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# Complications of Cesarean Operation

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## Abstract

In the last decades, there has been a huge increase in the incidence of the cesarean section that worldwide became a routine procedure in most hospitals despite the potential complications which in some cases can cause permanent damage or can even be fatal, affecting both the mother and the fetus. In this chapter, we will discuss the most frequent complications that occur in the cesarean section both in the surgical act and after the event.

**Keywords:** cesarean section, intraoperative complications, postoperative complications

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## 1. Introduction

The progressive increase in the incidence of cesarean section during the last decades has been constant worldwide, increasing; at the same time, the indications, many of them unnecessary, resulting in indiscriminate practice, becoming the most frequent surgical intervention performed in health institutions, both private and public. Currently, the obstetrician is able to more accurately assess the hostility of the intrauterine environment and thus, as the development of fetal medicine is so significant, and it is also safe to perform a cesarean section since there are also factors that facilitate decision-making in favor of interrupting pregnancy through the abdominal route such as new generations of antibiotics with greater coverage, suture materials with less adverse reaction, better surgical techniques and skills, better hospital infrastructure and greater ease of extra-hospital monitoring at the exit.

This increase is also favored by non-professional communication in social networks that minimize the surgical risks of cesarean section, promoting false advantages aimed mainly at family comfort; as well as by health professionals not related to obstetrics and although it bothers us to recognize it, also by some “obstetricians” who seek personal benefits [1–11].

In addition, we will never finish insisting that medical legal criteria encourage the belief that maternal morbidity and mainly the perinatal observed in the vaginal route, could be avoided with a cesarean section, favoring the growing doctor's fear to be subject of a legal claim thus evading the responsibility that comes with the adequate and justified indication of a cesarean section [11, 13].

A person who has never experienced the effect of surgery can hardly understand the physical effort required by a mother to take care of the newborn during the first months of life and be deprived of a tranquil convalescence and favored by the benefit provided by rest and the attentions that are given to any patient after surgery.

In 2016, it had been 100 years since Edward Craigin suggested that "once a cesarean, always cesarean," a concept that not only continues in many obstetricians but also becoming increasingly popular, so that the same patients increasingly request a cesarean section of repetition without considering the reproductive impact that it entails and without a full knowledge of the possible complications that even in our days have a considerable risk of high morbidity and mortality, both maternal and fetal [1–10].

We can divide the complications into trans-surgical and postsurgical, and the latter one into early and late.

## **2. Trans-surgical complications**

### **2.1. Hemorrhage**

Hemorrhage is the most frequent complication of the cesarean section during or after the surgical event. However, there is no consensus on the actual incidence, worldwide; it is estimated that around 75% of obstetric hemorrhages occur in cesarean section.

In developing countries, obstetric hemorrhage alternates the first and second position with preeclampsia as a cause of maternal death, and the World Health Organization accepts a rate of 10% worldwide in all births with live fetus [3, 4, 14–21].

The physiological changes that occur in the circulatory system during pregnancy act as an important factor, remember that the hypervolemia that occurs progressively from the first trimester reaches a maximum in the third quarter of up to 45% higher than the volume in the non-pregnant woman, which among other functions, and it has to meet the metabolic demands of the uterus which develops a very hypertrophic vascular network and protect the pregnant woman against blood loss related to childbirth. These two functions paradoxically become a risk factor for the pregnant woman undergoing cesarean section since this modification in the vascular network increases the risk of injuring important vessels when surgically affecting or extracting the fetus through the hysterotomy, and on the other hand, hypervolemia favors the tendency of the obstetrician to underestimate the bleeding that occurs during surgery, causing an excess of confidence that ends up in most of the cases causing adverse effects [19].

It is generally accepted to limit the amount of bleeding to a maximum of 500 ml for a vaginal delivery and 1000 ml for the cesarean section, and in case of larger amounts, it is termed as obstetric hemorrhage. It is also accepted as a 10% decrease in hematocrit, although this starts after 4 h with a maximum limit of up to 48 h [19, 21].

