Guide to the emergency management of morbidly obese patients

The rise in obesity means that more morbidly obese patients are being seen in emergency departments.

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The presence of an acutely ill or injured morbidly obese patient (MOP) in the emergency department (ED) is currently a common occurrence as obesity reaches epidemic proportions internationally. Morbid obesity is defined according to body mass index (BMI), which is equal to weight (kilograms) divided by the square of height (metres).[1] The calculated BMI is divided into ranges, with > 25 considered overweight, > 30 obese, > 40 morbidly obese and > 50 super obese.

Management of the acutely ill or injured MOP in the ED has a number of peculiarities that must be addressed to ensure adequate, appropriate and effective emergency medical care. The MOP, by virtue of abnormal size, body composition and habitus, deranged physiology and co-morbid disease, has been shown to have an increased morbidity and mortality on admission; this in addition to the effects of the acute medical threat. Besides patient characteristics, the size and weight of the patient may preclude the use of standard-sized beds, diagnostic radiological equipment and other medically required apparatus including effective manpower to provide adequate nursing care.

Prehospital management

The prehospital management of the acute MOP is fraught with its own difficulties, the effects of which have a negative impact on the condition of the patient presenting to the ED. Prolonged entrapment, special hoisting devices, stretcher limitation, maximum limitation in paramedic (ALS) drug doses and prehospital equipment limitations and failures all lead to the patient being admitted to the ED in a suboptimal condition. Transportation of the MOP often compromises the patient's condition because of lack of available working space, inability to place the patient in a semi-Fowler's position, to gain venous access or to ventilate the patient manually with bag/valve/mask (BVM). Therefore, by the time the patient arrives in the ED, the original medical threat may have caused further deterioration and/or become subject to additional unfavourable factors.

Positioning the patient

The MOP requires special preparation if his/her weight is beyond the maximum limitation of the standard ED stretcher, or if the girth of the patient prevents activation of standard safety measures that prevent falls from the stretcher.

Due to the large body habitus the MOP may not be able to be placed supine without developing respiratory distress. The patient must therefore be placed in the semi-Fowler's position, a feat that may tax the weight limitations of non-bariatric beds or stretchers. Once the head segment of the stretcher is elevated to provide semi-Fowler's, the weight restriction is dramatically decreased and may fail. This may lead to patient respiratory distress, hypoxia and death if not immediately remedied. Therefore, an appropriate bed with adequate semi-Fowler positioning or with an appropriate elevating device is mandatory during patient preparation, placement and positioning.

Airway management

The MOP often presents with a potentially difficult airway due to an abnormal anatomy caused by excess tissue. The optimal approach to intubation in the MOP is unclear, but the following changes may be expected:

- The tongue, the largest single structure in the mouth, affects accessibility to the larynx during direct laryngoscopy. Obesity contributes to difficult laryngoscopy whenever there is an increase in the size of the tongue.[2]
- The presence of redundant palatal and pharyngeal tissues may compromise mask ventilation, laryngoscopy and intubation.[3] The MOP tends to have smaller pharyngeal areas caused by deposition of adipose tissues into these structures. Virtually every pharyngeal structure increases in size with deposition of adipose tissue. Because of the smaller pharynx, caused by fat deposition, there is an increased likelihood that relaxation of the upper airway muscles during rapid sequence intubation (RSI) will cause collapse of the soft-walled pharynx between the uvula and epiglottis, making BVM ventilation and tracheal intubation more difficult.[2]
- It is more difficult to determine accurate landmarks on a thick and obese neck, and misapplied cricoid pressure may permit gastric insufflation and regurgitation and compromise laryngoscopy and intubation.[3]
- Cricothyroidotomy is more difficult because of the increase in neck circumference, thickness of subcutaneous tissues, anatomical distortions, adipose tissue-distorting landmarks and inability to place the patient supine with head extended.

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Because of the abovementioned anatomical airway peculiarities of the morbidly obese, airway management should always initially be regarded as potentially difficult. It must *be fully evaluated* as such before ventilation, laryngoscopy, intubation or cricothyroidotomy is contemplated or attempted, and if time and the critical condition of the patient allow this evaluation.

The first intubation attempt should always be made by the most experienced person available (emergency or anaesthesia), working under the best conditions possible with adequate assistance on hand and all difficult airway equipment on standby.[4] Each subsequent intubation attempt will worsen swelling and cause possible airway trauma, making it more difficult to visualise and intubate the glottis on any subsequent attempts.[4] Therefore, thoroughly evaluate the patient's airway initially using standard criteria and consider RSI only for patients with low-grade scores. If the criteria are unequivocal or of a high-grade nature, consider a 'semi-awake intubation' to further assess the nature of the airway and its applicability for RSI or for primary intubation of the patient. Semi-awake intubation involving light sedation combined with topical local anaesthetic spray on the pharyngeal and laryngeal area will usually allow adequate evaluation of the upper airway by direct rigid laryngoscopy.

