Patients with Morbid Obesity as a Special Population in Critical Care

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- 56 WM with morbid obesity in MVA found to be unconscious behind the wheel.
- What are the special issues or concerns?
- Extraction, additional EMS staffing, gurney lift, physical exam, IV access, intubation, medical hx, radiology access for >300 lbs, diagnosis and treatment are all special considerations.



Define obesity beyond BMI

- Raise awareness of special issues in emergency/critical care setting effecting patients with morbid obesity and their ICU and emergency care givers.
- Recognize bias and discrimination in attitudes towards patients with the disease of obesity

Population Data

Trends in overweight, obesity, and extreme obesity among adults aged 20–74 years: United States, 1960–2008



Increasing Prevalence





Sturm R. Public Health. 2007;121:492-496.

NIH – National Heart, Lung, and Blood Institute

Classification of Overweight & Obesity by BMI, Waist Circumference, & Associated Disease Risks				
	Disease Risk* Relative to Normal Weight and Waist Circumference			
	BMI (kg/m2)	Obesity Class	Men 102 cm (40 in) or less Women 88 cm (35 in) or less	Men > 102 cm (40 in) Women > 88 cm (35 in)
Underweight	< 18.5		-	-
Normal weight	18.5 – 24.9		-	-
Overweight	25 – 29.9		Increased	High
Obesity	30 - 34.9	I.	High	Very high
	35 – 39.9	П	Very high	Very high
Extreme obesity	≥ 40	Ш	Extremely high	Extremely high

* Disease risk for type 2 diabetes, hypertension, and CVD.

+ Increased waist circumference also can be a marker for increased risk, even in persons of normal weight

Edmonton Obesity Staging

Stage	Obesity-related Risk Factors	Example	Patient Health Risks
0	None		None
1	Subclinical	Pre-DM, pre-htn	Mild
2	Established	Htn, DM, OSA, OA, GERD, PCOS, anxiety	Moderate
3	Established end-organ damage	MI, HF, DM complication, disabling arthritis	Significant
4	Severe disabilities	End-stage disabilities	Severe

Sharma AM & Kushner RD. *Int J Obes*. 2009. Also as proposed by AACE/ACE Cardiometabolic Disease Staging System.

2014 AACE/ACE Consensus Conference on Obesity

The AACE Advanced Framework for a New Diagnosis of Obesity				
Diagnosis	Anthropometric Component	Clinical Component		
Overweight stage 0	BMI 25-29.9 kg/m2	No obesity-related complications		
Obesity stage 0	BMI ≥30 kg/m2	No obesity-related complications		
Obesity stage 1	BMI ≥ 25 kg/m2	Presence of 1 or more mild-moderate obesity-related complications		
Obesity stage 2	BMI ≥25 kg/m2	Presence of 1 or more severe obesity-related complications		

BMI = body mass index

WT Garvey et al, American Association of Clinical Endocrinologists and American College of Endocrinology Position Statement on the 2014 Advanced Framework for a New Diagnosis of Obesity as a Chronic Disease, Endocrine Practice Vol 20 #9 Sept 2014 977

Assess for the Presence of Obesity, Adiposopathy, Fat Mass Disease

Obesity may be assessed using several criteria (thresholds vary based on gender and ethnic differences):

Body Mass Index (BMI)	18.5-24.9 kg/m²	25.0-29.9 kg/m²	<mark>≥</mark> 30 kg/m²
Percent Body Fat	Male: <25% Female: <32%		Male: >25% Female: >32%
Waist Circumference	Male: <40 in. Female: <35 in.		Male: >40 in. Female: >35 in.
Edmonton Obesity Staging System		Stage 0, 1, 2, 3, 4	

No Obesity	Overweight		Obesity Class I: BMI 30.0-34.9 Class II: BMI 35-39.9 Class III: BMI <u>></u> 40.0	
Prevention	Primary care pro If treatment is ineffective, refer to an obesity medicine specialist		vider or dietitian Consider referring to an obesity medicine specialist.	