It must be borne in mind that the indication of cesarean section “per se” implies a pathological background disorder such as the anomalous insertion of the placenta, maternal hypertension, the infection, prolonged labor, uterine overdistention, and so on, which are factors that significantly alter the vascular network and uterine contractility, increasing the bleeding caused by the same vascular damage during the surgical act which increases when there is difficulty in extracting the fetus since it can easily tear the hysterotomy causing greater vascular damage [3, 4, 14–21].

In **Table 1**, we see the most frequent risk factors that are associated with bleeding as a complication of the cesarean section.

The treatment of the hemorrhage depends on the cause, and hemorrhage can precede the indication of cesarean section as in the low insertion of placenta or the premature detachment of placenta or appear in the course or even after surgery. **Figure 1** shows the placental bed invaded by the trophoblast.

The treatment should start with a quick and precise diagnosis of the origin of the hemorrhage accompanied by measures that maintain an adequate hemodynamics with intravenous solutions of preferably isotonic crystalloids in which blood is obtained for immediate transfusions, taking care not to pass more than 2000 ml of liquids that can cause an acute pulmonary edema or lead to a coagulopathy by dilution, and fresh blood or alternate erythrocyte concentrates should be administered with fresh frozen plasma for the immediate replacement of coagulation factors; immediate cleaning of the uterine cavity at the same time of a uterine massage applied in a uniform and compressive manner. Most of the time, it achieves the

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Low insertion of placenta
Placental accretism
Placenta abruption
Hypotonia/uterine atony
Multiple pregnancy, fetal macrosomia, polyhydramnios, Uterine scar
Arterial hypertension
Multiparity
Obesity
Chorioamnionitis
Prolonged labor
Poor technique and prolonged surgical time

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**Table 1.** Risk factor for hemorrhage.



**Figure 1.** Placenta accreta invading the uterine muscle layer.

adequate contraction of the uterus, and if it is not achieved, it must be started with the administration of the following substances to contract the uterus [3, 4, 14–18, 22–24]:

- Oxytocin. Apply 10 units in a slow intravenous form followed by a continuous infusion with 20–40 units taking care of the hypotension caused by the vasodilatation.
- Ergometrine. It is applied in doses of 0.2 mg intramuscularly and with minimum intervals of every 6 h, the main side effect is hypertension, especially with previous history of the same.
- Carbetocin. It is a synthetic analog of oxytocin with a long-acting synthetic analog of oxytocin that has a rapid and prolonged action, initiating its effect at 2 min and lasting up to 2 h intramuscularly and can be administered in slow intravenous form. It is administered as a single dose of 100 µg.
- Misoprostol. Analog of prostaglandin E1 is administered in a dose of 600–800 µg rectally obtaining an uterotonic effect 10 min after its administration, being possible to repeat doses with intervals of every 6 h.
- Tranexamic acid. It is an antifibrinolytic that is administered at a dose of 1 g in an intravenous bolus and can be continued in perfusion of 1 g for 8 h. Care should be taken in patients with a history of thromboembolic diseases.

If there is no response to the previous measures, it will be attempted to stop the bleeding by applying an intrauterine tamponade that can be immediately with textile compresses and if you have the resource, try latex or silicone balloons of the Sengstaken-Blackmore, Rush or Bakri type that act by increasing intrauterine pressure compressing the vascular network until hemostasis is achieved by hemostatic physiological mechanisms [25, 26].

If there is no recourse to the balloons, a compressive suture will be attempted.

