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NON-OBSTETRIC /GYNAECOLOGIC ABDOMINAL SURGERY DURING PREGNANCY

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Abstract

Pregnancy is the only physiologic condition that is treated in the hospital environment. All other medical conditions that are treated in such a setting are pathologic. When a pregnant patient develops a pathologic condition that requires surgical intervention, it is imperative to remember that the lives of two individuals are involved, the mother and the foetus. In such settings it is essential that the treating surgeon understand the physiologic states of these two individuals as an interdependent symbiotic relationship. Not only must appropriate maternal care be rendered, prevention of foetal complications is also desirable.

Changing physiology and anatomical landmarks frequently cause confusion and delay in dealing with surgical problems in the pregnant patient. Both symptoms and signs could be modified, contributing to delay in seeking medical attention, timely referral for surgical evaluation, or the initiation of appropriate diagnostic procedures.

Surgery during pregnancy is an uncommon event, but one that creates a great deal of anxiety for both patients and medical practitioners. Delays in diagnosis and definitive treatment represent the most significant risk for untoward outcome in both the mother and the foetus.

Laparoscopic surgery has rapidly and widely spread in the management of wide abdominal conditions, which resulted in several significant benefits to the non-gravid patients. Pregnant patients and their foetuses could drive the same benefits from minimally invasive surgery, which are received by the non-gravidas. However, due to the several physiological and anatomical factors encountered during pregnancy many issues need to be thought about and dealt with.

Optimal surgical treatment of the pregnant patient will be realized when there is collaboration between the various subspecialties involved in her care.

MATERNAL PHYSIOLOGICAL CHANGES DURING PREGNANCY

Cardiovascular: The cardiac output increases 30% to 50%; most of this increase occurs in the first trimester, with a maximal effect by 24 weeks of gestation[1,2]. There is an increase in the cardiac stroke volume by 25% to 30% and a decrease in the systemic vascular resistance, which results in a 5 to 10 mm Hg decrease in systolic blood pressure and a 10 to 20 mm Hg decrease in diastolic blood pressure at mid pregnancy[1,3-5]. In late pregnancy, blood flow may be affected profoundly by position changes in particularly the supine position. Compression of the inferior vena cava by the gravid uterus results in impaired venous return and a decreased cardiac preload with a resultant fall in cardiac output of 25% to 30%[1,6]. When a pregnant patient is treated during resuscitation or surgical intervention, efforts should be made to place the patient in the leftward tilt to avoid the supine hypotension synd-

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rome[1,7]. Furthermore, diligent replacement of fluid losses during operation is necessary to prevent hypovolaemia and to enhance uterine perfusion. Supplemental oxygen administered to the mother can also improve oxygen delivery to the foetus.

Because of changes in coagulation factors during pregnancy, the increased prevalence of venous thromboembolic disease can double that of the non pregnant state[1,6,8]. Those patients who undergo major non-obstetric operations should therefore receive adequate anticoagulation measures[1].

For the same reasons of intravascular blood volume alterations, these patients have a raised level of haematocrit greater than 30%, and the typical level during pregnancy at around 33% should not be considered abnormal and misinterpreted as evidence of haemorrhage[1].

The white cell count increases normally during the course of pregnancy and can reach levels of 15,000 to 20,000 mm³ in the absence of infection[1,9]. This may increase to 20,000 to 30,000 mm³ during labor and the immediate puerperim[1,10]. As a consequence leukocytosis must therefore be interpreted carefully.

Respiratory changes that occur during pregnancy result in an increase in the tidal volume of 30% to 40%[1,11]. Reductions in the maternal *pCO2* and increases in the maternal *pO2* enhance the gradient between the pregnant patient and her foetus and enhance the exchange of these gases, which creates a partially compensated respiratory alkalosis[1,11].

Gastrointestinal dysfunction is common during pregnancy[1,6,12]. This results in delayed gastric emptying time and increased small bowel transit times. These may increase the risk of postoperative regurgitation and aspiration.