Adiposopathy

Fat Mass

- Hypoventilation
- O Sleep Apnea
- O GERD
- O Venous stasis
- Bladder Dysfunction
- O Osteoarthritis
- O Intertrigo

'Sick' Fat

- Dysglycemia and insulin resistance
- O Hypertension
- Hormonal dysregulation
- O Non-alcohol fatty liver
- O Obesity related cancers
- Other inflammatory/hormonal/metabolic conditions

Factors Secreted by Adipose Tissue





Impact in ICU

25% of ICU patients



Brusco Jr, Critical Care of the Morbidly Obese Patient, Current Conceps in Adult Critical Care

Obesity and Morbid Obesity

- Associated conditions
 - O Diabetes 10-20%
 - CAD 14-19%
 - Hypertension 64%
- Unique challenges in management

Outcomes of Morbid Obesity in the ICU

- Higher rates of mortality
- Higher rates of nursing home admission
- Higher rates of intensive care unit complications
 - Sepsis, nosocomial pneumonia, ARDS, catheter infection, tracheostomy, ARF
- O Longer stays in ICU
- Longer time on mechanical ventilation

Yaegashi M, J Intensive Care Med, 2005 May-Jun;20(3):147-54

Obesity Paradox

'J' Curve of BMI and Mortality



Phenomenon

- Improved survival for critically ill patients with obesity and septic shock
 - selection bias in resuscitation?
 - Leptin benefits?
 - Short term beneficial immune and inflammatory response?
 - Improved protein nutrition?
 - Less fluid hydration?

Dickerson Critical Care 2013, 17:154

Prognostic Indicators

Non-inclusion in APACHE (Acute Physiological and Chronic Health Evaluation) score
 Non-inclusion in SAPS (Simplified Acute Physiological Score)

Issues for First Responders

- MVA's, home accidents
- Evacuation and Gurney
- Staffing and equipment
- Airway access
- Vascular access
- Abdominal thrusts/Heimlich maneuver



- Risks of accidents falls, MVA, contributing medical events, polypharmacy
- Evacuation "getting the patient out of the structure and onto a stretcher remains a challenge" EMSworld.com
- Positioning : place posterior fat pad off table to allow neck to extend
- Engineering: An ambulance company announces preparedness via an ambulance equipped with a cable and winch capable of handling a patient up to 1,000 lbs. 650 lb capacity not uncommon. www.emsworld.com/article/10324363
- Hazards: Among EMT's nearly 50% reported back injury on the job 2007 and therefore more staffing per call and delays www.jems.com



- Cot size
- O Physical Exam
- Radiology
- Limited physical reserve, lower functional capacity when supine, desaturate quicker
- IV Fluids, ?thiamine first (if history of bariatric surgery)
- NG tubes (special care in placing if history of bariatric surgery)
- O BLS, ACLS
- Other procedures

Procedures

- O Intubation
- Epidural or intrathecal catheters
- Cardiac Catheterizations
- Colonoscopy/EGD
- Vaginal Exam
- O Surgery
- Cesarean and vaginal deliveries

• "high initial failure rate"
Soens, Acta Anaesthesiol Scand 2008 Jan;52 (1):6-19
• "failed intubation and aspiration"

Roofthooft, Curr Opin Anaesthesiol 2009 Jun;22(3):341-6

 "Difficult Intubation under emergent conditions"

Vallejo, Curr Opin Anaesthesiol 2007 Jun;20(3):175-80

Intensive Care

Systems

- Pulmonary
- O Cardiovascular
- O Renal
- O GI
- O Endocrine
- Hematologic/Oncology

Special Consideration

- Procedures
- O Imaging
- Nutrition
- O Anesthesia
- Pharmacotherapy
- O Skin care
- O Mobility
- Staff safety

Pulmonary

• Deranged mechanics

- Marked reduction in exp reserve vol (ERV) and forced expiratory volume in 1st second (FEV1)
- Rapid desaturation, Hypoxemia and greater alveolar-arterial oxygen gradient.
 - Decreased compliance of chest wall, airway resistance abnormal diaphragmatic position, upper airway resistance.
 - Profound atelectasis, intrapulmonary shunting
- Obesity hypoventilation syndrome
 - 30% weaker respiratory muscle strength with more severe derangements TLC and FEV1
- Obstructive sleep apnea syndrome: 42-48% of morbidly obese men