If at the moment of compressing the uterus bimanually, a decrease in the hemorrhage is observed, it can be expected that by maintaining this compression with a suture, the cessation



of the hemorrhage will be achieved. B-Lynch described in 1997 a simple technique without ligating the uterine artery to control the obstetric hemorrhage that consists of passing a suture of chromic catgut of number 2 beginning under the uterine incision toward the interior of the cavity, later it is incised toward the outside above the incision to surround the uterine fundus and re-enter the cavity through the posterior part at the level of the segment, the same maneuver is carried out in reverse form on the opposite side leaving the cavity from the back to finish in the anterior face below the hysterotomy, nesting firmly and with adequate traction (**Figure 2**).

Since its creation, several authors have described modifications to the original technique; however, all handle the same concept, that is, uterine compression [27, 28].

Arterial ligation is a frequently used resource, especially when it is desired to preserve the reproductive function. Hemorrhage control is carried out by lowering the blood pressure without suppressing the uterine irrigation that continues through the collateral network where there is less pressure, allowing coagulation to be carried out adequately with the subsequent formation of a clot that will not be removed by the arterial pulse. The uterine artery is ligated in a primary form on the side near where the bleeding originates predominantly, if the entire surface is the ligature is performed bilaterally accompanied by the ovarian arteries. This resolves a high percentage of cases of uterine atony; otherwise, it is opted for the ligation of the hypogastric arteries.

Some hospitals have material resources and personnel specialized in interventional radiology with sufficient experience to perform an embolization of the pelvic arteries through an angiogram, being an adequate resource in a very high percentage to stop the hemorrhage and preserve the reproductive function [18].

If all the above is not enough to stop the hemorrhage, then the indication to carry out a hysterectomy appears, which can be performed subtotally given the haste and critical conditions in which most of the patients are, as well as being a surgery which implies greater difficulty due mainly to the vascular changes that arise with pregnancy. With this procedure, if there are



**Figure 2.** B-lynch technique.

still no significant alterations in the coagulation, the problem is solved in its entirety since the origin of the hemorrhage is removed, although the reproductive function is lost [17, 20, 21].

While there is no new technology and adequate measures to control bleeding, the above described will continue to be the best option for the management of this serious complication.

### 3. Urological injuries

Often the cesarean section involves careful dissections to reject the bladder, so that it can sometimes be injured. It is the most common lesion in urinary organs, although sometimes the ureter can be damaged by causing obstruction by ligature or angulation and partial or complete section.

Bladder injury can occur when the peritoneum is opened if care is not taken to empty it adequately through a catheter or in cases of previous surgeries that firmly attach the bladder to the anterior side of the uterus where it is also common to find a large engorgement of the venous plexus that easily breaks, complicating the dissection by the hemorrhage provoked. When tears of the hysterotomy occur, they can be prolonged to the bladder damaging it.

It is necessary to identify the bladder lesion well and outline the extension well. The repair is carried out with the inversion of the tissues in two planes with chromic catgut or vicryl 00, and it is important not to leave the suture under tension since it favors the appearance of fistulas. Always immobilize the bladder with a permanent catheter for at least 10 days. The appropriate closure should be confirmed with the instillation of methylene blue or when the resource is available, a cystoscopy is performed at the end of the closure. Sometimes, only the muscular layer is damaged, finding the mucosa intact, in which case, it must be repaired with chromic catgut 000 since they can easily produce fistulas.

The most frequent site of ureteral injury is in the bladder or in the junction with the uterine vessels, especially when the bladder is not rejected properly, being more frequent when a hysterectomy is performed. The injury is mostly possible when the cesarean section is performed urgently.

Bladder injury is easily recognized in the course of surgery, but not the ureteral injury that should be suspected at the time to be diagnosed in a timely manner. When we suspect we have to dissect the path in question to achieve an adequate identification of the problem, in case of section, it is convenient to request the intervention of an experienced surgeon or an urologist to perform the immediate anastomosis, if there is only an angulation by a suture, and it is corrected by removing the latter.

When the repair of damage is done immediate, morbidity is greatly reduced [29–32].

