laryngeal pressure to optimize glottis exposure (score = 0 if no external pressure or only the Sellick maneuver was applied, and score = 1 if external laryngeal pressure was used). N7 assesses vocal cord mobility (score = 0 if abducted, and score = 1 if adducted or not visible).