

How to Overcome Difficult-Bag-Mask-Ventilation: Recent Approaches

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Abbreviations: BMV: Bag-Mask-Ventilation; DMV: Difficult Bag-Mask Ventilation

Efficient airway management is considered as an inevitably vital skill required for emergency physicians [1]. Bag-mask-ventilation (BMV), the first step in airway management, is an essential rescue maneuver in situations where any attempt at establishing secure airway through intubation or supraglottic airway devices placement fails [2]. In spite of appearing a rather simple technique, performing appropriate BMV could accompany numerous difficulties. BMV should be performed by an experienced person so that the mask is placed firmly and appropriately and the required positive pressure is applied sufficiently. It should be emphasized that lack of expertise is considered a partial contraindication of performing BMV [3].

In the present article, we are to firstly describe Difficult Bag-Mask Ventilation (DMV), evaluate its associated risk factors and finally introduce the most recent approaches towards overcoming it.

In an original report of the American Society of Anesthesiologists (ASA), Task Force on Management of the Difficult Airway, in 1993, the following definition of DMV was introduced: "DMV is a situation that develops when it is not possible for the unassisted anesthesiologist to maintain the oxygen saturation 90% using 100% oxygen and positive pressure ventilation, or to prevent or reverse signs of inadequate ventilation" [4].

1. American Society of Anesthesiologists (ASA) consequently reported that DMV occurs in the situations in which the anesthesiologist is unable to establish ventilation using bag-mask due to one or more of the following reasons [5]:inadequate mask seal
2. excessive gas leak
3. excessive resistance to the ingress or egress of gas

Or whenever the following signs and symptoms of inadequate ventilation are present:

1. Absent or inadequate chest movement
2. Absent or inadequate breath sounds
3. Auscultatory signs of severe obstruction
4. Cyanosis
5. Gastric air entry or dilatation
6. Decreasing or inadequate oxygen saturation (SpO₂)
7. Absent or inadequate exhaled carbon dioxide (ETCO₂)
8. Absent or inadequate spirometric measures of exhaled gas flow
9. Hemodynamic changes associated with hypoxemia or hypercarbia (e.g.,hypertension,tachycardia,and dysrhythmia).

Additionally, in a valuable study carried out by Khaterpal et al., numerous significant risk factors for DMV have been introduced including: Age≥55yr, Male gender, Body Mass Index≥31 kg/m², Junior anesthesia provider, Sleep apnea, Snoring, Presence of beard,

Edentulousness, Thick neck, Neck radiation changes, Limited thyromental distance and Mallampati III or IV [6].

It should however be remembered that appropriate coverage of mouth and nose by mask is an essential basis of BMV as there are three major concerns regarding providing adequate ventilation using bag-mask including inadequate tidal volume, inappropriate oxygenation and gastric insufflation. Therefore providing complete coverage of mouth and nose is inevitable for eliminating the first two concerns [7]. Herein we would discuss the most recent approaches towards DMV in general and specific (described by Kheterpal) conditions:

General Approach to DMV

In general, the following procedures should be born in mind consequently facing DMV, provided that there are no associated contraindications [8]:

1. An exaggerated head tilt/chin lift
2. An augmented jaw thrust
3. An oropharyngeal airway (and/or nasopharyngeal airway)
4. A two-person BMV technique
5. Decreasing or eliminating cricoid pressure if previously applied
6. Replacing mask (size or type) to achieve the required seal
7. Evaluation of the existence of probable foreign body obstructing the airway
8. A 'rescue' extraglottic device
9. An early attempt at tracheal intubation

Regarding the two-person BMV techniques mentioned in part 4, numerous techniques have been introduced from which two standard ones, "E-C" grip and Thenar Eminence, are described here [9-11]:

The comparison between these two techniques has been made on the manikins with DMV resulting in the fact that Thenar eminence technique is more efficient than "E-C" grip technique. Health care providers should be aware of the difficulties associated with BMV techniques in emergency situations without the proper availability of airway devices.

Two-Person BMV has proven to be more efficient at providing greater tidal volumes with less air leak than one rescuer BMV and

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therefore it is recommended in case of possibility. The “standard” technique for holding the mask throughout two-person BMV includes the above-mentioned “E-C” grip using both hands rather than just one (Figure 1). Alternatively, a “Thenar Eminence” (TE) technique has also been introduced. This technique involves placing the thenar eminence and thumb of both hands on the top of the mask. The rescuer’s four other fingers of each hand would pull the jaw into the mask while the second rescuer would compress the bag to perform ventilation (Figure 2).

