

Current Anesthetic Considerations In High Risk Obstetrics

An Essay

Submitted for Fulfillment of M.Sc. Degree in Anesthesiology

By

Fatma El Zahraa Mohamed Ibrahim
(M.B. ,B.Ch.)

Supervised by

Prof .Dr.Amina Hassan Omran

Professor of Anesthesiology
Faculty of Medicine
Cairo University

Dr.Nesrine Abd El Rahman El-Refai

Professor of Anesthesiology
Faculty of Medicine
Cairo University

Dr.Ossama Hamed Aboushanab

Lecturer of Anesthesiology
Faculty of Medicine
Cairo University

Faculty of Medicine
Cairo University
2009

ACKNOWLEDGEMENTS

Thanks to Allah for giving me the power and strength to carry out this work.

Words stand short where they come to express my gratefulness to my supervisors.

I would like to express my thanks and deepest my gratitude to **Prof. Dr. Amina Hassan Omran**, Professor of Anesthesiology, Faculty of Medicine, Cairo University, for her remarkable effort, help and her continuous guidance which were the major factor behind the completion of this work.

My deep gratitude goes for **Assist. Prof. Dr. Nesrine Abd El Rahman El-Refai**, Assist. Prof. of Anesthesiology, Faculty of Medicine, Cairo University, for her kind help and great support throughout this work.

My deep gratitude goes for **Dr. Ossama Hamed Aboushanab**, Lecturer of Anesthesiology, Faculty of Medicine, Cairo University, for his help and valuable advice.

I would like to express my great thanks to all members of my family especially my mother and father for providing love and care till I finished this work and forever.

Abstract

Anesthetic management of the medically compromised parturients differs greatly from non-parturients due to major physiological changes and alterations in organ anatomy during pregnancy. The most common high risk conditions in pregnancy include hypertension, pre-eclampsia, peripartum hemorrhage, congenital and valvular heart diseases, peripartum cardiomyopathy, renal disease, gestational diabetes mellitus, hyperthyroidism and obesity. The medically compromised parturients represent a real anesthetic challenge. Identifying proper anesthetic management helps to reduce morbidity and mortality to the mother and fetus.

Keywords: Obstetric hemorrhage, hypertensive disorders of pregnancy, cardiac disease, renal disease, obesity, gestational diabetes mellitus, hyperthyroidism, anesthetic management.

List of Content

• Introduction	<u>Page</u>
	1
• Chapter 1 Physiologic changes during pregnancy	2
• Chapter 2 Obstetric hemorrhage	15
• Chapter 3 Hypertensive disorders of pregnancy	29
• Chapter 4 Cardiac disease and pregnancy	43
• Chapter 5 Renal disease and pregnancy	57
• Chapter 6 Obesity and pregnancy	62
• Chapter 7 Diabetes and pregnancy	70
• Chapter 8 Hyperthyroidism and pregnancy	75
• Summary	79
• References	81
• Arabic Summary	

List of Tables

		Page
Table 1-1	Physiologic effects of various serum magnesium levels	34
Table 1-2	NYHA classification of cardiac functional capacity	44

List of abbreviations

ABC	A irway, B reathing, C irculation
ACOG	A merican C ollege of O bstetricians and G ynecologists
AF	A trial F ibrillation
APTT	A ctivated P artial T hromboplastin T ime
ARDS	A dult R espiratory D istress S yndrome
AR	A ortic R egurgitation
ARF	A cute R enal F ailure
AS	A ortic S tenosis
ASD	A trial S eptal D efect
ATN	A cute T ubular N ecrosis
BMI	B ody M ass I ndex
BUN	B lood U rea N itrogen
CD	C esarean D elivery
CEMACH	C onfidential E nquiry into M aternal and C hild death
CNS	C entral N ervous S ystem
CO	C ardiac O utput
CPAP	C ontinuous P ositive A irway P ressure
CS	C esarean S ection
CSE	C ombined S pinal – E pidural
CVP	C entral V enous P ressure
DKA	D iabetic K etoacidosis
DIC	D isseminated I ntravascular C oagulation
ECG	E lectrocardiogram
ERPF	E ffective R enal P lasma F low

