Why I don’t want to anaesthetise your patient...

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Why am I doing this talk?

a) Dr Wysocki couldn’t find any other willing “volunteer”

b) I work at a hospital with a disproportionate population with high BMI so am an expert by default

c) Non-Bariatric surgery in obese patients has many anaesthetic implications and I am totally interested in exploring this
Why I don’t want to anaesthetise your patient…

a) It’s Monday and I just don’t feel like it
b) I have my cranky pants on
c) They look a bit dodgy (IHD, DM, smoker, asthmatic, current URTI)
d) *Mostly it is because their BMI is 63*….
I don’t mind it if the high BMI is due to muscle mass...
Why is obesity such a big deal for anaesthetists?

More importantly – Why should the surgeon care???
Surgeons should care because:

- More time consuming for the anaesthetist pre-, intra- and post-op
- Time is money
- *May limit YOUR surgical time as potentially less cases per list*
Some interesting facts

- Logan Hospital BMI cut off for elective surgery = 60
- Emergency surgery = Crack on
- I think you are skinny if you are pregnant and less than 100kg
- Common to have BMI 30-40. 50-60 not rare.
- Private land not exempt from the obesity epidemic
BMI

• Weight (kg)/[Height]^2 (m)

• How tall do you need to be for your BMI to be normal?

• BMI does not actually take into account if the weight is due to muscle or fat

• The distribution of the fat can be as important as the actual BMI
Superman physique is great!
As long as it is not steroid induced...
Morbid obesity = BMI > 40 or > 35 with associated co-morbidities of HTN or DM

<table>
<thead>
<tr>
<th>BMI Range</th>
<th>Classification</th>
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</thead>
<tbody>
<tr>
<td>&lt; 18.5</td>
<td>Underweight</td>
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<tr>
<td>18.5–24.9</td>
<td>Normal</td>
</tr>
<tr>
<td>25.0–29.9</td>
<td>Overweight/pre-obese</td>
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<tr>
<td>30.0–34.9</td>
<td>Obese Class 1</td>
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<tr>
<td>35.0–39.9</td>
<td>Obese Class 2</td>
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<tr>
<td>&gt; 39.9</td>
<td>Obese Class 3 (previously ‘morbid obesity’)</td>
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Is the patient an “apple” or a “pear”?
Is the patient an “apple” or a “pear”?

- Apples (Android) generally more likely to cause airway anaesthetic problems - more central fat.
- Waist: hip ratio: Females >0.8 and men >1.0.
- Waist circumference: female >88cm and males >102cm
- Intra-abdominal central fat is more likely to be highly metabolically active and can contribute to disease. Males > females.
Fat distribution - Pears

• Pears (Gynaecoid) can be an easier general anaesthetic (GA) but be more difficult for iv access or neuraxial/regional
If I had to anaesthetise the cast of STAR WARS...
Jabba the Hut = “apple that ate a large pear” kind of shape

• No neck - >42cm circumference
• Possibly no chin, big tongue
• Likely to regurgitate due to GORD
• Probably a difficult ventilation
• May be a difficult intubation, but unlikely as mouth is enormous
• Rotten teeth get in the way, become foreign bodies
Some BMI comparisons - Yoda
Some BMI comparisons

- Superman: 190cm, 100kg. BMI 28
- Yoda: 90cm, 25kg. BMI 30.
- If 1Kg per cm height = morbidly obese
- Most obese patients I have had so far this year
  - Emergency perianal abscess. 180cm, 176kg. BMI 54.
  - Elective grommets and removal nasal polyps. 165cm, 166kg. BMI 61. Cancelled nasal polyps.
Pre-op

- Difficult IV access, smaller veins, harder to see or feel.
- IVC more prone to tissuing
- May need ultrasound to place IVC
- Positioning difficult – hover mats/extra staff for moving patient, logistics.
Positioning