#### 3.1. Intestinal lesions

Intestinal lesions are extremely rare in the cesarean section, and when they occur, they are usually secondary to an urgent abdominal approach with intestinal adhesions to the anterior wall in cases of previous surgeries almost always non-obstetric. When an intestinal lesion is

identified, it is convenient to “mark” the damaged site with a wet compress since, if it is not done, the injured area is easily lost, and after the uterus closes, it is repaired [1, 6, 10].

### **3.2. Anesthetic complications**

They are very rare but when they occur, they are accompanied by high morbidity, becoming lethal.

In regional anesthesia, the most frequent are hypotension caused by sympathetic nerve block aggravated by aorto-cava compression that produces the pregnant uterus in the supine position, and it is solved with intravenous fluids prior to the event, with change of position to lateral decubitus and the use of ephedrine that has a vasoconstrictor effect without affecting the placental flow.

Another complication is headache by puncture of the arachnoid hard membranes that cause an escape of cerebrospinal fluid with loss of cushioning effect. It is solved with the application of a blood patch in the epidural space.

Finally, there may be a total blockage causing a respiratory arrest that forces to handle the airway with the difficulties that this implies in the pregnant patient.

General anesthesia presents the failed airway intubation as a main problem secondary to the difficulty implied by the pregnant woman due to an increase in body mass and decreased functional lung capacity. In most cases, it is resolved by temporarily deferring the surgery initiating 100% lime oxygenation with a face mask and the appropriate position of the head and neck. However, the deferral of the cesarean section, most of the time, it may not be possible due to the urgent indication of it.

Another complication of general anesthesia is the chemical pneumonitis by aspiration of gastric contents which has an unfavorable prognosis [33–37].

Fetal lesions with the scalpel when the uterus impinges are reported with a very low frequency, on average of less than 1%, and most of the occasions occur when there is an indication to extract the fetus with urgency. This frequency is higher in school hospitals due to the lack of experience of the obstetric surgeon in training [38].

## **4. Early postsurgical complications**

### **4.1. Hemorrhage**

Postsurgical hemorrhage occurs mainly due to hypotonia or uterine atony that is managed with sustained uterotonic medications during the following hours after the surgery; however, when there is no favorable response, the same sequence of treatment of trans-surgical hemorrhage must be followed. Less frequently, it is due to a poor technique in the repair of the surgical planes, favoring the formation of bruises that, when they extend, can dissect the adjacent tissues in an important way. Another cause is the defects in the coagulation either by the pathology previous to the event as in the case of preeclampsia or due to the consumption of



factors when a severe hemorrhage occurs. Finally, in few occasions, it can be due to the retention of placental remains, which is managed with the extraction by means of an instrumental curettage of the uterine cavity [1, 2, 7, 12, 14].

#### 4.2. Infection

The infection in most of the times is the result of a reciprocal action between the defenses of the host and the virulence of the germs, nevertheless in obstetrics unlike the other specialties, the immune state acts only in rare occasions as a factor of important selection. The increase in the number of leukocytes that occurs in pregnancy is maximum at the end of it, increasing the defenses and also has a higher bactericidal activity than in the non-pregnant women.

Most patients become infected with their own microflora, which depends on factors such as duration of labor, time of rupture of the chorioamniotic membranes, multiple vaginal examinations, nutritional status of the patient, deficient aseptic techniques and surgical time. Infection during cesarean section is one of the most frequent complications, and the main reason for hospital re-admission, which consequently increasing costs [39–44].

Almost 30 years after completing two centuries in which Ignatz Semmelweis established his concepts about asepsis in obstetrics and importantly in surgery, we are still surprised that the deficient asepsis, in most of the times due to excess of confidence acquired from the beginning of the antibiotic era, continues to be a risk factor for the appearance of obstetric infection, mainly during cesarean section [45].

It is well known that postpartum endometritis occurs approximately 5–20 times more frequently and with greater severity in the cesarean section than in vaginal delivery, thus becoming the major risk factor mainly due to situations involving uterine manipulation, instrumental contamination and sutures that cause ischemia and tissue necrosis, which favors the development of an infection.

