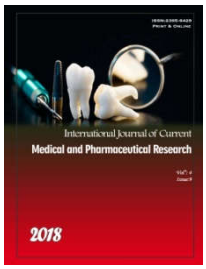
Review Article

INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH

ISSN: 2395-6429, Impact Factor: 4.656
Available Online at www.journalcmpr.com
Volume 4; Issue 9(A); September 2018; Page No. 3612-3616
DOI: http://dx.doi.org/10.24327/23956429.ijcmpr20180522



ANESTHETIC CHALLENGES OF OBESE PARTURIENTS

Eynas O. Abdalla., Ismat ELsaigh and Santhosh Gopalakrishnan

Anesthesia Department, Women's Hospital Hamad Medical Corporation, Doha, Qatar

ARTICLE INFO

Article History:
Received 11th June, 2018
Received in revised form 26th July, 2018
Accepted 18th August, 2018
Published online 28th September, 2018

Key words:
Obesity, Pregnancy, Anesthesia

ABSTRACT

Obese pregnant women have been reported to have increased risks of maternal, fetal, and neonatal mortality and morbidity compared with non-obese pregnant women. For example, the incidence of cesarean section is higher among obese than non-obese parturients. Moreover, caring for obese parturients is very challenging for all health team members, due to large body size, physiological changes of pregnancy, and associated medical comorbidities, including cardiovascular disease, fatty liver disease, pulmonary hypertension, depression, obstructive sleep apnea and degenerative joint disease. Therefore, early consultation with anesthesiologists is mandatory for obese parturients, allowing sufficient time for anesthesia planning and optimization. Neuraxial analgesia, however, should be started as soon as possible during labor, minimizing the need for general anesthesia. For caesarian delivery, the continuous catheter technique is better than the single shot spinal technique. It is also important not to jeopardize the mother's life to save a compromised fetus. Thrombo-prophylaxis is essential due to an increased risk of thromboembolic events. Communication with the obstetric team is important for good care, and adequate postoperative pain control is essential for early mobilization.

INTRODUCTION

Obesity is a widespread medical problem with an increased incidence among women. Obesity has been implicated as a direct cause of disease in many organ systems, with body mass index (BMI) found to correlate with the development of concomitant diseases. As reported by the World Health Organization (WHO), obesity and morbid obesity have reached pandemic status worldwide , especially among women of reproductive age {16-44 years}(Saravanakumar, Rao, and Cooper 2017).Because the likelihood of operative delivery is higher among obese than non-obese women, many obese parturients require anesthesia during delivery.

The Confidential Enquiry into Maternal and Child Health (CEMACH)study in 2006 mentioned obesity was a factor in four of the eight maternal deaths due to anesthesia(Confidential Enquiry into Maternal and Child Health 2006). Complication rates have increased among obese women of child-bearing age, as the combination of pregnancy and weight puts patients at increased risk, including during both general and neuro-axial anesthesia (Hedley *et al*. 2004).

High BMI during pregnancy has been associated with increased rates of some maternal and fetal comorbidities. The WHO and the National Institutes of Health (NIH) have classified normal BMI as 18.5-24.9 kg/m2, overweight as 25-29.9 kg/m2, obese class 1as 30-34.5 kg/m2, obese class 2 as35-39.9 kg/m2, and obese class 3as >40 kg/m2.

Physiological changes

The physiological changes related to pregnancy increase patient risks during anesthesia management. These risks are enhanced by obesity.

Cardiovascular system

Pregnancy directly affects and stresses the cardiovascular system, with changes proportionally related to increases in oxygen demand. These changes in cardiovascular and endothelial function may be exacerbated by obesity, with changes directly related to the length and degree of obesity (Vasan 2003).

Excess fat deposition is directly proportional to cardiac output. For example, cardiac output increases 30-50 ml/min for each 100 grams of fat deposited. Thus, an increase in weight of 50 kg requires an additional cardiac output of about 1-1.5 l/min. If the myocardium tissue is affected by fat deposition, conduction and contractility can be dangerously affected (Vasan 2003; Veille and Hanson 1994). Morbidly obese patients a reat greater risk of serious arrhythmias and sudden cardiac arrest, which may be due to minor QT prolongation.