ESRD	Endstage Renal Disease
FDP	Fibrinogen Degradation Products
FHR	Fetal Heart Rate
GA	General Anesthesia
GFR	Glomerular Filtration Rate
HD	Hemodialysis
HELLP	Hemolysis, Elevated Liver enzymes, Low Platelets
ICU	Intensive Care Unit
IV	Intravenous
LMA	Laryngeal Mask Airway
LR	Left to Right
LV	Left Ventricle
MAC	Minimum Alveolar Concentration
MAOIs	Monoamine Oxidase Inhibitors
MR	Mitral Regurgitation
MS	Mitral Stenosis
NG	Nasogastric
NICE	National Institute for Health and Clinical Excellence
NYHA	New York Heart Association
OSA	Obstructive Sleep Apnea
PDA	Patent Ductus Arteriosus
PIH	Pregnancy Induced Hypertension
PT	Prothrombin Time
PTH	Parathyroid Hormone
RBCs	Red Blood Cells
RCN	Renal Cortical Necrosis
RL	Right to Left
SIGN	Scottish Intercollegiate Guidelines Network

SVR	Systemic V ascular R esistance
TBG	Thyroxine B inding G lobulin
TRAb	Thyrotrophin R eceptor A ntibodies
TSH	Thyriod S timulating H ormone
TSIs	Thyriod S timulating I mmunoglobulin
VHD	V alvular H eart D isease
VSD	V entricular S eptal D efect

Introduction

The anesthetic management during labor or cesarean delivery is extremely important especially in patients who are critically ill. The hemodynamic changes that occur during pregnancy and labor may cause morbidity and sometimes mortality especially in patients who are critically ill. Adequate anesthetic management during labor minimizes these hemodynamic changes and eventually reduces the incidence of morbidity and mortality.

This essay was designed to discuss anesthetic management in some of these critically ill obstetric patients. It was necessary to start with the normal physiologic changes that occur during pregnancy, so as to understand the hemodynamic changes that occur during labor, and how to deal with it, regarding anesthesia. Each chapter of this essay was designed to discuss anesthetic considerations and management in one of the groups of the critically ill obstetric patients e.g. parturients with hypertensive disorders of pregnancy, peripartum hemorrhage, cardiac disease, renal disease, obesity, diabetes and hyperthyroidism.

PHYSIOLOGIC CHANGES DURING PREGNANCY

The Cardiovascular System

The pregnancy-induced changes in the cardiovascular system develop primarily to meet the increased metabolic demands of the mother and fetus.

Clinical findings:

The apex beat is palpated in the fourth intercostal space and lateral to left mid-clavicular line. On auscultation, the first heart sound is usually loud and may be split. There is reduced variation of the second sound with respiration. A third heart sound is commonly heard. A systolic murmur, loudest along the left sternal edge is heard in most pregnant women ⁽¹⁾.

Chest X-Ray and echocardiography:

Radiological investigation reveals the heart to be displaced upwards and rotated with a slight increase in the cardio-thoracic ratio. There is straightening of upper left cardiac border with increased prominence of the pulmonary conus. Echocardiography shows a small increase in heart size due to increased venous filling. Left ventricular hypertrophy is seen and begins in the first trimester ⁽¹⁾.

Electrocardiogram:

The electrocardiogram may show accentuated left axis deviation and minor ST-T wave changes owing to anatomic displacement that are common by the third trimester. Additional changes may be seen at cesarean section under regional anesthesia, but are now thought to be benign, and secondary to imbalance between sympathetic and parasympathetic supply. Similar non specific changes may be seen with β -adrenergic agents used for the suppression of premature labor ⁽¹⁾.

Cardiac output:

One of the most profound changes in pregnancy is the increase in cardiac output. When measured at 36-38 weeks of pregnancy, cardiac output is increased by 43% compared with measurements made at 11-13 weeks postpartum. The increase in cardiac output is progressive during the first and second trimesters and is detectable as early as 8 weeks gestation. Cardiac output does not change further in the third trimester. The increase in cardiac output is due to increase in both heart rate and stroke volume. Heart rate increases first and rises by up to 16 beats/min by term. Stroke volume increased from 65 ml before pregnancy to 83 ml in the second trimester ⁽²⁾.

Blood pressure:

There is a gradual fall in blood pressure during pregnancy. Systolic blood pressure falls on average by 5-10 mmHg, whilst the fall in diastolic blood pressure is of order of 10-15 mmHg. This difference results in an increase in pulse pressure. Systolic and diastolic blood pressure reaches its lowest values in the second trimester and then increase, to reach pre-pregnancy levels again. At term, it must be remembered that the first

blood pressure measurement recorded in the patient's maternity record is usually taken during the first trimester when the normal decrease in blood pressure has already begun ⁽³⁾.

Vascular resistance:

Systemic and pulmonary vascular resistance both decrease significantly in pregnancy. The former is in part related to the development of a low resistant utero-placental circulation and is in part due to progesterone driven vasodilatation. The blood vessels of pregnant women show increased refractoriness to angiotensin II. This may be mediated by endothelial and platelet derived prostaglandins ⁽³⁾.