Endometritis has a multiple microbial origin, and more frequently, aerobic Gram-positive cocci and Gram-positive anaerobic bacilli are found. In **Table 2**, we observe the most frequent microorganisms.

The diagnosis is made by clinic where we find the presence of fever, hypogastric pain, fetid lochia and pain to the mobilization of the uterus, the laboratory shows a leukocytosis.

The treatment should be started once the culture samples have been taken, although most of the time, they are not very helpful because of the little reliable information they provide given the vaginal contamination and the delay in reporting.

The antibiotics of choice must be broad spectrum, in the majority of patients, the use of third-generation cephalosporins achieves a good result, and in cases of penicillin allergy, clindamycin can be used either alone or in combination with some aminoglycoside.

Endometritis can occur accompanied by infection of the surgical site or urinary tract, and in these cases, the quinolones become a good treatment option.

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**Aerobic:**

Gram-positive cocci

*Streptococcus*

*Enterococcus*

*Staphylococcus*

Gram-negative

*Escherichia coli*

*Klebsiella pneumoniae*

*Proteus mirabilis*

Others

*Corynebacterium vaginalis*

*Neisseria gonorrhoeae*

**Anaerobes:**

Gram-positive cocci

*Peptococcus*

*Peptoestreptococcus*

Gram-positive bacilli

*Clostridium*

Gram-negative bacilli

*Bacteroides bivius*

*Bacteroides fragilis*

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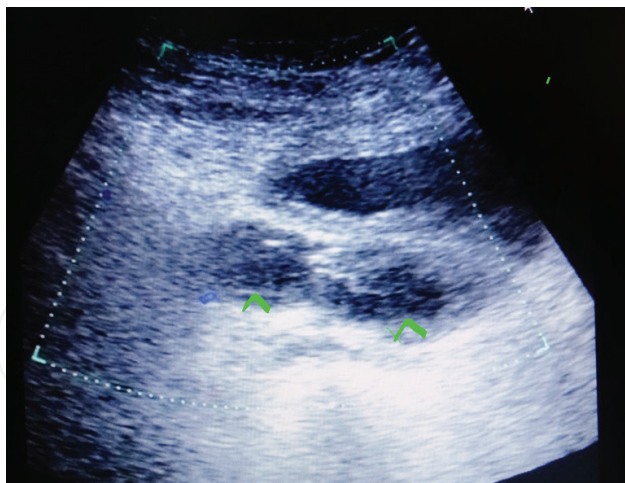
**Table 2.** Most frequent microorganisms in endometritis.

The infection of the surgical site before called surgical wound infection is caused by contamination, being the most frequent germ the coagulase-negative *Staphylococcus*. It occurs in a range of 3–15%. Cesarean section is considered contaminated when there is prolonged labor or rupture of membranes, in addition to various risk factors such as prolonged surgical time, poor tissue management, contaminated instruments, nutritional status and previous anemia or caused by surgery.

**Figure 3** shows a sonographic image of pelvic abscesses after obstetric hysterectomy.

Infection happen during the following 30 days of the intervention, and it is classified as follows:

- Surface infection of the incision. It affects only the skin and the subcutaneous tissue at the site of the incision.
- Deep infection of the incision. It affects the aponeurotic fascia and the muscle.
- Organ or space infection. It involves any part of the anatomy other than the open or manipulated incision during the surgery.



**Figure 3.** Pelvic abscess *after obstetric hysterectomy*.

The treatment is based on adequate drainage performed in the exploration and the use of broad-spectrum antibiotics.

Since the antibiotic era, a significant decrease in the infection in cesarean section is observed, especially with the use of prophylactic antibiotics evidenced through multiple studies, and it is almost universally accepted nowadays, in the same way, there is increasing evidence of better results with the application prior to the incision and not after clamping the umbilical cord, although there is still controversy in this regard. The recommended antibiotic continues to be the first-generation cephalosporins.

