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Clinical characteristics of patients presenting with difficult mask ventilation in the operating room at HU PZAGA Mahajanga (Madagascar)

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Abstract

Introduction: Face mask ventilation is a fundamental skill in general anaesthesia, used both for preoxygenation and as a rescue technique. Difficult mask ventilation represents a high-risk situation that may lead to severe hypoxemia. The aim was to assess the frequency of difficult mask ventilation and to describe the clinical characteristics of the affected patients.

Methods: This descriptive observational study was conducted over a 6-months period at University Hospital Professor Zafisaona Gabriel Mahajanga (Madagascar). A total of 167 patients undergoing surgery under general anaesthesia were included. Demographic and clinical data that could compromise mask ventilation were systematically collected.

Results: The frequency of difficult mask ventilation was 25.7%. Patients had a mean age of 34.8 ± 16.1 years, with a female majority (60%). Patients with difficult mask ventilation mainly presented with Mallampati class III (32.5%) or IV (39.5%), a thyromental distance < 6 cm (69.7%), a mean BMI of 23.56 ± 5.40 kg/m², and snoring (62.1%).

Discussion: The high frequency of difficult mask ventilation observed in this series highlights the persistence of this issue in general anaesthesia, and especially in resource-limited settings. The predictive clinical factors identified in our patients are consistent with those reported in the literature.

Conclusion: This study shows that difficult ventilation is a significant reality in our anaesthetic practice in Mahajanga. It emphasizes the crucial importance of systematic preoperative airway assessment to improve patient safety.

Keywords: Airway Management, General Anaesthesia, Hypoxemia, Mask Ventilation

Introduction

General anaesthesia requires effective airway management, of which facemask ventilation is a key component [1]. Used for preoxygenation and as a rescue technique in case of intubation failure, it helps prevent hypoxia [2, 3]. Facemask ventilation is therefore a fundamental skill for anaesthesia practitioners. However, it can be challenging even for experienced operators, potentially leading to anaesthetic complications. The most feared of these is severe hypoxemia, which is the leading cause of anaesthesia-related morbidity and mortality [3]. This study aims to determine the frequency of difficult facemask ventilation at University Hospital Professor Zafisaona Gabriel (UH PZAGA) Mahajanga, and to describe the clinical characteristics of affected patients.

Methods

This was a descriptive, prospective, observational study conducted in the operating room of the UH PZAGA in Mahajanga. The study period ran from September 2024, to February 2025. All patients aged 18 years or older, of either sex, who underwent general anaesthesia requiring facemask ventilation, were included. Patients with incomplete medical records or unusable data were excluded from the study.

Difficult facemask ventilation was defined according to clinical criteria as the inability of an experienced, unassisted anaesthesiologist to maintain oxygen saturation above 90% during positive pressure ventilation with 100% oxygen, requiring two-handed ventilation and/or the intervention of a second operator to correct or prevent inadequate ventilation.

The variables studied included sociodemographic characteristics (age, sex), types of surgery, body mass index (BMI), upper airway assessment parameters (mouth opening, neck circumference, thyromental distance, Mallampati score, dental status), and medical history that could compromise facemask ventilation (cervical stiffness, presence of a cervical mass, and snoring).

Data entry was performed using Microsoft Office Excel 2021, and statistical analysis was conducted using IBM SPSS Statistics version 25.0. Categorical variables were reported as counts and percentages, whereas continuous variables were presented as mean ± standard deviation.

Results

Table 1: Clinical Criteria for Defining Difficult Facemask Ventilation (DMV)

	Effectives (n=43)	Percentages (%)
Age		
< 50yrs	27	62.7
> 50yrs	16	37.2
BMI		
≤ 25 kg/m²	28	65.1
≥ 25 kg/m²	15	34.9
Mouth opening		
< 3cm	11	25.6
3cm	23	53.5
> 3cm	9	20.9
Mallampati score		
I	2	4.7
II	10	23.2
III	14	32.5
IV	17	39.5
Thyromental distance		
≤ 6cm	30	69.7
> 6cm	13	30.2
Neck circumference		
≥ 37cm	32	74.3
<37cm	11	25.7
Other factors		
Cervical mass	4	9.3
Edentulism	14	32.6
Snoring	27	62.1
Chin beard	3	6.9

During the study period, 167 patients were included and underwent general anaesthesia with facemask ventilation. After applying the inclusion criteria, difficult facemask ventilation was observed in 43 patients, representing a frequency of 25.7%.

Patients under 50 years of age were in the majority (62.8%), with a mean age of 34.8 ± 16.1 years (range: 18 to 90 years). Females predominated, with a sex ratio of 0.79.

The most frequent procedures were gynaecological and obstetric surgery (28%) and trauma surgery (27.9%).

Regarding body mass index (BMI), the majority of patients (51.2%) had a BMI between 18 and 25 kg/m². The mean BMI was 23.56 ± 5.40 kg/m² (range: 15–37 kg/m²) (Table 1).

Airway assessment revealed a mouth opening ≤ 3 cm in 79.1% of patients. Mallampati class 3 (32.5%) and class 4 (39.5%) predominated, and a cervical mass was present in 9.3% of cases. Thyromental distance was less than 6 cm in 69.7% of patients, while neck circumference exceeded 37 cm in 74.3% of cases.

