

# Surgical management in preeclampsia. Literature from a high specialty medical unit in Mexico City

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Review

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## Background

The intervention of the obstetrician-gynecologist and the surgeon in the management of patients with preeclampsia is not limited to pregnancy termination through vaginal delivery or cesarean section. It also includes the control of obstetric hemorrhage from the placental insertion site, due to uterine complications or accidental injury to blood vessels, urinary structures and intestines. The participation of the general surgeon, vascular surgeon, urological surgeon or gastroenterological surgeon in the management of extremely serious cases can make a difference in the evolution and outcome of patients.

Coordination with medical specialists in critical medicine is necessary at all times to achieve successful results. The multidisciplinary team must share the basic knowledge of the subject, the advances in surgical technique, advanced intensive care and the experience acquired with each case. This review offers an overview of the surgical management of patients with preeclampsia. Only publications from the years 2015 to September 2023 of the authors who work in the host hospital have been included. The intention is to share the criteria and local evidence with the international community.

**Keywords:** Preeclampsia; Cesarean section; Ruptured liver hematoma; Obstetric hemorrhage; High risk pregnancy; Intensive care in obstetrics

**P**reeclampsia-eclampsia (P-E) is the most important group of hypertensive states that complicates 2 to 30% of pregnant patients and is one of the first causes, if not the first, of maternal death mainly in developing countries. Preeclampsia is defined as a disease of placental origin characterized by the appearance of systemic arterial hypertension and/or edema and/or abnormal proteinuria (> 300 mg/24 hours) after the twentieth week of pregnancy, or earlier in the most serious cases or in the puerperium. According to arterial pressure values and their clinical impact, preeclampsia is classified as mild preeclampsia (blood pressure  $\geq$  140/90 mmHg but < 160/110 mmHg), severe preeclampsia (SP) (blood pressure  $\geq$  160/ 110 mmHg, with or without generalized edema and/or abnormal proteinuria, but with clinical data, laboratory studies, or imaging studies of injury or failure of maternal target organs such as the brain, liver, heart, lungs, kidneys, or the mechanism of coagulation) and eclampsia (onset of generalized tonic-clonic seizures that are not secondary to epilepsy or neurological disease in a patient with preeclampsia).<sup>1</sup> HELLP syndrome is a term introduced in 1982 for its acronym in English (H for microangiopathic hemolysis, EL elevated liver enzymes, LP low platelet count). This is a particularly serious condition that can accompany P-E that increases patient morbidity and risk of death from systemic complications.<sup>2-4</sup>

## Overall management

The initial management of P-E at home includes general measures such as rest in lateral decubitus, avoiding family and work stress, and an adequate diet. The administration of oral antihypertensive drugs (Methyldopa, Hydralazine, Metoprolol, Labetalol, Nifedipine, Clonidine) is questioned in non-severe cases, but it is absolutely necessary in patients complicated by SP, HELLP syndrome and eclampsia.<sup>1</sup> A hypertensive crisis represents a medical emergency for which the administration of intravenous antihypertensive agents (Labetalol, Hydralazine, Sodium Nitroprusside) is necessary. In these cases, the recommendation is to send patients to a second-level care center, but rather to a tertiary care center that has an Intensive Care Unit (ICU) for multidisciplinary management.<sup>5</sup>

Regardless of the management guide or protocol that should be applied, in clinical practice the main objective of the medical team is to achieve maternal stabilization as far as possible based on the following parameters: control of arterial pressure, circulating volume expansion, correct tissue perfusion and improve the metabolic status of vital organs, correct abnormalities of hemoglobin, platelet count and others parameters of clinical chemistry (glycaemia, urea, creatinine, colloid osmotic pressure), reduce the risk of seizures or encephalopathy, and

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Parameters	Goals
Mean arterial pressure (mmHg)	≤ 95
Central venous pressure (cm water)	6 to 10
Uresis (ml/K weight/hour)	1.5 to 2
Blood glucose (mg/dL)	≤ 160
Plasma colloid osmotic pressure (mmHg)	24 ± 2
Arterial blood pH	7.37 to 7.44
Hemoglobin (g/dL)	10 to 14
Platelet count (platelets/μL)	≥ 100,000
Seizures	none