- John *from WALL-E*
Positioning

- Pressure areas – more likely if obese?
- Venous stasis – more likely if obese.
- Weight capacity of theatre bed = 300kg
- Hover mat cut off 120kg
- Patient may slide off table with extreme positioning
- If unlock the bed with the patient on it, the bed may tip over

POSITIONING ISSUES

- Bed capabilities with morbidly obese patient – arm boards may be needed
- Prone position = Nightmare
- Lateral position = Can be hard work.
- Trendelenburg (head down) = not very nice. Makes sedation difficult
- Reverse Trendelenburg = WONDERFUL
- Want a ramped sniffing position
Induction – Obese patients

• Head up position best - RAMPING
• Induction may be rocky
• Can be harder to ventilate.
• May be more difficult to intubate.
• De-saturate quickly – hypoxic risk
• Aspiration risk increased
Harder to ventilate

- Face Mask not fit the face
- 2 hand bag mask ventilate
- Using positive pressure to push O2 into the patients lungs via pharynx
- Obese airway prone to collapse after induction agents given. Esp. if OSA
- Ventilation may then become more difficult
- Muscle relaxants may/may not help
Obese patients desaturate quickly
Higher O2 consumption, harder to ventilate

- Basal metabolic rate normal in obese patients when corrected for BSA. But with increasing weight BSA increases so absolute BMR higher than in lean. So greater absolute O2 consumption and CO2 production
- Increased work of breathing
- Can have small airway collapse at normal Vt so causing V/Q mismatch and shunting

De-saturate quickly – Reduced O$_2$ storage

- Functional residual capacity (FRC) = store is reduced in obese patient
- Even more important to spend time pre-oxygenating as reduced total O$_2$ store in obese patients
- Obesity hypoventilatation syndrome or OSA
- Obese lungs have less compliance (pulmonary blood volume increased)
- Obese chest wall may result in a restrictive lung defect (reduced compliance)

Reverses ventilation can be difficult apart from obesity.

Chewbacca
Chewbacca – too hairy to ventilate

• BMI likely high due to muscle mass (2m tall, 120kg, BMI 30)
• Probably has a decent chin
• Teeth debatable, can be even harder to ventilate if edentulous
• BEARD IS BAD! Very difficult to ventilate even if easy to intubate
Obesity increases the risk of a difficult intubation...

*Captain McCrea from WALL-E*
Obesity & Difficult Airway

- Obesity alone increases risk of a difficult airway (intubation) and ventilation
- When added to other features that make an airway difficult = Perfect Storm…
Other reasons for a difficult intubation – increase the angle we are trying to reduce with a blade.

- Thick neck = Difficult intubation/ventilation
- Small mouth opening
- Restricted neck extension
- Upper teeth present, buck teeth
- Small lower jaw or under bite
- Full or partial beard – hiding small jaw? plus now hard to obtain face mask seal
- OSA can be associated with difficult intubation
NO CHIN = DIFFICULT INTUBATION
A thick neck - >42cm independent predictor difficult intubation
Obese patients - Harder to intubate

- >42cm neck circumference predicts difficult airway
- Enlarged chest wall in the way of laryngoscope. As per pregnant patient
- Collapsing pharyngeal wall due to neck fat makes for a small target
- More soft tissue for ETT to get caught on
- LMA placement may still be easy
But Hulk probably easy intubation
Airway complications increased in obesity – NAP4

- Obese patients are twice as likely to develop serious airway problems during a GA than non-obese patients.
- Higher failure rate of rescue with supraglottic devices and emergency cricothyroidotomy
- Adverse events more frequent with junior anaesthetic staff for obese patients

http://www.rcoa.ac.uk/document-store/nap4-executive-summary
Obesity and increased risk of Aspiration

- Obesity has high incidence of GORD and hiatus hernia
- Increased gastric juice volumes
- Low gastric pH
- Increased intra-abdominal pressure
- Combined effect = increased risk of aspiration