However, prophylaxis remains debatable in that, it does not prevent more serious infections such as thrombophlebitis and pelvic abscess, so its use should be limited to cases where there is a high risk of infection such as prolonged labor, the rupture of long-lasting membranes and the indication of cesarean section in urgent form.

The incision in the abdominal wall acquires a great importance in the presence of complications since the transverse incisions restrict the surgical field in such a way that the vertical



**Figure 4.** Transverse abdominal infected wound.

middle incision seems the most suitable for obstetric approach although it has its esthetic disadvantages.

The prognosis regarding the possibility of infection or dehiscence depends more on performing an adequate technique than on the type of incision, although controversy still exists in this regard. In which does exist an agreement is that the infection in transverse incisions evolves in more torpid form when the subaponeurotic plane is affected [39–44, 46–51].

In **Figure 4**, we observed a transverse abdominal wound infected with purulent discharge at the edges.

## 5. Thromboembolisms

Thromboembolisms are more frequent in the cesarean section than in the vaginal delivery and are favored by the triad relatively common to the gestational term of venous stasis, hypercoagulability and endothelial injury. Symptoms at the site of thrombus formation are usually minimal or absent until detached and manifest as a pulmonary or pelvic embolism. The diagnosis is usually made by exclusion in those patients who have insidious fever accompanied by tachycardia and an inadequate response to treatment with antibiotics most of the time already established.

In the cases of pulmonary thromboembolism, the picture manifests suddenly with tachypnea, dyspnea, general malaise, severe chest pain and hemoptysis, and in severe forms, it progresses to the state of shock with a high percentage of mortality.

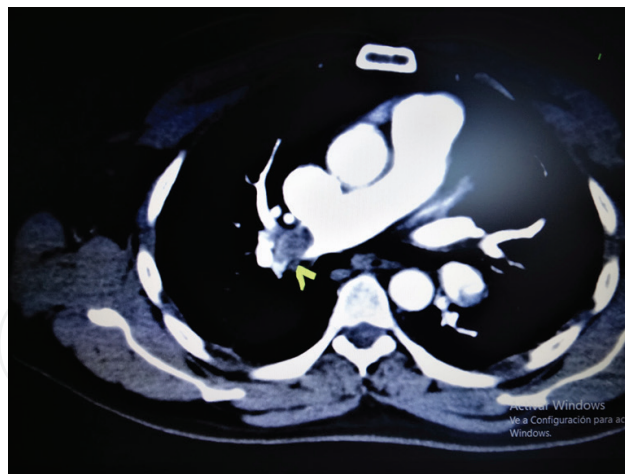
In the pelvic presentation, there is no local pain or malaise, and its manifestation is usually delayed, producing septic emboli mainly to the lung, manifesting initially as micropulmonary infarcts.

The treatment consists of immediate anticoagulation to end the obstruction and avoid new emboli. Unfractionated heparin is used in necessary doses until the activated partial thromboplastin time is lengthened up to 1.5–2 times over the control time. Most of the time, the recovery is amazing only with anticoagulation; however, it is necessary to modify the antimicrobial treatment with a double scheme that covers both Gram-positive and Gram-negative bacteria. Surgical intervention is rarely necessary to remove the clot [6, 39, 42, 52–56].

In **Figure 5**, we observed a contrast tomographic image of a major pulmonary thrombosis.

Postoperative ileus rarely occurs in the obstetric patient since little is manipulated in the intestine due to the pregnant uterus, and when it occurs, with fasting, parenteral solutions and the placement of a nasogastric tube is usually enough to solve it [4, 57].