Endothelial abnormalities in obese patients can be induced by inflammation of the vascular system as well as hyperlipidemia. In pregnant women, these changes may predispose to pregnancy induced hypertension (PIH) (Saravanakumar, Rao, and Cooper 2006). There are strong associations among

Corresponding author:* **Eynas O. Abdalla
Anesthesia Department, Women's Hospital Hamad Medical Corporation, Doha, Qatar

obesity, high blood pressure, diabetes, high lipid concentrations and compromised cardiac function, with all being leading preconditions to the development of cerebrovascular accidents and coronary artery diseases (Tomoda *et al*. 1996). In addition, obesity has been associated with peripartum cardiomyopathy, a potentially fatal disease(Ramsay *et al*. 2002; Kaufman, Bondy, and Benjamin 2003).Hormonal changes during pregnancy include progesterone-induced relaxation of smooth muscle, reducing vascular resistance. These changes may not occur in obese pregnant patients, as their blood vessels are less reliable. The combination of high cardiovascular yield and lifted after load can induce left ventricular hypertrophy. Left ventricular hypertrophy was found to correlate with the extent of obesity in pregnant women (Veille and Hanson 1994).

PIH affects 7% of all pregnancies, with a linear relationship between PIH and the degree of obesity (Robinson *et al*. 2005). Supine hypotension syndrome due to an aortocaval compression is an early phenomenon in obese parturients, observed as early as 18 to 20 weeks of gestation. In supine hypotension syndrome, the extra fat of the abdomen combines with uterine and vascular compression, markedly reducing cardiac output and placental perfusion. Some obese patients experience resting tachycardia, which resolves in the lateral position (Carson, Powrie, and Rosene-Montella 2002). Therefore, left uterine displacement is essential to prevent supine hypotension syndrome (**Table 1**).

Table 1 Cardiovascular changes in obesity and pregnancy.

Parameter	Pregnancy	Obesity	Combined
Heart rate	↑	↑↑	↑
Stroke volume	↑↑	↑	↑
Cardiac output	↑↑	↑↑	↑↑↑
Blood volume	↑↑	↑	↑
Mean arterial pressure	↑	↑↑	↑↑
Systolic function	↔	↔↓	↔↓
Diastolic function	↔	↓	↓
Systemic vascular resistance	↓		↓
CVP	↔	↑	↑↑
Pulmonary hypertension	Absent	May be present	May be present
Pre-eclampsia			↑↑

Pulmonary system

The pulmonary system compensates for the increased oxygen and ventilation demands of pregnancy. Minute ventilation is one of the most important respiratory parameters, increasing by 50% at term. In contrast, chest wall compliance decreases, enhancing the effort needed to breathe, with ventilation depending mainly on position. Restrictive lung diseases are common in obese patients, with characteristic increases in inspiratory capacity and reductions in expiratory reserve volume, vital capacity and functional residual capacity (**Table 2).**The decrease in expiratory lung volume along with the increase in closing volume leads to hypoventilation of dependent lung regions (**Figure 1**).Changes in the respiratory system related to obesity and pregnancy have been found to include:

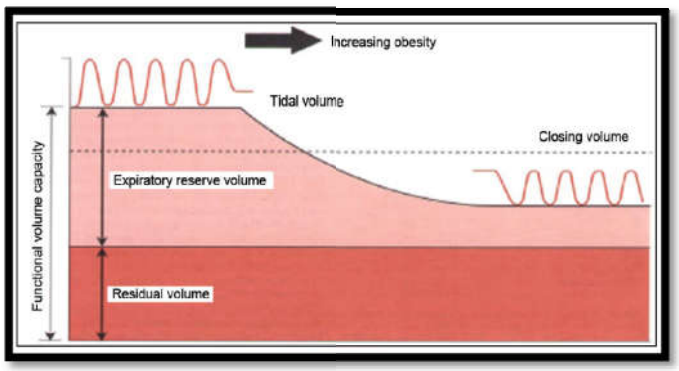
1. Increased oxygen consumption, in direct proportion to the increase in body fat
2. Decreased chest compliance due to extra fat in the chest wall, which will pressurize the thorax, increasing the work of breathing and deterioration of ventilatory parameters, including further reductions in FRC, increases in closing volume and atelectasis formation
3. Thoracolumbar lordosis {kyphosis} due to the mechanical posture of obese parturients
4. Increased incidence of obstructive sleep apnea (OSA), characterized by periodic pharyngeal obstruction, resulting in respiratory depression, airway obstruction, hypoxia and hypercarbia during sleep. The main cause of the pharyngeal obstruction is soft tissue enlargement. STOP-BANG criteria have been employed to identify those at increased risk of perioperative complications associated with OSA. The definitive test is a sleep study. Patients with OSA will require postpartum monitoring of their respiratory function, especially if they receive opioid analgesics. Postoperative CPAP should be considered to minimize airway collapse and desaturation.

