An Interdisciplinary Challenge- Growing Interest on Laparoscopic Surgery during Early & Advanced Stage of Pregnancy

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INTRODUCTION

A literature search was performed using Medline and the search engine Google. Criteria for selection of literature were methods of analysis (statistical or non statistical), operative procedure (only universally accepted procedures were selected) and the institution where the study was done (Specialized institution for laparoscopic surgery).Approximately 1 in 500 to 1 in 635 women will require non-obstetrical abdominal surgery during their pregnancies [1.2].

The most common non-obstetrical surgical emergencies complicating pregnancy are acute appendicitis, cholecystitis, and intestinal obstruction [1]. Laparoscopic surgery in the pregnant patient is not yet broadly accepted; concern has been for fetal wastage, effects of carbon dioxide (CO_2) on the developing fetus, and long-term sequelae during childhood development. The anesthesiologist must be aware of the physiologic changes associated with pregnancy and the effects of positioning, and the consequences of CO2 pneumoperitoneum on the parturient and the fetus. Important factors in laparoscopic surgery – risk of aspiration, Supine hypertensive syndrome. Pneumoperitoneum during pregnancy results in more pronounced restrictive lung physiology. Avoid hypoxemia, hypotension, acidosis, hypoventilation, and hyperventilation. Anesthesiologists must maintain a high index of suspicion for complications such as gas embolism, extraperitoneal insufflations surgical emphysema, pneumothorax and pneumomediastinum. Invasive monitoring could be required in those patients with significant cardiovascular or pulmonary disease.Now a days Minimally invasive surgery is being performed more frequently in pregnant patients. Literatures suggest that Laparoscopic surgery during pregnancy is safe, has multiple advantages over open techniques and can be performed during all gestational ages.

PHYSIOLOGIC CHANGES IN PREGNANCY

In the normal pregnant state, increased minute ventilation upto 50% leads to decreased PCO2 and a mild respiratory alkalosis [3]. The fetus has a

mild respiratory acidosis in the normal state that may facilitate the delivery of oxygen. Many other changes in pregnancy occur including a normal mild anemia, increased cardiac output, increased heart rate, and an increased oxygen consumption that allows the mother and fetus to be adequately oxygenated.

In addition, the gravid uterus is well known to push the abdominal contents cephalad, altering landmarks by displacing organs and possibly inhibiting the migration of the omentum [3,4].

Clearly, these changes can alter the clinical picture. The gravid uterus often causes a decrease in gastric motility and an increase in the risk of gastroesophageal reflux disease, including aspiration (Mendelson's syndrome) [5], a life-threatening issue feared by anesthesiologists and obstetricians alike, remaining to this day the number one cause of maternal death.

Often overlooked are the hematologic "abnormalities" in the pregnant patient. These changes include an increase in fibrinogen, factor VII, and factor XII, but a decrease in antithrombin III. All of these changes result in an increased risk of venous thromboembolism [6,7],

MATERNAL ORGANS INJURY

Extreme care must be exercised when placing the insufflation needle and canullas to avoid injury to the uterus,complications can easily be avoided by choosing an appropriate entry site Veress needle and trocars. Many authors have advice to place the first trocar just below the xiphisternum and place the supraumbilicaltrocarsunder direct vision or to use an optical trocar which allows the surgeon to see the tissue planes and the intra-abdominal organs as the trocar advanced. Some surgeons complied with the open technique for the port placement to create pneumoperitoneum with no bowel or uterine injury. The most life threatening laparoscopic complications are those to large retroperitoneal blood vessels (aorta, ivc, iliac vessels). To avoid these injuries early recognition and prompt treatment is critical. Stomach and bowel injuries from needle or trocar have

reported, large number of these injuries may go unrecognized, because of the ability ofthe stomach and intestines to heal small injuries. Undetected bowel injury is a major factor of postoperative mortality, such patients usually present late in sepsis and peritonitis that could lead to fetal, maternal morbidity and mortality [7-11].