FOETAL CONSIDERATIONS

Medications: Because of the concern of the administration of drugs to the pregnant patient and the possible teratogenicity of particular drugs, two stages of pregnancy are described. The first trimester is a time of organogenesis (weeks 2-8 after conception), and the remainder of time is devoted to organ growth. Foetal malformations primarily develops during organogenesis and it has been suggested that drug exposure be limited during the third trimester when central venous system myelination occurs[1,6].

The most common medications prescribed for the gravida undergoing operation are anaesthetics, analgesics or antibiotics. Little is known about specific effects of anaesthetic gases on the human foetus[6]. Without doubt, the major risks are maternal hypoxia, hypotension and acidosis[6,13]. Most authors conclude that there is little to support the superiority of one anaesthetic agent over another regarding the risks of prematurity, spontaneous abortions, perinatal mortality or congenital malformations if maternal blood pressure and arterial oxygen concentration are adequately maintained[6,14]. Therefore, it was suggested because of these physiologic changes that occur during pregnancy, regional anaesthesia is preferred when possible[1,6]. However, it is not without problems as it may produce vasodilatation, with subsequent decrease in placental blood flow leading to foetal hypoxia[1,6]. Again maternal positioning is important to ensure adequate foetal oxygenation.

Short courses of opioid analgesics appear to be safe during pregnancy[1]. Respiratory depression is the primary neonatal effect if the drug is administered within a few hours of delivery. With chronic use of opioid maternal addiction is a concern and congenital narcotic addiction has been

documented[15]. Nonsteroidal anti-inflammatory drugs (NSAID) block the synthesis of prostaglandins. Foetal effects of this action may include narrowing of the ductus arteriorus, pulmonary hypertension, and impaired renal function, which may lead to oligohydramnios[16]. Because of the availability of the opioid and acetaminophen NSAID are best avoided in pregnancy.

Antibiotic therapy for the abdominal conditions must take into consideration the organisms involved in the disease process and their possible effects they might have on the foetus[9,17]. Penicillins, cephalosporins, and erythromycin are considered safe during pregnancy. Conversely, gentamicin and other aminoglycosides have been associated with nephrotoxicity and ototoxicity in the foetus[1, 17, 18]. However, the risk of using these agents is small and they may be used for a life threatening maternal infection[1,18]. The use of tetracycline, which may cause permanent discolouration of the teeth and long-bone malformations in the foetus, and fluoroquinolnes, which may cause cartilaginous dysplasia, should be avoided in pregnancy[1].

IMAGING IN PREGNANCY

Diagnostic radiologic procedures may be performed in pregnant patients but should not be performed unless indicated. Maternal risks are negligible. However, the risk to the foetus is real and occurs in two patterns: risk related to organogenesis and risk related to oncogenesis[9]. Foetal organogenesis occurs in the first trimester, but the risk for oncogenesis is uniformly distributed throughout the gestational period. The standards set by the National Council on Radiation Protection and Measurement (NCRP) specify an absolute limit of exposure for the foetus of 500 mrem during gestation and exposure limits of 50 mrem/month[19]. Standards for radiation exposure are based predominantly on work done on individuals exposed in utero at Hiroshima and Nagasaki. The term "rem" refers to the measure of radioactive dose multiplied by a quality factor that determines the effect of radiation on living tissue. Others[1,20] indicated that direct foetal irradiation of 10 cGy or more is associated with adverse effects. However, most commonly performed diagnostic studies involve a foetal dose far less than 1 cGy[1]. Microcephaly is the most common adverse effect, however intrauterine growth retardation, developmental delay, and even foetal death may also result from radiation exposure[20]. Additionally, there is concern about increasing the likelihood of childhood neoplasms[20]. When contrast agents or radionuclides are used, which are cleared by the kidney, Foley catheter placement may decrease the foetal radiation dose[9].

The imaging findings of common abdominal problems in the pregnant patient in general are similar to those found in the non pregnant patient. However, considerations of foetal radiation exposure, and the almost complete absence of demonstrable bioeffects at clinically utilized acoustic power level makes ultrasonography the mainstay of abdominal imaging in the pregnant patient in spite of its limitations[9,21].

Plain film X-ray evaluation of the abdomen can be achieved at low exposure levels to the foetus[9, 22] but the information to be gained is frequently nonspecific.