Pulmonary

- Intubation Issues: surgery, smaller airways, redundant oropharyngeal tissues, small oral aperture, limited range of short/thick neck, resp failure due to hypercarbia. Even tracheostomy can be technically difficult
- Ventilator Management:
 - TV initially 5-7 mL/kg IBW, or based upon IBW. adjust to blood gas.
 - Higher levels of PEEP (positive end-expiratory pressure) 7-10 cm H2O to overcome atelectasis
 - Peak inspiratory pressure <35 cm H2O
 - High FIO2 60%
- O Increased barotrauma, aspiration, nosocomial pneumonia, ARDS, mechanical ventilation
- Mallempati score

Mallampati Score



Cardiovascular

- Venous thrombosis and embolism
 - Decreased mobility, pulm hypertension, venous stasis, hypercoagulable state
- Total blood volume and cardiac output (hyperdynamic state) elevated linearly to excess body weight
- Impaired cardiac function:
 - Decr LV contractility, LV hypertrophy, decr compliance, diastolic ventricular dysfunction.
 - Inability to tolerate handling fluid loads
 - Cor Pulmonale, pulmonary htn 2nd to OSA
- EKG abnormalities:
 - Left axis deviation, flattened T waves, prolonged QTc intervals

Renal

- CKD 2nd to hypertension and diabetes
- O Acute kidney injury
- Intraabdominal hypertension
 - Venous congestion and poor arterial perfusion
- ARDS, sepsis, embolism risks



- Stress ulcers
- Vomiting, aspiration, GERD
- Gastroparesis
- O Cholelithiasis
- O Hepatomegally, NAFLD, NASH, Cirrhosis, hepatocellular ca
- Upright positioning may be helpful

Hematology/Oncology

- O Hypercoagulable
- O 2nd polycythemia
- O Nutritional deficiency and anemia
- O Lymphoma
- O Multiple Myeloma

- Hormonal cancers
 - Breast, prostate, thyroid
- Gyn cancers
 - O Endometrial, ovarian
- GI cancers
 - Esoph, gastric, gallbladder, liver, pancreatic, colon
- O GU cancers
 - O Renal

Infection and Sepsis

- poor wound healing, poorly vascularized adipose tissues
- elevated inflammatory state
 - Linear to level of excess visceral adiposity
 - Can deteriorate rapidly
- diabetic, cardiac, pulmonary, renal, and pharmacologic considerations in therapy
- Increased risk nosocomial infection

Dermatologic

• Pressure ulcers, venous stasis, lymphedema, DM foot ulcers

- Intertrigo, psoriasis, perineal dermatitis, panniculitis
- Wound: dressing, dehiscence, seroma formation, graft failure
- O Cellulitis
- Posture changing
- Nursing mechanical challenges
 - Risk for accidental extubation, dislodgement of vascular lines
 - O Injury to staff



- Glycemic control (NICESUGAR trial) sustained hyperglycemia is less detrimental than fluctuating blood glucose levels
- Insulin resistance, may unmask new DM in the ICU including high dose insulin infusions
- Diabetes and co-morbidities: nephropathy, poor wound healing, gastroparesis, cardiac disease

Hormonal aspects in morbidly obesity

- Higher glucose levels, more exaggerated response to stress
- Lower human growth hormones, but normal response to stress
- Higher insulin levels with lower response to stress
- Higher cortisol levels with normal response to stress
- Higher norepinephrione and epi levels with much lower response to stress
- Higher levels of ketones and free fatty acids
- Normal resting energy expenditure (REE) with higher muscle and nitrogen loss in ICU

Nutritional/Hormonal

• Protein malnutrition risks protein catabolism

- 50% greater than non-obese
- Protein breakdown to fuel gluconeogenesis
- Increased insulin suppresses lipid mobilization from fat stores

Insulin and Lipolysis



Nutrition Formulas

Harris-Benedict Equation

- very accurate in all BUT:
 - The very muscular (will under-estimate calorie needs) and
 - Excess adiposity (will over-estimate calorie needs).
- O Based upon actual weight, results in overfeeding
 - Women: BMR = 655 + (4.35 x weight in pounds) + (4.7 x height in inches) (4.7 x age in years)
 - Men: BMR = 66 + (6.23 x weight in pounds) + (12.7 x height in inches) (6.8 x age in years)
 - Sedentary BMR x 1.2