GORD risk

• Moderate to severe GORD increases risk of aspiration
• Limits depth of sedation
• For GA - will generally need an endotracheal tube (ETT) (usually with muscle relaxation) rather than laryngeal mask airway (LMA).
• ETT takes more time – patient needs to be “reversed” and extubated
• If LMA can go straight to recovery
LMA vs ETT
Emergency case in morbidly obese

- Obese patient with full stomach - high risk aspiration e.g. bowel obstruction, sepsis, trauma
- May be a better option to do an awake fibre optic intubation with minimal sedation and topicalisation – but still takes time!!
In summary, Santa Claus is an anaesthetic airway nightmare...
Obese Hearts

• Increased metabolic demands of excess adipose tissue – increased total blood volume, cardiac output, arterial pressure

• Systemic HTN more common (x10) – results in LV dilation, LV hypertrophy (LVH), reduced compliance – diastolic dysfunction.

• Obesity cardiomyopathy is systolic dysfunction when LVH fails to keep pace with LV dilation


Obese Hearts

• Right heart failure eventually secondary to pulmonary HTN secondary to OSA (cor pulmonale) or left heart failure

• IHD more prevalent in obese patients. Causes: hypercholesterolemia, HTN, DM, lower [HDL], physical inactivity

Obesity causing arrhythmias…

- Increased incidence of arrhythmias due to fatty infiltration of conducting system and dysfunction of SA node. Increased risk for AF and sudden cardiac death.
- OSA (sinus tachy and bradycardia)
- Increased incidence of long QT with increasing BMI – risk with certain anti-emetics.

CVS problems associated with obesity

- GA drugs – generally cardiac depressants
- If have obesity with cardiac complications then GA will worsen these
- Laparoscopic surgery can increase stress on the heart
- Neuraxial blocks – gives a sympathetic blockade, depending on height of block
Obesity & Diabetes

- Obesity strong association with increased insulin resistance
- High NIDDM amongst obese
- High BSL impairs wound healing
- End organ damage increases risks
- Autonomic neuropathy including reduced gastric emptying – increased aspiration risks

Anaesthetic Options

- 1) Sedation +/- LA
- 2) General anaesthesia (GA)
- 3) Regional Local Anaesthetic (LA) block, continuous catheter or single shot
- 4) Neuraxial block – spinal, epidural, both
Captain McCrea…from Wall E
SEDATION a little more tricky in the obese

- Obese patient prone to airway obstruction and apnea with sedative drugs
- If OSA – apnea intra- and post-op
- If mod-severe GORD, limits sedation
- Sedation = supposed to be conscious
- Avoid some of the risks of airway issues with GA, still need ramping
- Surprising what you can achieve with good sedation and LA blockade
Regional or Neuraxial block

- Technically more difficult, may be impossible
- Lack of palpable bony landmarks
- Depth of the space vs length of needle
- Longest spinal needle 16.5cm
- Longest epidural needle 13cm
- Loss of resistance may be “false” in fatty tissues
- Possible issues with higher failure rate of epidurals in obesity
What drug dose in obese patient?

**TBW (total body weight)** = patients actual weight

**IBW (ideal body weight)** = what the patient should weigh with a normal ratio of lean to fat mass (15% fat mass)

\[
IBW = \text{Height (cm)} - x
\]

(where \(x\) is 105 in females and 100 in males). Varies with age.

**LBW (lean body weight or mass)** = The patient's weight excluding fat. Many complex formula. *Regardless of TBW, LBW rarely exceeds 100kg in men and 70kg females*
What dose in obese patient?

- **ABW (adjusted body weight)** = takes into account the fact that obese individuals have increased LBW and an increased volume of distribution (Vd) of drugs. Calculated by adding 40% of the excess weight to the IBW

- **ABW = IBW + 0.4 \times (TBW – IBW).**

- Do we use IBW, TBW, ABW, LBW?

What dose in obese patient?