EFFECT OF CO2 PNEUMOPERITONEUM

CO_2 pneumoperitoneum can produce significant alteration in maternal and fetal blood gases, but this transient effect remain unclear. Other studies confirm the lack of intra-abdominal CO_2 pressure under 15mmHg on fetal, placental perfusion and blood gases [11,12,13,14].

Monitoring maternal arterial blood gasses has proven superior to maternal capnography in this regard [15, 16].Various organizations continue to recommend both end-tidal carbon dioxide and arterial blood gas monitoring for pregnant patients undergoing a minimally invasive surgical procedure (e.g., The European Association for Endoscopic Surgery, Eindhoven, The Netherlands). Reviewing results from several different research groups, (and allowing for procedural difference), the general responses to near term carbon dioxide insufflations are maternal and fetal respiratory acidosis, and some have reported decreases in perfusion (i.e., decreased UBF). However, no group has reported a decreases in fetal oxygenation, and hence it can be concluded that the preterm fetus exhibits an increased sensitivity to maternal carbon dioxide pneumoperitoeum. Different factors may contribute to the preterm fetal responses. Certainly the reduction in UBF was an initiating event, and there is the possibility that the 60 min of pneumoperitoneum produced placental injury. However, perfusion changes alone cannot account for the continued decreases in fetal oxygenation because UBF was at or above baseline during the post insufflaiton period. Instead, the initial physiologic changes (increased PCO2 and decreased pH) seem to have produced a prolonged reduction in the oxygen-carrying capacity of the

fetal blood. In this regard, fetal hemoglobin is structurally and functionally different from adult variant. The differences act to enhance placental uptake of oxygen(i.e. fetal hemoglobin has a higher affinity to enable the transfer of oxygen from maternal hemoglobin).

Current society of American Gastrointestinal Endoscopic Surgeons guideline for conducting mainimally invasive non-obstetric-related surgery during pregnancy recommend that, when possible, the procedure be conducted during the second trimester. However, the empirical evidence to support this stance is not strong because it is based mainly on case reports and small serial studies. One exception is a retrospective analysis of the Swedish Health Registry between 1973 and 1993, 2, 181 women with singleton pregnancies underwent a laparoscopic procedure while 1,522 underwent an open procedure; for both groups, the reasons for surgery were not related to pregnancy status. Group comparisons determined that there were no differences in fetal outcome when the procedure was conducted between the 4th and 20th weeks of gestation. Unfortunately, question about the safety of later term procedures were left unanswered because of insufficient numbers. Conversely, the experimental animal studies conducted to date have centered exclusively on the near-term fetal responses to maternal insufflations. Currently, carbon dioxide is the most frequently used gas for insufflations because it is noncombustible and has a high plasma solubility. However, carbon dioxide is not physiologically inert with respect to its actions on a patient's respiratory and circulatory status. Researchers have evaluated that use of other gases (e.g., helium, argon) with varying results. In one study insufflations with helium produced less maternal hypercapnia and acidosis compared with carbon dioxide, but there was a similar degree of impaired fetal perfusion (i.e. reduction in UBF). As a result, it is uncertain whether use of a different insufflations gas would offer substantive benefits to the mother and the fetus, especially because the gases studied to date have higher risks

of gas emboli development (compared with carbon dioxide) because of their decreased solubility. Observations suggest significant difference between the end-tidal and arterial blood carbon dioxide levels, but the clinical significance of this difference is unclear.

EFFECT OF INCREASED INTRA-ABDOMINAL PRESSURE

Pneumoperitoneum enhances lower extremity venous stasis, pneumatic compression devices must be used, in addition to faster postoperative recovery and early mobilization probably reduce the risk of thromboembolic complications [6, 19,22]

Below 15mmHg intra-abdominal pressure is not only to prevent ventilatory and circulatory complications, but also to prevent the risk of gas embolism, which is a lethal complication for both the mother and the fetus, adequate exposure is still possible with less pneumoperitoneum, and does not prevent laparoscopic surgery [18,19,20,21,].