EVALUATION OF FOETAL WELL-BEING

Foetal heart rate monitoring during maternal surgery is recommended whenever feasible[23]. Although continuous monitoring of the foetal heart may be achieved early in the second trimester, foetal heart rate variability, a sign that the foetus is well

oxygenated, does not appear until approximately 26 weeks. There are no established standards for the interpretation of the foetal heart before the third trimester[1,23]. Furthermore, some anaesthetic agents may cause a temporary decrease in the variability of the foetal heart. Additionally, certain operations (eg, laparotomy) and maternal conditions (eg, morbid obesity) can make intra-operative foetal heart rate monitoring difficult[1,23].

Whatever the decision regarding intra-operative monitoring, assessment of the foetal heart rate and uterine contraction may be instituted in the recovery room. In addition to the continued assessment of the foetal status, this monitoring may detect regular uterine contractions and preterm labor, a possible complication of surgery[1,23]. When signs of foetal compromise are severe or refractory to the resuscitative measures, emergent caesarean section delivery may be performed.

RISK FACTORS FOR LOWER BIRTHWEIGHT AND RATE OF PRETERM DELIVERY OR SPONTANEOUS LOSS

Surgery during gestation is a rare event. Previous studies have reported an incidence between 0.2 and 2.2%[14]. Delay in diagnosis and treatment secondary to pregnancy, as well as high rates of maternal and foetal morbidity have been raised[14]. Many studies reported that abdominal surgery has been associated with preterm delivery between 12%-43%, a foetal loss rates as high as 12% and a low birth weight rate of 16%[14, 24, 25]. It has been suggested that many of the previous studies are more than 20 years old, are limited in outcomes described, included obstetric and non-obstetric indications, surgeries were carried in all trimesters, and many may not reflect current practices[26,27].

In a recent review Gerstenfeld et al[26] conducted a retrospective study of 106 cases of non-obstetrical abdominal surgery at Los Angeles County/ University of Southern California Women's Hospital. Eighty-eight (83%) women underwent exploratory laparotomy, and 18 (17%) had laparoscopic abdominal surgery. The mean gestational age at the time of surgery was 13.7 weeks (range 4-32.7). Fifty-three (50%) women had surgery in the first trimester, 49.1% in the second trimester, and one woman had surgery in the third trimester. The majority of their surgical procedures (69%) were considered to be emergency and found no correlation of gestational age at surgery and at delivery. Their preterm delivery rate was 18%, which although was not significant when comparing women who had no non-obstetrical abdominal surgery during pregnancy delivered in the same hospital it was higher than the national (USA) preterm delivery rate in 1997, which was 10.9% [26]. Although the authors admitted that their preterm delivery rate is concerning they attributed that rate as a reflection of the acute care administered in that tertiary hospital[26]. The authors also found no significant difference in the birth weight between women who had surgery and those who didn't have surgery, and between the emergency and elective surgery groups. They reported two spontaneous abortions following surgery and both women have had confounding factors that may have been responsible for the foetal losses. Outcomes for laparoscopic surgery did not differ from those of laparotomy. The authors reported 76% of cases that had the same preoperative and post-operative diagnosis. They concluded that fears of adverse perinatal outcome are not justification to avoid indicated surgery during pregnancy. They also acknowledge the limitations of their study, which included the lack of delivery data and small sample size.