Progesterone is important in relaxing the smooth muscles of the airways, reducing the negative effect on the respiratory system and airway resistance (Unterborn *et al*. 2001).

Table 2 Respiratory changes in pregnancy, obesity and both. With permission from (Rao and Rao 2010)

Parameter	Pregnancy	Obesity	Combined
Progesterone level	↑	↔	↑
Sensitivity to CO_2	↑	↓	↑
Tidal volume	↑	↓	↑
Respiratory rate	↑	↑↔	↑
Minute volume	↑	↓↔	↑
Inspiratory capacity	↑	↓	↑
Inspiratory reserve volume	↑	↓	↑
Expiratory reserve volume	↓	↓↓	↓
Residual volume	↓	↓↔	↑
Functional residual capacity	↓↓	↓↓↓	↓↓
Vital capacity	↔	↓	↓
FEV_1	↔	↓↔	↔
FEV_1/VC	↔	↔	↔
Total lung capacity	↓	↓↓	↓
Compliance	↔	↓↓	↓
Work of breathing	↑	↑↑	↑
Resistance	↓	↑	↓
V/Q	↑	↑	↑↑
PaO_2	↓	↓↓	↓
$PaCO_2$	↓	↑	↓

Figure 1B



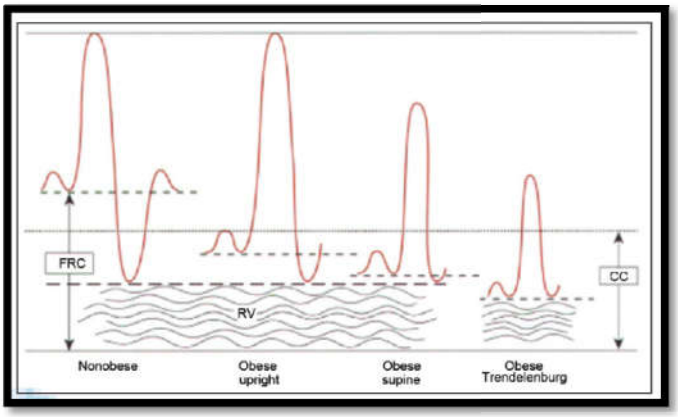


Figure 1 A Effect of obesity on lung volumes and closing pressure (Errol Lobo). **B.** Effect of positioning on morbidly obese patients. With permission from (Rao and Rao 2010).

Gastrointestinal system

The combination of pregnancy and obesity puts patients at high risk of gastric content regurgitation and possible lung aspiration. Among the physiological changes observed during pregnancy are progesterone-induced reduction in lower esophageal sphincter tone, an increased incidence of gastric reflux because of anatomical and hormonal changes and increases in the residual volume of the stomach and gastric acidity. The administration of opioids to women in labor has been found to reduce gastric motility and may even block emptying completely. Obese patients are less mobile, further increasing the risk of aspiration. Thus, nil-by-mouth guidelines should be adhered to strictly during labor, as well as the timely administration of nanoparticulate antacids, H2 receptor antagonist, and metoclopramide before induction of anesthesia.

Obesity increases the incidence of gallstones, fatty infiltration of the liver, and abnormalities on liver function tests. Hiatus hernia is not uncommon in obese fatty parturients, with these women being at increased risk of aspiration under anesthesia. Gastric volume during labor was found to be five times greater in obese than in non-obese pregnant women(Roberts and Shirley 2017).

Renal system

Pregnancy and obesity also induce multiple changes in the kidneys. Renal perfusion increases because of an increase in cardiac output. This, in turn, leads to a 1 cm increase in kidney size and hypertrophy. In contrast, the collecting system and ureters dilate because of hormonal changes and mechanical obstruction by the enlarged uterus, leading to physiological hydronephrosis.

Intra-abdominal pressure is high in pregnant, obese women, resulting in a reduction in renal blood flow. Increases in angiotens in converting enzyme and levels of rennin and leptin can increase sodium absorption and renal vasodilation. Glomerular filtration rate (GFR) increases during the first 12 weeks of gestation, peaks during the second trimester at 50% higher than the pre-pregnancy value and drops by 20% during the third trimester. This increase in GFR is due to the increase in renal plasma flow,t he reduction of plasma oncotic pressure in the glomerular capillaries resulting from hemodilution, and a slight increase in the filtration coefficient of the glomerular filtration barrier. This increase in GFR results in a reduction in plasma creatinine concentration of 0.4-0.6 mg/dl(**Table3).**

Table 3 Systemic and renal vascular changes during pregnancy.