Intra-abdominal pressure has to kept to minimum while maintaining adequate visualization not more than12mm Hg, higher insufflation pressures increase in intra-abdominal pressure and affect cardiac and respiratory physiology [11]. Some authors prefer the use of gasless laparoscopy and the results are good, but the technique has a higher conversion rate than conventional laparoscopy, other surgeons advice to use open / Hasson method for access as a safest technique during pregnancy [2,5,6,7].

EFFECT OF ANESTHESIA AND ANESTHETIC DRUGS

A part from CO2, anesthetic drugs administered during first trimester of pregnancy may cause abnormalities during the period of organogenesis, such objections are contradicted by a Swedish registry study for the years 1973-1983 covering 720.000 pregnant women, of these 5405 underwent surgery, mainly diagnostic laparoscopy 34%. According to this study, it appears that general surgery in pregnancy causes no increase in stillbirths or birth defects and results in no

difference in time or type of delivery, compared with controls, but leads to increased infant mortality and lower birth weight. These authors concluded that the causes are related more to the mothers illness that required surgical treatment than to surgery or anesthesia [2,13,18].

The available animal data suggest that caution should be used when considering laparoscopic surgery in pregnant women, and additional clinical and laboratory investigation may be indicated to evaluate fetal risk associated with such surgery [16,18].

In a recent study published in journal of American society of anesthesiologist 2004, the authors concluded that CO2 pneumoperitoneum produces respiratory acidosis, but does not decrease fetal oxygenation, in contrast the findings indicate that in the preterm fetus, insufflation induced hypercapnia and acidosis are accompanied by prolonged fetal hypoxia and cardiovascular depression. This result suggests that additional work should be conducted to confirm the presumed safety of doing laparoscopic procedures during the second trimester [12, 13, 20,].

Haemodynamic Effects of Laparoscopic Surgery

Hemodynamic effects of CO2 pneumoperitoneum have been detailed in several studies in nonpregnant subjects, as reviewed by Wahba et al. the major cardiovascular changes in nonpregnant patients may be summarized as follows : with induction of anesthesia and head-up tilt, Cl decreases by approximately 25%. During CO2 insufflation, there is further depression of Cl to approximately 50% of awake values together with increases in MAP and SVR. Partial recovery of Cl and SVR follows. The reduction in Cl after CO2 insufflation may be delayed by performing CO2 insufflation in the horizontal position. Thoracic electrical bioimpedancecardiography is a noninvasive method that provides accurate reproducible estimation of Cl comparable to CO2 pneumoperitoneum during laparoscopic surgery in nonpregnant patients. During laparoscopic surgery in pregnant patients, hemodynamic changes are similar to those in nonpregnant patients, i.e., decreases in Cl together with increases in MAP and SVR.

HORMONAL CHANGES

Depending on the medical condition, perioperative antibiotics may be indicated for either prophylaxis or treatment. It should be noted that pregnancy is a mildy immunosuppressed state stemming from decreased chemotaxis and adherence ability of polymorphonuclear leukocytes. Antibiotic regimens should be chosen accordingly.

Hormonal changes in pregnancy lead to decreased motility throughout the gastrointestinal tract. Decreased lower esophageal sphincter tone combined with delayed gastric emptying and mechanical compression from an enlarging uterus predisposes the pregnant patient to gratroesophageal reflux. Strict adherence to preoperative nothing-by-mouth status and intraoperative gastric emptying by orogastric suctioning, along with careful airway management by anesthesiology, reduces the risk of preoperative aspiration complications.