In a more recent study Jenkins et al[27] assessed the risk for preterm birth and

low birth weight for women undergoing non-obstetric surgery during gestation in two perinatal tertiary centres in the United States. They found the mean gestational age at surgery was 19.4 ± 8.9 weeks (range 4-38 weeks). Most procedures (53%) were carried out during the second trimester, versus the first (23%) or third trimester (24%). Surgery in the second trimester resulted in the lowest rate of preterm birth (11%). The overall preterm birth rate was 21% (20/96), with 13 out of 20 (65%) occurring between 35 and 37 weeks. The mean interval from surgery to delivery was 18.7 weeks. Preterm birth secondary to a surgical procedure has been defined in past reports as either 2 or 4 weeks from the procedure [14,28]. Rates of preterm birth were similar for either intra – versus extra abdominal procedures, or general versus regional anaesthetics, even when rates of smoking, history of preterm delivery, or maternal age were considered[27]. The authors also found that a significantly lower birth weight was seen with intra-abdominal procedures, procedures carried under general anesthetic despite similar gestational ages at birth, and longer procedure duration. It is unclear why this may occur. However, no difference in rates was found between procedures performed for inflammatory and non-inflammatory conditions. The mean decrease in birth weight ranged between 392g and 461g. This difference is much greater than the average decrease in birth weight that is demonstrated in women who smoke during gestation (100 g - 274 g)[29]. In this study, there was only one neonatal loss (an infant born at 25 weeks that died secondary to extreme prematurity), one maternal morbidity (superficial wound infection), and no maternal mortality. The authors acknowledge the limitations of their study that includes its retrospective nature, which limits the ability to reduce confounding variables, and the small sample size.

In general, lower abdominal or pelvic surgery carries a risk of preterm labor of less than 5%[1]. More specific ascertainment of this risk is hampered by the wide variety of surgical procedures that gravidas may undergo and by the retrospective nature of studies on this topic. It is clear that the risk of preterm labor increases with advancing gestational age. This is another reason performing non urgent surgical procedures during the second trimester, which is thought to be justified for two reasons: avoidance of the embryonic period and the possibility of teratogenicity, and performance prior to viability in attempt to avoid extremely premature infant[1,27]. Although the overall rate of preterm labor seems to be low, the risk is much higher in special situations[1,24]. For example, complicated appendicitis may be associated with a risk of 20%, especially when it occurs in the third trimester[24]. Although the cause of even term labor is unknown, the high rate of preterm labor in such situations could be due to the additive effects of uterine manipulation and enhancement of the inflammatory response as a consequence of the intraperitoneal infection[1].

Tocolytic Therapy is the use of agents to halt premature labor and thus avoid preterm delivery of low birth weight infants. They include progesterones, ethyl alcohol, beta adrenergic agonists, magnesium sulfate, and the NSAID indomethacin[1,6,30]. The use of these agents is controversial. It was suggested that these agents particularly magnesium sulfate and beta-sympathomimetic agents, can stop labor, as demonstrated by some controlled clinical trials[30,31]. However, serious maternal side effects may occur (congestive heart failure and pulmonary oedema), and it is uncertain whether their use actually decreases the

incidence of low birth weight infants[32]. Some reporters[33] reviewed their experience with hydroxyprogesterone and found no difference in foetal mortality between those patients who were given hydroxyprogesterone and a group of matched controls. While others[25,30] who used several tocolytic agents, whether therapeutically after onset of premature labor or prophylactically to prevent the development of premature labor reported successful results. These encouraging results were coupled with no serious maternal side effects and no evidence of foetal distress[30].

MOST COMMON NON OBSTETRIC/ GYNAECOLOGIC CONDITIONS

Appendicitis is the most frequent condition encountered during pregnancy [6,9,25,30]. It occurs in every 1 in 300 to 1 in 10,000 pregnancies, with the usual frequency of 1 in 1500 to 2000 pregnancies[24,33]. The condition can occur throughout the pregnancy but is more frequent in the first two trimester overall[9,33]. The diagnosis is frequently delayed because of confusion between pathologic conditions and the normal physiologic changes of pregnancy[6]. It has long been thought that as the uterus enlarges, the appendix moves upwards toward the right flank, reaching the level of the iliac crest after the fourth month of pregnancy[34]. Thus, the abdominal pain of appendicitis in pregnant women can be felt anywhere from the mid umbilicus to the entire right upper abdomen. However, recently Mourad et al[35] reviewed abdominal pain location in their series of pregnant women with appendicitis and found that most women with confirmed appendicitis described their pain in the right lower quadrant of the abdomen regardless of gestational age. As it was mentioned earlier, the white blood count increases normally during the course of pregnancy and therefore should be interpreted carefully[1,9,10]. However, a left shift (WBC with an increased number of immature forms) has noted in pregnant patients with appendicitis[25]. The use of high-resolution ultrasound with graded compression technique has been used to aid in the diagnosis[36]. A normal appendix is found in up to 30% of cases at surgery[6] with the most common missed diagnosis being pyelonephritis, ovarian cysts, and cholecystitis[6]. Complications occurring as a result of appendicitis during pregnancy include maternal morbidity and mortality, premature onset of labor, and foetal loss[9]. The most significant factors associated with increased risk are the presence of symptoms for more than 24 hours prior to operation, marked leukocytosis with significant left shift (granulocytosis), and appendiceal perforation at the time of surgery[9]. The risk of premature labor is 10% to 15%[9,25,30]. This risk is similar for both negative laparotomy and appendectomy for early acute appendicitis[9]. Foetal loss occurs in 3% to 5% of cases, but increases to 20% when advanced or perforated appendix is found at the time of surgery[9,24]. Overall maternal mortality should be less than 1% when appendicitis is diagnosed and treated in a timely fashion[9].