Parameter	Change	
Kidney	Slightly enlarged	{increase up to 2 cm in length}
Ureter	Slightly dilated	Progesterone mediated smooth muscle relaxation and a tendency for urinary stasis and infection.
Glomerular filtration rate	increase	Up to 50%
Serum creatinine and uric acid	increase	Due to increased renal plasma flow
Glucosuria	Present	Decreased renal tubular threshold for glucose and amino acid

Musculoskeletal System

The combination of obesity and pregnancy results in a technical difficulty in positioning patients, including placing them in the left lateral tilt position to minimize aortocaval compression. Prolonged surgery can increase the likelihood of rhabdomyolysis, which is characterized by ischemia and death of muscle because of reduced blood supply caused by immobility.

Pharmacokinetics

The pharmacological effects of pregnancy and obesity on anesthetic drugs are extremely complicated and do not always mirror expectations. This complexity results from the many physiological changes that occur during these conditions, including increases in fat and lean body mass, and reductions in total body water and serum albumin concentration. Theoretically, lipophilic drugs, such as Propofol, opioids, benzodiazepines and barbiturates, have a larger volume of distribution in obese than in non-obese patients secondary to increased deposition in body fat. Although basing initial loading dose on total body weight (TBW) may be reasonable, the situation is more complicated. Therefore, a reasonable approach may be to calculate initial dose based on ideal body weight (IBW) and titrate additional dose based on clinical effect.

Thrombo-prophylaxis

The likelihood of venous thromboembolism (VTE) is five times higher in pregnant than in non-pregnant women(Toglia and Weg 1996), with VTE being a leading cause of maternal mortality. The incidence of VTE is more than twiceas high in obese than in non-obese parturients. This increased incidence of VTE can be explained by:

1. Immobility.
2. Increased lower limb venous stasis.
3. Hypercoagulability state induced by increases in fibrin and factors 2,7, and 9 and decreases in protein S and the fibrinolytic system.
4. Vascular damage induced by normal and cesarean delivery.
5. Increased blood viscosity due to polycythemia.

The incidence of VTE can be decreased by proper use of screening tools, such as ultrasound and Doppler, and administration of thrombo-prophylactic agents, such as low molecular weight heparin and unfractionated heparin.

Anesthetic Challenges

Technical issues arise during administration of anesthetic to obese pregnant women. These issues result from the combination of larger body size, physiological changes that occur during pregnancy and the presence of other medical conditions. Anesthesiology consultation is crucially important for obese women antepartum or early in labor toprovide sufficient time for planning and optimizing anesthesia. Specific written guidelines are required to deal with obese parturients during pregnancy, labor and delivery. These guidelines should include recommendations for:

1. Establishing early intravenous access, a difficulty that increases with BMI
2. Thrombo-prophylactic regimens
3. Early administration of regional anesthesia
4. Antacid prophylaxis
5. Availability of resuscitations and difficult airway trolleys
6. Proper measurement of BP with correct cuff size; if not visible, early insertion of an arterial line is essential
7. Availability of blood and blood products because of high risk of uterine atony and postpartum hemorrhage.
8. Involvement of a senior anesthetist

Anesthetic management for labor

Obese patients may experience more pain during labor than non-obese patients. This phenomenonmay be due to:

1. Fetal macrosomia
2. Shoulder dystocia
3. A positive correlation between BMI and pain (Melzack *et al*. 1984)

Systemic opioid and nitrous oxide have been associated with maternal drowsiness, hypoxia, and airway obstruction (Elbourne and Wiseman 2006). During labor, analgesia that includes neuraxial blockade is the most effective as it provides superior analgesia compared with inhalational and parenteral medication (Somuah, Smyth, and Howell C 2017). Neuraxial blockade (epidural catheter) provides a safe and effective bridge to surgical anesthesia if required, as well as reducing the risk of general anesthesia which was found to directly increase maternal mortality. The most common cause of maternal death is failure to oxygenate and ventilate the lungs. Although technically difficult, neuraxial analgesia should be introduced early, even before patient request or the onset of active labor. If placement of the epidural catheter is doubtful, it should be replaced immediately. Neuraxial analgesia has been found to improve respiratory function and reduce systemic catecholamine concentrations (von Ungern-Sternberg *et al*. 2004).