- Most drugs based on TBW as in normal BMI patient TBW ~ LBW ~ IBW
- Obese patients have increased LBW but very high fat mass means IBW < LBW < TBW
- If base doses on TBW in obese patients, will overdose them. If base on LBW, can underdose
- Overall LBW or ABW is safest approximation for iv opioid and anaesthetic agents

Unpredictable effects and prolonged duration of action of GA drugs

- Mass of adipose tissue affects pharmacokinetics of most GA drugs.
- Increase in Vd for fat soluble drugs so use IBW
- Change free drug fraction - Changes to plasma protein binding: plasma albumin unchanged, increased a1-acid glycoprotein, adsorption of lipophilic drugs to lipoproteins
- Altered metabolism.
- Altered clearance: Increased Renal blood flow. Increased GFR.
- Some drugs cleared more rapidly in obese patients than in normal controls due to higher CO and splanchnic blood flow

TIVA = Total intravenous anaesthesia
Propofol bolus dose or an infusion

- Propofol bolus induction dose should be based on LBW
- Propofol highly lipid soluble but high clearance so infusion rate should be based on TBW not IBW.
- But infusion pump max weight 150kg (Marsh Model) or BMI >35 in females or >42 in males (Schneider model)

• Is this the right dose? AWARENESS RISK…

Awareness in obese patients

- Increased incidence in obese patients of accidental awareness under anaesthesia – NAP 5
  - 50% during induction anaesthesia (thiopentone > propofol)
  - 93% with muscle relaxants
- Induction dose correlates well with LBW for unconsciousness but obese patients wake up more quickly after a bolus dose due to redistribution of lipophilic drugs into a higher fat mass
- If use based on TBW – hypotension ++++
- So sick obese patient – high risk awareness…

http://www.nationalauditprojects.org.uk/NAP5report
Volatile Maintenance

• Sevoflurane accumulation in fatty tissues over time, longer wake up time
• Desflurane less accumulation in fatty tissues, potentially better choice in obese patients but more noxious to environment
Drugs – Obesity changes Pharmacodynamics

- Incidence of OSA and increased fat deposition in pharynx and in chest wall increases risk of adverse respiratory events secondary to anaesthetic drugs

"Dose adjustment of anaesthetics in the morbidly obese." British Journal of Anaesthesia 2010. 105 (S1)i16-i23.
Muscle relaxants & Obesity

• Less fat soluble drugs show little to no change in Vd e.g. Non-depolarising muscle blockers – so should use LBW or IBW plus 20%
• Rocuronium at high dose has unpredictable duration before reversal possible.
• Except Suxamethonium = dose on TBW. Wears off in 5 minutes.

• *Dose adjustment of anaesthetics in the morbidly obese.*” British Journal of Anaesthesia 2010. 105 (S1)i16-i23.
Sugammedex – instant reversal

- Dose based on actual body weight
- Instant reversal
- Higher doses (16mg/kg) needed if given straight after Rocuronium vs later on (2mg-4mg/kg)
- Each ampoule 200mg
- Very expensive (~$120/ampoule)
- Time saver
- Very useful especially in obese patients

Source: Bridion production information
ANALGESIC AGENTS

- Marked increased incidence of adverse respiratory events secondary to opioids in obese or morbidly obese patients
- More susceptible to opioid induced upper airway obstruction and respiratory depression
- Dosing should be based on IBW or LBW and age.
- Fentanyl may be better choice as no long acting metabolite. Avoid background infusions
- Avoid spinal morphine in OSA?
- Especially important not to mix sedative medications with opioid PCA in obese patient

Dose adjustment of anaesthetics in the morbidly obese.” British Journal of Anaesthesia 2010. 105 (S1)i16-i23.
Opioid sparing agents...