Biliary tract disease occurring during pregnancy may become symptomatic in 0.05% to 0.16% of pregnant women and 10% to 40% of symptomatic patients will require operation[1,2,25]. It is the second most frequent intra-abdominal inflammatory condition seen during pregnancy[6,9,25]. Common bile duct stones occur in 7% of the cases[2]. The incidence of pancreatitis ranges from 1 in 1,066 live births to 1 in 3,333 pregnancies[37]. Sonography is very accurate at identifying the biliary problem[9,21]. However, it is less useful for determining the state of the pancreas in those patients with suspected gallstone pancreatitis[9]. Patients with an elevated serum amylase, and an

ultrasound scan that shows gallstone are treated for gallstone pancreatitis[9]. The initial treatment for biliary tract disease of pregnancy is nonoperative. This is often the first consideration during the first and third trimester[6,9]. Patients who are treated successfully with conservative management are followed closely throughout the remainder of the pregnancy and are scheduled for cholecystectomy in the postpartum period whenever it is possible[9]. When indication for surgery is non resolution of acute cholecystitis or gallstone pancreatitis, regardless of trimester, the patient is resuscitated and operation is performed. In this situation, the maternal risks associated with delay in treatment are more significant than risks for the foetus[9]. The incidence of foetal loss is higher when operation is performed during the first trimester compared to the second trimester (5.1% to 15% versus 1.4% to 5%)[6]. In general, maternal mortality is low and complications are not significantly increased over those operated on urgently who are not pregnant. Recently, there have been reports of the use of laparoscopic cholecystectomy in pregnant patients[38,39], which seems to be well tolerated as in the open cholecystectomy. It is not used during the third trimester owing to the size of the uterus. When used during the second trimester, the open technique of trocar insertion and modification of the placement of the other ports for dissection is used. Disagreement exists about the use of operative cholangiography in patients who are pregnant[9]. In general, it should be performed when there is a suspicion or risk for common bile duct stones such as in those with gallstone pancreatitis and should not be used routinely. The technique should be modified to include the provision for intraoperative foetal shielding[9]. Cosenza et al[39] reviewed the surgical management of biliary gallstones in pregnancy. The most common indications were acute cholecystitis (38%), acute gallstone-related pancreatitis (28%), common bile duct stones (19%), and persistent biliary colic (16%). In this study, two women required preoperative endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic stenting. They reported on a total of 32 cholecystectomies, 7 open common bile duct explorations, and 12 laparoscopic cholecystectomies. One spontaneous abortion was noted in the laparoscopy group. One woman in the cholecystectomy group had a preterm delivery.

Intestinal obstruction occurs in 1 in 1,500 to 1 in 66,550 pregnancies[6,40]. Although adhesions is the most common cause, it was reported that volvulus (25%), intussusception (5%), malignancies, hernias, and worsening diverticulitis/diverticulosis can contribute to the development of bowel obstruction[40]. The condition is extremely rare in the first trimester but occurs more than 50% of the time in the third trimester as the uterus occupies more of the abdominal cavity and distorts previous relationships of adhesions to the surrounding bowel[6]. Premature labor and foetal loss occur in 33% to 50% of cases developing in the third trimester, primarily as a result of maternal shock, but appear to be less frequent in the first and second trimesters[41]. Maternal mortality varies from 10% to 20%, primarily because of delay in diagnosis[6,41].