Preoperative assessment

Due to the significant risk of mortality and morbidity associated with the combination of pregnancy and obesity ("CMACE/RCOG Joint Guideline Management of Women with Obesity in Pregnancy Centre for Maternal and Child Enquiries" 2010) published guidelines recommend a multidisciplinary team approach when caring for obese pregnant women. These recommendations include:

1. Preconception counseling.
2. Measurement of BMI to screen for obesity.
3. Monitoring of BMI during pregnancy.
4. Strict guidelines for prenatal weight gain.
5. Anesthetist consultation during the third trimester with women having BMI >40 kg/m2 during this consultation, the anesthetist should:

- Take a comprehensive medical history and perform a physical examination with detailed evaluation of the airways because of the possibility of difficult intubation (Chestnut, n.d.). Other evaluations should include Mallampati scoring and measurement of thyromental distance and neck circumference (Gaszynski 2004}.
- Properly evaluate the cardiovascular and pulmonary systems.
- Perform baseline laboratory tests, including basic blood profile, lipid measurement, ECG, lower limb venous Doppler and a sleep study (Naguib *et al*. 1999) .
- Further examine patients with specific diseases, like chronic lung disease. These should include baseline arterial blood gas analysis, imaging (CXR) and pulmonary function tests.(Smetana 1999).

The anesthetist should clearly discuss the risks and benefits of different types of anesthesia with the parturient. These discussions should include a detailed explanation of the importance of neuraxial anesthesia and analgesia, including an awareness that the neuraxial technique may be technically difficult and time consuming, while encouraging parturients to request neuraxial analgesia as early as possible.

Acknowledgments

Funding

There was no funding for the development of this article.

Financial Disclosures

The author reports no conflicts of interest relevant to the content of this article.

References

Carson, M. P., R. O. Powrie, and K. Rosene-Montella. 2002. "The Effect of Obesity and Position on Heart Rate in Pregnancy." *The Journal of Maternal-Fetal & Neonatal Medicine* 11 (1). Taylor & Francis: 40-45. doi:10.1080/jmf.11.1.40.45.

Chestnut, David H. n.d. *Chestnut's Obstetric Anesthesia : Principles and Practice*.

"CMACE/RCOG Joint Guideline Management of Women with Obesity in Pregnancy Centre for Maternal and Child Enquiries." 2010. https://www.rcog.org.uk/globalassets/documents/guidelines/cmacercogjointguidelinemanagementwomenobesitypregnancya.pdf.

Confidential Enquiry into Maternal and Child Health, info@cemach.org.uk, Phone: 020 7486 1191. 2006. "Confidential Enquiry into Maternal & Child Health (CEMACH)." http://www.thehealthwell.info/node/214725?&content=resource&member=6744&catalogue=none&collection=none&tokens_complete=true.

Elbourne, Diana, and Richard REW Wiseman. 2006. "Types of Intra-Muscular Opioids for Maternal Pain Relief in Labour." In *Cochrane Database of Systematic Reviews*, edited by Diana Elbourne. Chichester, UK: John Wiley & Sons, Ltd. doi:10.1002/14651858.CD001237.pub2.

Hedley, Allison a, Cynthia L Ogden, Clifford L Johnson,

Margaret D Carroll, Lester R Curtin, and Katherine M Flegal. 2004. "Prevalence of Overweight and Obesity among US Children, Adolescents, and Adults, 1999-2002." *JAMA : The Journal of the American Medical Association* 291 (23): 2847-50. doi:10.1001/jama.291.23.2847.

Kaufman, Ian, Richard Bondy, and Alice Benjamin. 2003. "Peripartum Cardiomyopathy and Thromboembolism; Anesthetic Management and Clinical Course of an Obese, Diabetic Patient." *Canadian Journal of Anesthesia/Journal Canadien D'anesthésie* 50 (2). Springer-Verlag: 161-65. doi:10.1007/BF03017850.

Melzack, R, R Kinch, P Dobkin, M Lebrun, and P Taenzer. 1984. "Severity of Labour Pain: Influence of Physical as Well as Psychologic Variables." *Canadian Medical Association Journal* 130 (5): 579-84. http://www.ncbi.nlm.nih.gov/pubmed/6697268.