In cases with definite DMV causes (Causes mentioned by Kheterpal and special cases), after performing general principles, the following procedures should be considered:

Special approach to DMV

Beard or Moustache

Thick and long moustache or beard would cause DMV due to preventing mask sealing. It is recommended to use water-soluble lubricant over moustache or beard to flatten hair or use clear occlusive plastic over face with hole over mouth opening to minimize air escaping that occurs through moustache or beard hairs and therefore facilitating BMV [8].

Obesity

In obese patients, DMV is likely due to decrease in chest wall and diaphragm compliance, limitation in head extension and narrowed pharyngeal lumen. “Ramp” position, being one of the most popular techniques in airway management and also named HELP (Head Elevated Laryngoscopy Position) or the ‘troop’ is achieved maximizing sniffing position utilizing a “Ramp” which in turns would assist in establishing a more direct airway [8]. Ramping obese patients in order to achieve optimum positioning has been shown to significantly improve the view at laryngoscopy. The main objective of the method is to align the auditory canal with the sternal notch in a straight line which can be achieved either by placing folded blankets behind the occiput and shoulder blade or by using already-made products (Figure 3) [8,11]. At the time being “Ramp” position is widely accepted as one of the required steps towards airway management enhancement [12].

The elderly

Old age is associated with loss of teeth and tissue elasticity and decrease in muscle tone. Establishing an oral and/or nasal airway would assist in overcoming this problem [8].



Figure 1: The Two-hand E-C technique of Bag-Mask-Ventilation.



Figure 2: The Two-hand Thenar Eminence technique of Bag-Mask-Ventilation.



Figure 3: Ramp position is achieved by alignment of the patient's auditory canal with the sternal notch and placement of the folded blankets behind the occiput.

Edentulous patients

BMV seems to be difficult in toothless patients and as the prevalence of toothlessness is almost 60% among the patients older than 65, BMV is considered a major concern in this age group [13]. Due to the difficulty in appropriate mask sealing in patients with cheeks, as a consequence of lack of teeth, BMV has always been considered too difficult in these patients. Every physician is likely to face this problem in edentulous patients and it is regarded as one of the predictive factors of DMV. To overcome this problem, diverse techniques including small oral masks, intraoral Randell Baker Saucek Mask, special anatomic masks, oral airways, nasal masks and leaving dentures in place during induction of general anesthesia have been practiced [13,14].

Furthermore, we studied the efficiency of ventilation by placing a folded gauze in the buccal cavities (on the both sides of the airway) in edentulous patients and concluded that placing a folded gauze in the buccal cavities (on the both sides of the airway) in edentulous patients would significantly facilitate BMV compared with no intervention in edentulous patients (Figure 4). Another significant result of our study was that female edentulous patients were ventilated more efficiently compared with the male edentulous patients [15].

In a study performed by Racine et al. on 49 edentulous patients, it was concluded that placing the mask in a lower lip position by repositioning the caudal end of the mask above the lower lip while maintaining the head in extension would lead to less air leak and better



Figure 4: Placing a folded gauze in the buccal cavities (on the both sides of the airway) in edentulous patients is performed to improve Bag-Mask-Ventilation.

BMV compared with the conventional approach in which the rim of the mask is placed on the chin [16].

Snoring

A history of snoring is indicative of redundant oropharyngeal tissue. In such situations using an oral airway and head extension position, if not contraindicated, would be helpful [8].

Nasogastric tube

In the study of Noguchi et al., dental glue was administered in the patients with NGT to improve BMV. The obtained results indicated that using denture adhesive in patients with NGT would increase Expiratory volumes compared with the patients in which denture adhesive was not used ($P < 0.001$) [17].

Drug-related causes

Opioids: Large doses of opioids decrease chest wall compliance and therefore lead to DMV, a condition known as “Wooden Chest Syndrome” [5]. However using premedication including Midazolam and Diazepam and non-depolarizing muscle relaxants significantly decreases the incidence of this syndrome and treats it [18].

Succinylcholine: Frequently, administering succinylcholine both in children and adults leads to increased muscular tone of masseter muscle which in turn can result in clinically significant jaw rigidity, (Jaw of Steel), affecting ventilation efficiency [5,19,20]. Masseter spasm per se is considered a benign phenomenon; however it might also be an early alarming indicator of malignant hyperthermia. In a study by Meakin et al., it was hypothesized that this increase in muscular tone or spasm may be due to administering doses lower than the required doses [21].

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