Aorto-caval compression:

From mid-pregnancy the enlarging uterus compresses both the inferior vena cava and the lower aorta when the patient lies supine. Compression of the inferior vena cava reduces venous return to the heart leading to a fall in pre-load and cardiac output. The fall in blood pressure may be severe enough for the mother to lose consciousness. Compression of the aorta may lead to a reduction in uteroplacental and renal blood flow. During the last trimester, maternal kidney function is markedly lower in the supine than in the lateral position. Furthermore, fetal transplacental gas exchange may be compromised. For these reasons no woman should lie supine in late pregnancy ⁽⁴⁾.

Clinical implications:

Despite the increased workload of the heart during gestation and labor, the healthy woman has no impairment of cardiac reserve. In

contrast, for the gravida with heart disease and low cardiac reserve, the increase in the work of the heart may cause ventricular failure and pulmonary edema. In these females, further increases in cardiac workload during labor must be prevented by effective pain relief, optimally provided by extradural or spinal analgesia. Since cardiac output is highest in the immediate postpartum period, sympathetic blockade should be maintained for several hours after delivery and then weaned off slowly ⁽⁵⁾.

The Respiratory System

Respiratory tract:

Hormonal changes to the mucosal vasculature of the respiratory tract lead to capillary engorgement and swelling of the lining in the nose, oropharynx, larynx, and trachea. Symptoms of nasal congestion, voice change and upper respiratory tract infection may prevail throughout gestation. Manipulation of the airway can result in profuse bleeding from the nose or oropharynx; endotracheal intubation can be difficult; and only a smaller than usual endotracheal tube may fit through the larynx ⁽⁵⁾.

Lung volumes:

During pregnancy, the tidal volume increases gradually with gestation. By term it is almost 40% greater than in non- pregnant women. Functional residual capacity falls progressively starting in the second trimester. Upward displacement of the relaxed diaphragm causes a reduction in functional residual capacity by as much as 25%. Similar reductions occur in the residual volume and expiratory reserve volume. Functional residual capacity falls further when supine. Minute ventilation is increased by 40% in pregnancy. This change is detectable by 6 weeks.

Physiological dead space may increase due to dilatation of the smaller bronchioles ⁽²⁾.

Airway resistance:

Airway resistance depends on large airway caliber and is unchanged in pregnancy. The potential bronchial dilatatory effects of progesterone are matched by the reduced resting lung volume. Small airway volume, (estimated by measurement of closing volume), may increase slightly, but does not encroach on normal tidal volumes ⁽²⁾.

Respiratory rate changes during labor:

Many women notice dyspnea in pregnancy, with almost half becoming symptomatic by 19 weeks gestation, it is reported as a feeling of labored or unnaturally difficult breathing. After 31 weeks, few mothers report an increase in their symptoms. During labor there is a further increase in both respiratory rate and tidal volume, the magnitude of which largely correlates with the degree of pain experienced. Without analgesia, the laboring woman shows the greatest hyperventilatory response, with marked hypocapnia, (PaCO_2 as low as 2 kPa). Minute ventilation and oxygen consumption increase markedly as labor progresses ⁽⁶⁾.

Clinical implications:-

The changes in respiratory function have clinical relevance for the anesthesiologist. Most importantly, increased oxygen consumption and the decreased reserve due to the reduced functional residual capacity, may result in rapid falls in arterial oxygen tension despite careful maternal positioning and pre-oxygenation. Even with short periods of

apnea, whether from obstruction of the airway or inhalation of a hypoxic mixture of gas, the gravida has little defense against the development of hypoxia. The increased minute ventilation combined with decreased functional residual capacity hastens inhalation induction or changes in depth of anesthesia when breathing spontaneously ⁽⁵⁾.

The gastro-intestinal tract

Since aspiration of gastric contents is an important cause of maternal morbidity and mortality in association with anesthesia, an examination of the controversy surrounding gastrointestinal changes in pregnancy is justified.

Mechanical changes:

The enlarging uterus causes a gradual cephalad displacement of stomach and intestines. At term the stomach has attained a vertical position rather than its normal horizontal one. These mechanical forces lead to increased intragastric pressures as well as a change in the angle of the gastroesophageal junction, which in turn tends toward greater esophageal reflux ⁽⁵⁾.

Physiological changes:

Relaxation of the lower esophageal sphincter has been described, but there have been differing views about the effect on motility of the gastrointestinal tract and the times at which it is most prominent. Many believe that there is also retardation of gastrointestinal motility and gastric emptying, producing increased gastric volume with decreased pH, beginning as early as 8-10 weeks of gestation. Measuring peak plasma