Naguib, Mohamed, Tajuddin Malabarey, Raed A. AlSatli, Saleh Al Damegh, and Abdulhamid H. Samarkandi. 1999. "Predictive Models for Difficult Laryngoscopy and Intubation. A Clinical, Radiologic and Three-Dimensional Computer Imaging Study." *Canadian Journal of Anesthesia* 46 (8). Springer-Verlag: 748-59. doi:10.1007/BF03013910.

Ramsay, Jane E., William R. Ferrell, Lynne Crawford, A. Michael Wallace, Ian A. Greer, and Naveed Sattar. 2002. "Maternal Obesity Is Associated with Dysregulation of Metabolic, Vascular, and Inflammatory Pathways." *The Journal of Clinical Endocrinology & Metabolism* 87 (9). Endocrine Society: 4231-37. doi:10.1210/jc.2002-020311.

Rao, Durga Prasada, and Venkateswara A Rao. 2010. "Morbidly Obese Parturient: Challenges for the Anaesthesiologist, Including Managing the Difficult Airway in Obstetrics. What Is New?" *Indian Journal of Anaesthesia* 54 (6). Wolters Kluwer -- Medknow Publications: 508-21. doi:10.4103/0019-5049.72639.

Roberts, R B, and M A Shirley. 2017. "Reducing the Risk of Acid Aspiration during Cesarean Section." *Anesthesia and Analgesia* 53 (6): 859-68. Accessed September 12. http://www.ncbi.nlm.nih.gov/pubmed/4473928.

Robinson, Heather E, Colleen M O'Connell, K S Joseph, and N Lynne McLeod. 2005. "Maternal Outcomes in Pregnancies Complicated by Obesity." *Obstetrics and Gynecology* 106 (6): 1357-64. doi:10.1097/01.AOG.0000188387.88032.41.

Saravanakumar, K., S. G. Rao, and G. M. Cooper. 2006. "Obesity and Obstetric Anaesthesia." *Anaesthesia* 61 (1): 36-48. doi:10.1111/j.1365-2044.2005.04433.x.

Saravanakumar, K, S G Rao, and G M Cooper. 2017. "Obesity and Obstetric Anaesthesia." Accessed September 5. doi:10.1111/j.1365-2044.2005.04433.x.

Smetana, Gerald W. 1999. "Preoperative Pulmonary Evaluation." *New England Journal of Medicine* 340 (12). Massachusetts Medical Society : 937-44. doi:10.1056/NEJM199903253401207.

Somuah, Anim-, M Smyth, and Howell C. 2017. "Epidural versus Non-Epidural or No Analgesia in Labour (Review)." Accessed August 14. http://www.thecochranelibrary.com.

Toglia, Marc R., and John G. Weg. 1996. "Venous Thromboembolism during Pregnancy." *New England Journal of Medicine* 335 (2). Massachusetts Medical Society : 108-14. doi:10.1056/NEJM199607113350207.

Tomoda, Shoji, Toshitsugu Tamura, Yuji Sudo, and Sachio Ogita. 1996. "Effects of Obesity on Pregnant Women: Maternal Hemodynamic Change." *American Journal of Perinatology* 13 (2): 73-78. doi:10.1055/s-2007-994295.

Ungern-Sternberg, B. S. von, A. Regli, E. Bucher, A. Reber, and M. C. Schneider. 2004. "The Effect of Epidural Analgesia in Labour on Maternal Respiratory Function." *Anaesthesia* 59 (4). Blackwell Science Ltd: 350-53. doi:10.1111/j.1365-2044.2004.03667.x.

Unterborn, J, S.T. Weiss, W.R. Cohen, and *et al*. 2001. "Pulmonary Function Testing in Obesity, Pregnancy, and Extremes of Body Habitus." *Clinics in Chest Medicine* 22 (4). Lippincott Williams and Williams, Baltimore, MD: 759-67. doi:10.1016/S0272-5231(05)70064-2.

Vasan, R S. 2003. "Cardiac Function and Obesity." *Heart (British Cardiac Society)* 89 (10): 1127-29. http://www.ncbi.nlm.nih.gov/pubmed/12975393.

Veille, Jean Claude, and Regina Hanson. 1994. "Obesity, Pregnancy, and Left Ventricular Functioning during the Third Trimester." *American Journal of Obstetrics and Gynecology* 171 (4): 980-83. doi:10.1016/0002-9378(94)90018-3.

How to cite this article:

Eynas O. Abdalla *et al* (2018) 'Anesthetic Challenges of Obese Parturients', *International Journal of Current Medical And Pharmaceutical Research,* 04(9), pp. 3612-3616.

****