Mifflin-St Jeor Equation

- most reliable, predicting RMR (resting metabolic rate) within 10% of measured in more nonobese and obese individuals <u>Am Diet Assoc.</u> 2005 May;105(5):775-89
 - 10*wt(kg) + 6.25*Ht(cm) 5*Age(yrs) + 5 = resting energy expenditure (male)

10*wt(kg) + 6.25*Ht(cm) - 5*Age(yrs) -161 = resting energy expenditure (female)

Multiply that amount by an "activity factor" based on how active you are during the day: 1.3=sedentary

Body Composition Testing

Indirect Calorimetry

- Method of choice
- Hypocaloric, Hyperproteic
 - Calorie: 60-70% of requirements
 - 11-14 kcal/kg current body weight, OR
 - 22-25 kcal/kg IBW with 2-2.5 g/kg IBW of protein daily

Other

- Bioelectric impedance analysis
- O Air densitometry
- Indirect Calorimetry
- O Radiology: DEXA, MRI, CT
 - Gold Standard
- Archived
 - Skinfold thickness/calipers
 - Hydrostatic (water displacement)

Body Composition Testing

Bioelectrical Impedance

Air Plethysmography





Body Composition Testing: Indirect Calorimetry



- In critically ill patients receiving TPN, indirect calorimetry, if available, remains the most appropriate clinical tool for accurate measurement of REE. Am J Clin Nutr 1999;69:461–6.
- REE (Resting energy expenditure) = caloric needs
- determination of heat production of an oxidation reaction by measuring uptake of oxygen and/or liberation of carbon dioxide and nitrogen excretion and then calculating the amount of heat produced

Body Composition

Indirect Calorimetry

- Resting Energy Rate (RMR)
- Measures O2 consumption, Co2 production
- Respiratory exchange ratio (RER = VCO2 / VO2).



Pharmacotherapy

• Ideal Body Weight (IBW), most commonly used

- IBW males = 50 kg + 2.3 kg/in > 5 ft
- IBW females = 45.5 kg + 2.3 kg/in > 5 ft
- Adjusted body weight (AdjBW) for 130 % 200 % of IBW
 - O AdjBW = (Actual BW IBW) 0.4 + IBW
- Volume of distribution, clearance
 - Increase with lipophilic meds, so may require higher bolus doses to rapidly achieve therapeutic plasma concentrations vs ideal body weight
 - Hydrophilic meds do not distribute significantly to adipose, so IBW may be more appropriate

O Unpredictable

Pharmacotherapy – Titrate to Clinical Effect

Ideal Body Weight (IBW)

- cephalosporins, penicillins, beta-lactams
- propofol, lorazepam, midazolam (lipophilic)
- atracurium, vecuronium (muscle relaxants)
- fentanyl, morphine (initially small dose to desired clinical effect, ensure naloxone availability)
- Amiodarone, procainamide, beta blockers, digoxin, calcium channel blockers
- O Phenytoin

Total Body Weight (TBW)

- Vancomycin, incr dosing freq (measure levels!)
- succinylcholine (neuromuscular blocking agents)
- O Benzos, propofol
- anticoagulants enoxaparin and low molecular weight heparin (LMWH)
 - SC variable peripheral perfusion
 - consider using adj BW with more frequent dosing i.e. q 8 hr.



- Chest x-ray compression of lungs and thick chest wall, large breasts female & male
- Ultrasound limited by body habitus
- Echocardiogram thick chest wall, large breasts
- Nuclear cardiac images compressed apex
- CT or MRI better images, however may have table size constraints
- Veterinary scanners may be considered

Nursing

Medical Issues

- Pressure ulcers Compression of low blood flow in contact with mattress
- Positioning & turning of patient optimal is lateral decubitus allowing for pannus, or reverse Trendelenburg for pulmonary toilette
- Skinfold issues, harboring pathogens and breakdown of barrier
- Catheter hygiene, urinary and other
- May require additional staffing to assist in appropriate care with safety to patient and staff

Special Equipment

- Air mattress, bariatric bed
- O Patient lifts, transfer equipment
- Specialized bed chairs
- XL or XXL sphygmometers
- Laryngoscope handles
- Soft clothes between skin folds, support pannus or limbs
- Antifungal powders or creams
- Incontinence pads size appropriate
- Longer needles for IM injections

Attitudes {at risk of} in ICU

- Dehumanized?
- Appearance based?
- More work?
- Higher utilization of resources?
- Less hope of outcome?