Fetal complications are rare, and the most frequent is respiratory distress syndrome in terms of newborns mainly in elective cesarean section. The immediate transition required by the fetal lung filled with fluid to change it by air at birth occupies physiological mechanisms that accelerate with labor, so in the absence of this, a dysfunction of these mechanisms occurs and



**Figure 5.** Pulmonary thromboembolism.

with a probable failure of the action of pulmonary surfactant. In some cases, mechanical ventilation with supplemental oxygenation and surfactant administration is required until the aforementioned adaptation is achieved [58–61].

## 6. Late postsurgical complications

Late postsurgical complications include endometriosis of the abdominal wall in the surgical scar, the formation of adhesions, and as an important sequel, the high possibility of low placental insertion, placental accreta or uterine rupture in later pregnancies.

Endometriosis is defined as the ectopic presence of tissue, whose histological and functional characteristics are identical to the endometrium. Secondary endometrial transplantation is performed secondarily to the surgical incision site manually, with instruments or through sutures during cesarean section with a frequency of less than 0.5%. The diagnosis is made by the antecedent of cesarean section accompanied by cyclic pain and is confirmed by the histological study. Cabinet studies are only useful for deep localization of lesions. The treatment consists of the surgical removal of the lesion in its entirety. Medical management does not provide good results in these cases [62, 63].

Adhesions that occur during abdominal surgeries tend to occur with a high frequency, and there is increasing evidence of long-term morbidity that results in intestinal obstruction as a more severe sequel, chronic pelvic pain and infertility, and in the case of later surgeries, difficulty in carrying them out increasing their morbidity.

In our case, there is important evidence that the greater the number of cesarean sections, the greater the possibility of developing adhesions, although a single cesarean section is not exempt in fact. The presence of adhesions becomes more important when the indication for gynecological causes of performing a hysterectomy appears since it increases morbidity.

Modifications to surgical techniques have not yet been adequately evaluated in the long term such as the decision not to close the peritoneum, and more conclusive evidence is needed regarding the formation or not of adhesions [64–73].



The surgical scar of the cesarean section is considered the main risk for low placenta insertion and placental accreta in subsequent pregnancies. It is also the main risk factor for uterine rupture when a labor test is performed, increasing the possibility of rupture by five times when there are two previous cesarean sections compared to when there is only one.

It can be concluded that the best way to prevent complications in cesarean section is not to indicate an unnecessary one. It is a reality that the inevitable increase in the frequency of the operation worldwide and increasingly with new indications motivated by the most known factors such as better techniques and surgical concepts, surgical materials, the best hospital infrastructure, greater pressure in medical treatment for a high incidence of legal demands but also exist popular concepts that favor the request of completion of pregnancy through the abdomen, whether for esthetics, poorly understood comfort or some other medical justifications that are enough to convince the obstetrician to perform it.

All of the above lead us to question the following: is the cesarean section performed by a justified indication or by a justified concern?

There are also more and more situations around pregnancy that imply an increase in the risk of pregnancy itself such as the tendency to postpone the first pregnancy at a later age, obesity, treatments to promote fertility and others that go beyond the hand with an increase in risk in case of indicating a cesarean section.

When complications occur, the impact on cost is truly important not only because they affect maternal health, but also because of the psychological damage that occurs in the mother-child relationship by prolonging hospital stay and altering home convalescence.

The tendency to limit the number of cesarean sections must be considered seriously for the benefit of the patient since, in addition to preventing the complications that potentially exist in each event, they have a favorable impact on economic, social and reproductive aspects.

It will never be stopped insisting that the identified risk factors may not be so important if proper precautions are taken and a real responsibility is assumed, first in indicating the cesarean section and then when doing it.

Knowledge of the gestational pathophysiology gives us the ability to make appropriate decisions, and when the intervention is timely and accurate in most cases, the possibility of harm is avoided. For the abovementioned intervention, basic concepts such as the careful management of tissues, use of appropriate instruments and minimize surgical time should be kept in mind as much as possible [1, 2, 4, 6, 8–10, 75].

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