Trauma is the leading non obstetric cause of maternal death, it occurs in approximately 7% of pregnancies[1]. It could result from motor vehicle accidents, domestic abuse and assaults, falls, burns, puncture wounds or animal bites. The anatomic alterations of pregnancy predispose pregnant women to a greater risk of peritoneal haemorrhage after lower abdominal and pelvic trauma but protect against bowel

injuries to some degree. However, the marked engorgement of pelvic vessels because of intravascular volume during pregnancy increases the potential severity of retroperitoneal haemorrhage. Pressure transmission through the uterus also increases the risk of abruption placenta, which complicates 1% to 5% of minor injuries and 40% to 50% of major, life-threatening injuries[1,42]. Uterine rupture accounts for approximately 0.6% of all injuries during pregnancy. Direct foetal injury most commonly involves the foetal skull and brain, usually late in gestation, associated with pelvic fracture and an engaged foetal head[1,42]. Penetrating trauma during pregnancy is primarily due to gunshot and stab wounds. Foetal and maternal morbidity and mortality rates are significantly different. Maternal death occurs in fewer than 5% of cases[1]. The cephalad displacement of the bowel caused by the enlarging uterus and the cushioning effect of the uterus have been deemed protective to the mother. The incidence of visceral injury in pregnant women with penetrating abdominal trauma is 16% to 38%, compared with 80% to 90% in the general population[43]. Perinatal mortality rates are 47% to 71%, and although perinatal death is frequently due to prematurity associated with delivery, foetal injury is observed in 59% to 89% of cases[44]. Treatment of the pregnant trauma patient is actually treatment of two patients. The health of the mother takes over that of the foetus and is of primary concern unless vital signs cannot be maintained in the mother then perimortem caesarean section must be performed[1]. In treating the mother, all the maternal physiologic states mentioned before must be kept in mind[1-11]. The routine basic and advanced life support measures should be considered, and the patient should be evaluated for unsuspected injuries. Laparotomy for maternal indications is not an indication to perform a caesarean section unless there is a foetal indication. When it is known at the time of surgery that the foetus has died, the mother should be treated surgically as indicated, and the pregnancy should be treated conservatively by subsequent vaginal delivery[1]. If however, the uterus sustained significant injury, foetal removal should be accomplished[1].

Perimortem Caesarean Section (CS): Katz and colleagues[45] reviewed neonatal consequences of delivery intervals between maternal death and delivery by emergency CS. Seventy percent of surviving infants were delivered within five minutes after maternal death and all were neurologically intact. Although there has been neonatal survival as many as 22 minutes after documented maternal cardiac arrest, the general observation has been that, because delivery of the infant usually occurs within 1 minute of the initial skin incision, the 4-minute rule for starting a CS should be applied when the gestational age is compatible with foetal survival[1,45]. If this time interval has been exceeded, one may still consider perimortem CS, given several case reports of neonatal survival with longer arrest to delivery intervals[1,45]. It should also be remembered that delivery of the infant abdominally might have resuscitative benefits for the mother by diminishing the foetal-placental mass and improving cardiac return, and thereby, the cardiac output[1].

LAPAROSCOPY FOR NON-OBSTETRIC RELATED SURGERY DURING PREGNANCY

Significant experience with laparoscopy in pregnant patients to rule out ectopic pregnancy exists in the gynaecology literature[45,46]. Most of these patients had normal intrauterine pregnancies. They tolerated the procedure well, without an increase in foetal loss or adverse long-term outcome regardless of the trimester