FETAL TRAUMA DURING LAPAROSCOPY

According to the recent findings, hemodynamic changes during laparoscopic surgery in pregnancy are similar to those in non-pregnant state, the procedure appears to be safe and reduces hospital admissions and stay and frequency of preterm labor. The safest time to perform laparoscopic surgery in pregnancy is second trimester. However it can be complicated by injury of the enlarged gravid uterus and pregnancy loss, in one report the author concluded that ; inadvertent introduction of the Veress needle into the gravid uterus with subsequent pneumoamnion represents a catastrophic complication of midtrimester laparoscopic surgery and ended by fetal loss [17,19,]

Brendan C in his study points that, the rate of nonobstetric abdominal surgery during pregnancy was 1 in every 527 births. Among the 77 patients

the indication for surgery were; adnexal mass 42%; acute appendicitis 21% ; gallbladder diseases 17% and others 21%, there was no maternal or fetal loss. Preterm labor occurred in 26% of the second trimester, and 82% of the third trimester patients. Preterm labor was most common in patient with appendicitis and after adnexal surgery. His conclusion indicates that surgery during first and second trimester is not associated with significant preterm labor, fetal loss and risk of teratogenicity. Surgery during the third trimester is associated with preterm labor, but not fetal loss [2, 7].

UTERINE BLOOD FLOW

Uterine blood flow hypothetically decreased. therefore it is reasoned that this is unlikely to be a major concern given the frequent pressure alternations induced during valslva, coughing, and straining [22], further, it is maintained that pneumoperitoneum may well be safer than manual uterine retraction during open appendectomy and cholecystectomy [23].

LONG- TERM FETAL EFFECT

Despite recent advances in anesthetic, perinatal, perioperative care, surgical intervention during pregnancy may still result in fetal loss from either spontaneous abortion (especially in the first trimester) or preterm labor (especially in third trimester). Additionally, there is an increased of low birth weight infants, preterm labor and growth restricted babies with surgical intervention during pregnancy. Therefore, whenever possible, surgery should be deferred until after delivery. Unfortunately, urgent surgical intervention in the gravid patient is occasionally necessary. The most common situations encountered by the general surgeon are acute appendicitis and acute cholecystitis.

Currently, in nonpregnant patients, appendectomy and cholecystectomy are frequently performed laparoscopically. While pregnancy has been considered a relative contraindication to laparoscopy, recent reports have refocused attention on this issue [24, 25, 26].

Most case reports and small series indicate that laparoscopy can be safely performed during pregnancy. Despite the growing clinical experience suggesting laparoscopy is safe as laparotomy in pregnancy, long- term clinical studies are lacking.

To avoid and minimize the fetal and maternal risks during laparoscopic surgery in pregnancy, it is recommended to follow the guidelines for laparoscopic surgery during pregnancy. The following guideline is suggested:

Operative intervention should be deferred until second trimester. Pneumoperitoneum pressures should be minimized to 8-12mmHg. Left lateral position of the patient to avoid supine hypotension syndrome. Use of open access technique during laparoscopy in advanced pregnancy.

The uterus should be protected with a lead shield if radiological investigations are needed. Pneumatic compression devices should be used to reduce thromboembolic disorders. Fetal and maternal end tidal CO_2 and arterial blood gases should be monitored. Capnography, Pulse oximetry, NIBP and ECG should be strictly monitored.

CONCLUSION

About1-2% of pregnant women require a non-obstetric operation during pregnancy; Laparoscopic surgery widely used in the last 3 decades by both gynecologists and general surgeons, because of its major advantages. With the advancement in anesthesia and laparoscopy , it has been used in third trimester of pregnancy for different intra-abdominal obstetrical and non-obstetrical pathologies. The most common operation is appendectomy, followed by cholecy-stectomy. The most important perioperative considerations for the surgeon and anesthetist are: safety of the mother, safety of the fetus, avoiding teratogenic medications, and avoiding fetal acidosis and hypoxemia, as well as preventing preterm birth. Meta-analyses have shown that a

laparoscopic appendectomy leads to significantly more miscarriages than an open procedure. If the indications for a surgical procedure are present, then one can operate during each trimester without increasing the risk for the mother or the fetus. Surgery during pregnancy should ideally be performed in centers that have interdisciplinary experience in the surgical management of pregnant patients and where even in non-obstetric procedures, an obstetrician and a neonatologist are readily available.

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