Alternative airway adjuncts in the difficult airway tray should include the laryngeal mask airway (LMA).[5] Additionally, long spinal needles should be on hand in the difficult airway tray to function as 'probe guides' in the event that cricothyroidotomy or retrograde intubation is contemplated in the MOP with a thick, short, and large circumferential neck.

Breathing and ventilation

The functional respiratory physiology of the MOP is already altered detrimentally before any emergency state owing to the physical effects of increased body mass internally and externally. The weight of the chest wall and impingement on the thoracic cavity by a large abdomen limit respiratory expansion in these patients. In addition, fat deposition in the diaphragm and intercostal muscles impairs the mechanics of breathing, decreasing functional residual capacity (FRC), expiratory reserve volume (ERV), forced expiratory volume (FEV), minute ventilation (MV), and lung and chest wall compliance, and causing ventilation/perfusion mismatching.[6] It is estimated that the respiratory resistance of the MOP is 8 times higher than normal, increasing the work of breathing 4-fold.[4] This equates to a patient who normally may have chronic hypoxia, hypercarbia and little, if any, respiratory reserve. So one must consider early and elective mechanical ventilatory support whenever possible.

As discussed above, placing the MOP in a supine position may rapidly reduce respiratory volumes to desaturation and acute life-threatening hypoxia. If practical, it is therefore mandatory to provide the acute MOP with high-concentration oxygen via an appropriate facial mask and to attempt to position him/her in at least a reverse Trendelenburg position at 30 - 45° if semi-Fowler's cannot be maintained.[4,7]

Manual ventilation (via BVM) in the MOP is fraught with difficulties. It may be difficult to fit and seal the mask adequately for ventilation, and it is advisable to always use the recommended 2-person 4-handed technique with oral *as well as* nasopharyngeal airways in place for BVM ventilation. This is because of increased chest and abdominal wall weight, increased facial girth, redundant pharyngeal tissues, increased tongue size and tendency of obese men to have facial hair. In severe or super obesity, the pressure required to ventilate manually with a BVM may simply not be possible.

When ventilating mechanically, current consensus favours parameters based on ideal body weight (IBW) initially and adjusting according to regular arterial blood gas measurements. This is based on the decreased expected lung volumes and increased airway resistance. A tidal volume calculated according to total body weight (TBW) would probably result in high airway pressures, alveolar over-distension and resultant baro/atelectrauma. Once again, to maximise ventilatory volumes, consider positioning the patient in a semi-erect or reverse Trendelenburg posture in order to move the weight of the breasts, abdominal fat and panus off the chest wall and diaphragm.[8]

Suggested initial ventilatory settings therefore include:[5,7]

- high FiO_2 initially
- tidal volume at 10 ml/kg based on IBW
- positive end-expiratory pressure (PEEP) 7 - 10 cm H_2O
- peak inspiratory pressure 35 cm H_2O.

Circulation

The MOP presents particular difficulties when one attempts to assess and manage the circulation. Assessing and monitoring the acute MOP's pulse rate, blood pressure, electrocardiographic (ECG) rhythm, central venous and arterial pressures may be severely compromised owing to obscured anatomical landmarks, inadequately sized blood pressure cuffs and increased depth of insertion necessary to gain venepuncture. Venous tourniquets may not work well or may cut into the flesh if applied too tightly – one should use a large blood pressure cuff instead. An external jugular venous access line may be impossible to insert, as may a femoral line, owing to difficulty in locating landmarks, lifting the abdomen away from the intended insertion site and moisture/fungal infections in the groin area. The

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reliability of the ECG may be affected by incorrect lead application due to loss of landmarks and inconsistent voltages.[5]

Some solutions to these problems, based on expert opinion and experience, include:

- Use of correct cuff sizes when attempting blood pressure measurements. The width of the cuff should be 40 - 50% of the upper arm's circumference. The cuff should be long enough for the bladder to encircle the arm almost completely (80% of the arm's circumference).
- Use of a small-bore locator needle and, where available, the application of Doppler ultrasound techniques may increase the probability of successful catheter placement.[7] This may reduce complications and decrease the need for multiple insertion attempts.[9]
- Peripheral insertion of central catheters is an alternative to centrally placed catheters.[9]
- Attempted subclavian line insertion may require a longer than normal locator needle in the form of a long spinal needle of adequate gauge to accept the necessary guide wire.
- Medications administered by intramuscular injection may require the use of longer needles in order to prevent intra-adipose injection.

Diagnostic evaluation

The acquisition of plain X-ray films, especially portable films in the ED, may be limited by cassette size, patient positioning, maximum voltage limitation, and hence inadequate soft-tissue penetration. Morbid obesity also decreases the quality of the portable chest X-ray. Excessive mediastinal adipose tissue projects an abnormal mediastinum on plain chest X-ray, mimicking thoracic aortic aneurysm. A CT would offer improved visualisation, barring weight restriction on the scanner table. CT scanning tables have load limits of 150 - 200 kg, although manufacturers may have special kits that support the free end of the table for very large patients. However, this does not overcome the problem of aperture size, which may be insufficient to accommodate the large thorax and/or abdomen. Other load limitations in radiology include X-ray screening (135 kg), angiography (165 kg), nuclear medicine (150 kg) and magnetic resonance imaging (150 kg).[5]

Ultrasound imaging of the lower extremities is limited by surrounding oedema. Ultrasound has the advantage of not requiring a specialised table, with the option of bedside portability. However, the excess adiposity can impair image quality.