Attitudes

Physicians:may view patients as

- O non-compliant
- O lazy
- O lacking self control, weak willed
- O unintelligent
- O Unsuccessful

• Nurses:

- O31 percent "would prefer not to care for individuals affected by obesity"
- O24 percent agreed that individuals affected by obesity "repulsed them"
- O12 percent "would prefer not to touch individuals affected by obesity"

Consequences of Attitudes towards patients with obesity

Patient psychological outcomes can include:

- O Depression, Anxiety
- O Low self-esteem
- Poor body image

The social effects can include:

- Social rejection by peers
- Poor quality of interpersonal relationships
- Potential negative impact on academic outcomes

The physical health outcomes can include:

- Unhealthy weight control practices
- O Binge-eating
- Avoidance of physical activity

Avoidance of health care visits, screening, early treatment and maintenance !!!

Obesity as a Disease: AMA 2013

AMERICAN MEDICAL ASSOCIATION HOUSE OF DELEGATES

Resolution: 420 (A-13)

- Introduced by: American Association of Clinical Endocrinologists American College of Cardiology The Endocrine Society American Society for Reproductive Medicine The Society for Cardiovascular Angiography and Interventions American Urological Association American College of Surgeons
- Subject: Recognition of Obesity as a Disease

What if....

- Genetics, epigenetics
- Dysregulation of appetite gut/brain neuro-hormonal processes
- O Sarcopenia
- O Hypothalamic inflammation
- Traumatic brain injury, sleep disruption
- Abuse history/Trauma
- Leaky gut syndrome, Microbiome
- Mitochondrial Dysfunction / Oxidative Stress
- Viruses, pollution, environ contaminants
- Food additives, High fructose Corn syrup, etc
- Cross Addiction
- Physical or psychological disability
- Obesogenic medications
- Following a low fat diet per guidelines ???



Dietary

guidelines

McAllister, et al, Ten Putative Contributors to the Obesity Epidemic, Crit Rev Food Sci Nutr 2009;49 (10):868-913

Other thoughts....

Robert Lustig, Mark Gold, David Ludwig and others

Sugar ACCORDING TO BRAIN SCANS. IS AS ADDICTIVE AS

Obesogenic Cycles



Applying Osteopathic Principles to Obesity Medicine

The body is a unit/a person of mind, body and spirit

 E.g. nutrition, behavioral, physical activity, medical, surgical, community/social are combined options for preventing and treating obesity thru the lifespan. Treat the person, not the weight Structure and function are reciprocally interrelated

• E.g. the interplay of gut hormones such as ghrelin from the stomach, hypothalamic NPY and reduction of leptin results in food intake. Adequate leptin, GLP1, PYY, OXM, & amylin secretion as result of food intake send signals of satiety to stop food intake.

Self-regulation, self-healing

 E.g. With removal of obesogenic diet, environment, stressors, & medications some patients experience recovery from obesity. Add back appropriate foods, water, activity, sleep and mindfulness. Rational treatment based upon understanding of the basic principles

• E.g. applying something as simple as carbohydrate reduction with increased protein/fat nutrition in diabetes can result in satiety, weight loss, and diabetes control without or with minimal use of medication.

Summary

"Care of the morbidly obese patient on the ICU presents a formidable challenge to healthcare professionals and has considerable economic implications. With adequate training of staff and appropriate use of resources along with multidisciplinary team management including relatives of patients, better outcomes can be achieved."

Continuing Education in Anesthesia, Critical Care & Pain, Vol 14 #2, 2014



Additional Resources

- Obesity Medicine Association <u>www.obesitymedicine.org</u>
- The Obesity Society www.obesity.org
- AACE https://www.aace.com/files/guidelines/ObesityAlgorithm.pdf
- Obesity Action Coalition www.obesityaction.org
- 2013 AHA/ACC/TOS Guideline for Bariatric Surgery https://asmbs.org/resources/clinicalpractice-guidelines-for-the-perioperative-nutritional-metabolic-and-nonsurgical-support-of-thebariatric-surgery-patient

References

• Noted on individual slides and supplemental page

Questions



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