in which laparoscopy was performed[45,46]. During the first trimester, the major risks are secondary to teratogenesis and a miscarriage rate of 12%[38,45]. During the third trimester, a 30% rate of preterm labor and premature delivery exists and increases with gestational age[45,47]. Also the gravid uterus in the third trimester can interfere with adequate visualization of the abdominal cavity and the operative field[45,47]. In the second trimester, the rate of miscarriage is 0%, the rate of preterm labor is only 5% to 8%, no risk of teratogenesis exists, and the gravid uterus does not create an obstruction[45,46]. For these reasons, the second trimester is considered the safest time for laparoscopic surgery in pregnant patients[45,48]. However, Uemura et al[49] questioned the safety during the second trimester. From their recent studies[49] they found that maternal carbon dioxide pneumoperitoneum during the second trimester equivalent produces significant hypercapnia and acidosis, along with prolonged hypoxia. They therefore concluded that the foetal effects of insufflation at this gestational age seem more severe than at near term, but clinical importance of these observations remains unclear[49]. They thought that an additional work should be conducted to confirm the presumed safety of conducting minimally invasive procedures during the second trimester[49]. Other studies evaluating the effects of carbon dioxide pneumoperitoneum in pregnant baboons and sheep have demonstrated similar findings of foetal tachycardia, foetal hypertension, prolonged hypercarbia, and severe maternal and foetal acidosis[7,45]. Furthermore, Reynolds et al[7] found that the severity and duration of these effects could not be predicted from maternal arterial blood gas data. The same authors[7] thought that as such, as long as oxygenation is maintained, the foetus may well tolerate other changes in blood gas status with no untoward effects[7]. They also suggested that because all experimental studies conducted to date have used healthy animals, it is difficult to predict how the underlying maternal pathology (appendicitis, cholecystitis, etc.) may alter the physiologic response to pneumoperitoneum[7].

Similar to the non-pregnant patients the same potential advantages of a minimally invasive approach exist for pregnant patients requiring surgery[7,45]. These include earlier return of gastrointestinal function, earlier ambulation, decreased hospital stay, and quicker return to routine activity, in addition to others.

Due to the same physiologic/haemodynamic changes and respiratory risks mentioned before[1-11] several guidelines should be followed when performing laparoscopic surgery in pregnant patients to ensure the safety of the mother and foetus[48]. A left lateral position should be used as in open surgery, and minimizing the degree of reverse Trendelnburg position. Prophylaxis against deep venous thrombosis and prophylactic antibiotics are used[45].

An open Hasson technique for abdominal access is safer option in pregnancy compared with the blind needle insertion[45]. Trocar placement should not differ significantly from positions used in non pregnant' patients, however, some modifications might be necessary to accommodate the gravid uterus size and displacement of the bowel. An angled scope greatly facilitates viewing over and around the uterus[45]. Caution should be used to minimize manipulation of the uterus. Intra-abdominal pressure should be as low as possible while adequate visualization is still achieved[45]. A pressure of 10 mm Hg to 12 mm Hg meets these criteria[48]. As mentioned before[9], if intra-operative cholangiography is necessary, the foetus should

be protected with a lead shield[9,48]. The use of and the precautions of using of the Tocolytic agents during laparoscopic surgery are the same of those mentioned before during the open procedures[1,6,25,30,31].

ABDOMINAL CANCER IN PREGNANCY

Apart from some details in the management of adnexal masses including ovarian cancer[1] and lymphomas[50] during pregnancy no specific detailed presentation was found in the literature concerning other types of abdominal cancer, specifically gastrointestinal and bowel cancer. The present author decided not to discuss these conditions (adnexal masses, ovarian cancer and lymphomas) any further because of their specific conditions and they usually involve other specialties in their management and not primarily the general surgeon. The absence of any details in the literature of cancer cases, certainly does not rule out their existence but more likely the deficiency in reporting them. The present author recently treated a young patient in her mid thirties of age who was 19 weeks pregnant. She presented with partial large bowel obstruction due to a large tumour at the hepatic flexure. The patient lost her two Fallopian tubes previously due to ectopic pregnancies. This current pregnancy was successful through an IVF. The patient successfully underwent extended right hemicolectomy. Significant lymph nodes metastases were found and the patient subsequently received full course of systemic chemotherapy while the pregnancy continued till full-term without any detrimental effects to the patient or foetus. She eventually had full-term normal vaginal delivery. The details of that case and further events will be presented in another publication.

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