Diagnostic peritoneal lavage (DPL) may have a role in the morbidly obese when ultrasound and CT scanning are technically impossible and excess load excluded. The use of the Seldinger technique for intraperitoneal access in the MOP has been shown to be relatively quick, safe and effective. However, thick layers of adipose tissue and increased risk of visceral perforation require a large incision for catheter placement.[6] Laparotomy may therefore be the best alternative in suspected abdominal trauma.

Problems encountered with lumbar puncture include adequate landmark identification, inadequate depth of penetration of standard length needles and vertebral degeneration found commonly in the MOP. Upright positioning, use of extra-long spinal needles and ultrasound-guided assistance are all recommended in the morbidly obese if practically possible.[5]

Drug administration

The appropriate dosing schedule for the acute MOP is as much an art as it is a science, given the lack of published material that could be used for an evidence-based approach. The clinician therefore has to decide whether to base the required dosage of emergency medication on the patient's estimated TBW, IBW or adjusted body weight (ABW). The TBW is physically determined by weighing the patient, which is impossible in the ED. The IBW can be estimated by the Broca index, namely patient height (centimetres) minus 100 for men and 105 for women.[10] The ABW is a calculation often used for medications that have an increased distribution pattern due to increased body mass. The distribution is usually presumed to be 20 - 50% of the excess body mass.

When referring to ABW one should indicate what percentage of excess weight will be used in the calculation. For example, using 40% as the excess, the formula is ABW = (TBW - IBW) x 0.4 + IBW. The difficulty of emergency medicine dosing is knowing which medication to base on what body weight calculation to avoid inadvertent under- or over-dosing of life-saving medications (Table I).

Table I. Suggested altered dosing schedules for morbid obesity[11]

Medication	Proposed weight	Dosage alterations
Anticoagulants	Heparin – ABW	
	Low molecular weight heparin (LMWH) – ABW	Higher end of dose range for prophylaxis
Anticonvulsants	Phenytoin – ABW 14 mg/kg IBW + 19 mg/kg for the weight in excess of IBW	1 500 mg for patients 125 - 150% IBW and 2 000 mg for patients weighing more than 150% IBW
Anti-infectives	Aminoglycosides – ABW IBW + 40% of weight > IBW	Either on ABW with a 12-hour dosing schedule, or ABW with a once daily dosing regimen, limiting the daily dose, e.g. 1 000 mg/day
	Quinolones	ABW = IBW + 45% of IBW
Cardiac	Lignocaine	Studies suggest that loading doses should be based on TBW. However, it is best to err on the conservative side by using ABW with supplemental doses when needed
	Verapamil	When based on weight, use ABW for the loading dose, and supplement clinically when required
Immunomodulators	Corticosteroids	For short courses of therapy (< 2 - 3 days), where efficacy is paramount, use ABW for dosing to avoid sub-therapeutic levels of the drug and to limit side-effects

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Conclusion

Acute emergency management of the MOP is fraught with many potential and real difficulties. If possible these difficulties must be anticipated well in advance if optimal care is to be provided. Many EDs have given little attention, if any, to this escalating problem, as obesity progresses to become one of the modern medical epidemics of the 21st century. Although it is now mandatory for hospitals to start addressing the increasing problem of the MOP by providing appropriate accommodation and adequate diagnostic and therapeutic facilities, medical, nursing and ancillary staff must be adequately educated and trained in acute bariatric care. This is required not only to provide the patient with optimum effective, efficient and compassionate acute medical care, but also to safeguard the medical carers from evident occupational health risks.

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In a nutshell

- The emergency care of morbidly obese acutely ill or injured patients presents special problems both outside and inside the hospital emergency department.
- Adequate preparation is required in order to provide adequate care.
- Position the morbidly obese patient in the semi-Fowler's or reverse Trendelenburg position at 45° to protect the airway.
- Always administer high-flow, high-concentration oxygen to all morbidly obese patients, as they are chronically hypoxic.
- Use the 2-person, 4-handed technique during manual bag/valve/mask ventilation.
- Use adequately sized cuffs when attempting blood pressure measurements.
- Plan intravenous access carefully and use appropriate size needles and cannulas to ensure success and prevent repeated attempts.
- Radiological and surgical specialist advice may be necessary for diagnostic procedures that cannot accommodate the patient owing to physical limitations.
- Use ideal body weight or adjusted body weight measurements when calculating most emergency dosages and titrate where necessary.
- Do not be afraid to ask for advice when necessary.