- Ketamine
- Tramadol
- Paracetamol and NSAIDS
- Single shot regional block, continuous LA infusion catheters.
- TAP blocks – Intra-op by surgeon or at the end of case, ultrasound guided by anaesthetist. Opioid sparing, better patient satisfaction
- Spinal with morphine before GA (caution in suspected OSA)
Obesity & Pain

- No hard evidence obese patients feel pain differently or have different analgesic requirements
- Chronic pain issues in obesity (DM, OA)
- Harder to elicit surgical signs
- Obese patient with diabetes may experience neuropathic pain/peripheral neuropathy with potential for reduced sensation
EPIDURAL AND SPINALS
Doses in Obesity

- LA doses should be reduced by 25% for spinal and epidural blocks as engorged epidural veins and fat impinge on the volume of the epidural space. Height of person, how many weeks of pregnancy.
- Heavy Marcaine vs Plain Marcaine
- High block, inadequate block
- Current study on failure rate of early epidurals in labour on obese parturients.
Infiltration LA doses in obese patients

- Estimations of max infiltration doses of LA should be based on ideal body weight
  - IBW (kg) = height (cm) – 100 (males)
  - IBW = height (cm) – 105 (females)

- LBW = 20% + IBW

- Many complex formula. Regardless of TBW, LBW rarely exceeds 100kg in men and 70kg females
Post-op

- Slow to wake-up
- Problems with post-op recovery
- OSA – CPAP/Bipap, Optiflow
- Analgesia post-up
- HDU or ICU post-op
- Near the nurses station, SPO2 probe
THE FUTURE – HIGH FAT, LESS BONEY BITS?

Wall-E : 2008; PRODUCED BY pixar, RELEASED BY WALT DISNEY)

- *Earth’s original inhabitants have become morbidly obese due to effects of microgravity and relying on spaceship robots for every need*
Obesity Game Changers…

- Rocuronium with nearly instant reversal Sugammadex
- Video laryngoscopes – C-MAC.
- Pre-oxygenation and post-extubation with Optiflow. Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE). Up to 70L/min 100% O2. Increases apnea time - Apneic oxygenation with washout of anatomical dead space (less CO2 build up).
Obese Children

- Gas induction vs IV induction
- Generally healthy apart from respiratory derangement secondary to obesity
- De-saturate quickly on gas induction
- Hypoxia post induction more likely – bradycardia and arrest
- IV access difficult
- OSA
- My worst case this year 40kg 4yo.
How to give a GA to the heaviest man in the world

• 20yo male 610Kg, airlifted to hospital Saudi Arabia.
• 100kg weight loss over 4 months
• Laparoscopic gastric sleeve performed when patient 510kg
• Video laryngoscope, ramped: propofol 350mg, roc 80mg, fentanyl 200mcg
• Maintenance desflurane and remifentanil infusion
• Sugammadex used to reverse

Some issues to consider when booking Obese patients

- Don’t leave it to the anaesthetist to be the baddy and cancel “inappropriate” cases.
- We can give an anaesthetic to anyone but we can’t guarantee everyone would survive.
- Elective vs emergency surgery.
- Elective – cancel until some weight is lost? E.g. TKR/THR, nasal polyps…
- Risk vs benefit analysis
Some issues to consider when booking Obese patients

- Can it be done with amazing sedation from us and LA from you?
- Can we give a neuraxial or regional block?
- ERAS model for obese patients?
Our future??

Wall-E
Take home messages

• Obese patients increase anaesthetic time and risks
• Spinal/Epidural or LA with sedation generally safer than a GA for obese patient.
• Any condition that would make a patient a difficult anaesthetic is magnified when the patient becomes obese
• If the patient has developed end-organ damage from the obesity, have increased risk of complications from anaesthesia
JUST CALL YOUR FRIENDLY ANAESTHETIST IF...

• OBSESE – *how much does the patient weigh exactly? How tall?*
OR YOUR ANAESTHETIST MIGHT LOOK LIKE THIS...
Instead of this...
I can handle BMI 60.
I am Yoda.