Among the other clinical characteristics associated with difficult mask ventilation, snoring was present in 62.1% of patients and edentulism in 32.6% (Table 1)

Discussion

In this study, the frequency of difficult mask ventilation (DMV) was 25.7%, which remains higher than the data reported in the majority of published studies.

Recent studies show wide variability in the incidence of DMV depending on the population studied and the diagnostic criteria used. A meta-analysis including over 335,000 patients reported an overall incidence of approximately 6.1% in the general surgical population, which can reach up to 14.4% in obese patients [3].

Other recent studies report incidences ranging from 2% to 15%, depending on the definitions used and the populations studied [4].

We observed that DMV occurred in patients with a mean age of 34.8 ± 16.1 years. This relatively young age profile may be explained by the surgical case mix at our center, which was characterized by a predominance of orthopaedic and obstetric surgery disciplines that mainly involve younger individuals. This finding is consistent with the data reported by Pei *et al*. (2023) [5] and Cao *et al*. (2021) [6], who found comparable mean ages (40.94 ± 12.61 years and 40.81 ± 14.62 years, respectively). Although our population was young, literature shows that advanced age is associated with an increased risk of difficult mask ventilation. In contrast, our study population appears significantly younger than those described in some series from high-income countries, particularly in China [7] and Singapore [8], where the mean age exceeded 55 years. This discrepancy may reflect structural differences, both demographic and epidemiological, as well as distinct surgical profiles across the settings studied. It should also be noted that advanced age is an independent predictor of DMV, possibly due to anatomical and functional changes in the upper airway that progressively increase risk with aging [9].

Regarding gender, our study found a slight female predominance (male/female ratio = 0.79). This finding is consistent with the observations of Riad *et al*., who reported that 85% of patients with DMV were female [10]. However, the literature remains heterogeneous regarding the association between gender and DMV. Some studies suggest a significant relationship, although the direction is not consistent. For example, Pei *et al*. [5] reported a doubled risk, whereas Kheterpal *et al*. [11] found a 3.7-fold increased risk of DMV in male patients. These seemingly contradictory findings highlight the complexity of the interaction between anthropometric, anatomical, and contextual factors, and suggest that gender, taken alone, may be an indirect marker rather than a direct causal factor.

Body mass index (BMI) is widely recognized as a risk factor for difficult ventilation, mainly due to the mechanical and anatomical changes it induces in the upper airway. The literature consistently reports an increased incidence of DMV in overweight or obese patients [3]. In our series, the mean BMI was 23.56 ± 5.40 kg/m², which is lower than

values generally reported in Western cohorts. This difference may reflect nutritional and epidemiological characteristics specific to low- and middle-income countries, where obesity is less prevalent. It may also help modulate the risk profile for DMV in our population, suggesting that the determinants of this complication are not directly transposable from one setting to another.

In our study, we observed that even when the thyromental distance was considered satisfactory (> 6 cm), DMV persisted in 30.2% of cases. However, this finding should be interpreted with caution given the relatively small sample size. Nevertheless, it suggests that thyromental distance taken alone has limited predictive value and should be integrated into a multifactorial approach that includes other clinical variables, such as obesity, limited cervical spine mobility, and Mallampati score. Indeed, a reduced thyromental distance is frequently associated with reduced cervical spine mobility, whether due to osteoarthritis or the presence of a cervical mass. These conditions are recognized risk factors for DMV because of their impact on the alignment of the oropharyngeal axes and on upper airway patency [11-13].

Furthermore, the proportion of edentulous patients in our series was high (32.6%), likely reflecting unfavorable socioeconomic and health conditions associated with limited access to dental care in our setting. This finding is generally concordant with the literature, although lower proportions are typically reported in high-income countries [11, 14]. From a pathophysiological perspective, edentulism leads to changes in facial anatomy, including loss of lip support and alteration of the perioral conformation, which can compromise facemask seal and promote air leaks [15]. It is a factor associated with DMV, particularly when combined with other factors such as obesity or limited cervical spine mobility [16].

Finally, snoring was the most frequently reported medical history finding in our population (62.1%), which is consistent with the observations of Pei *et al*. (74.3%) and Cao *et al*. (63.9%) [5, 6]. Snoring often reflects chronic upper airway obstruction, frequently associated with obstructive sleep apnea syndrome. This condition is known to increase the risk of DMV due to increased airway collapsibility and impaired airway patency [11, 13].

Conclusion

Difficult mask ventilation (DMV) is a non-negligible situation in general anaesthesia, with a high frequency in our population. It particularly affects young, female patients who frequently present unfavorable anatomical factors for ventilation. Taken together, these findings underscore the multifactorial nature of DMV, resulting from the complex interaction between anthropometric characteristics, anatomical features of the airway, and associated clinical factors. No single factor appears predominant, but their combination synergistically increases the risk of difficult ventilation. In this context, a comprehensive and systematic preoperative airway assessment appears essential to identify at-risk patients early and to optimize anaesthesia management strategies.

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