**Table 1.** Goals of antepartum management of preeclampsia-eclampsia in the Intensive Care Unit<sup>6</sup>

prevent or manage emerging complications (disseminated intravascular coagulation, anemia, obstetric hemorrhage, respiratory failure, metabolic acidosis, etc.).<sup>6-8</sup> **Table 1**

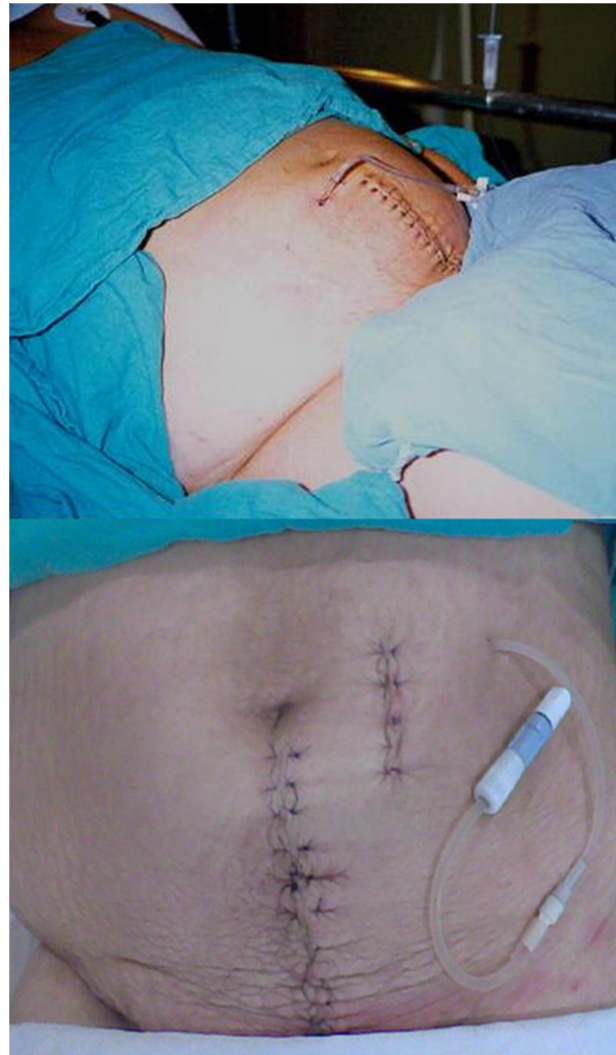
Multidisciplinary management of critically ill P-E patients in an ICU has favorably modified their morbidity and mortality.<sup>9</sup> Hemodynamic and metabolic follow-up has made it possible to punctually correct alterations in vital parameters in the antepartum stage, during delivery care, and in the postpartum stage.<sup>10-11</sup>

### Gestational termination

This is the only measure considered curative in patients with preeclampsia. Most patients improve after the birth of the fetus and the removal of the placenta. However, a select group of patients show persistent preeclamptic activity or slow and delayed improvement with prolonged stay in the ICU.<sup>12,13</sup> The best route for delivery care should always be individualized based on maternal and fetal conditions. The appropriate time for termination of pregnancy has been a subject of debate, now it is no longer. In the last decade, termination was still recommended after having made the diagnosis of P-E. Expectant management was later preferred, but maternal and fetal complications increased and the benefit was questioned.<sup>14</sup> Currently, the recommendation is scheduled termination of pregnancy after maternal stability and control of the most serious complications have been achieved to reduce the possibility of maternal death and long-term sequelae.<sup>1,6,14</sup>

When the condition of the binomial allows it, in pregnancies with premature fetuses, conservative management can be attempted to complete the latency period of the lung maturation scheme to improve their condition at birth.<sup>1,6,14</sup>

Unfortunately, there are not rare cases of pregnant women with life-threatening complications that must be operated on as a real emergency without



**Figure 1.** Cesarean section and postpartum peritoneal dialysis.<sup>19</sup> Upper: Temporary rigid catheter. Lower: Permanent Tenckhoff-type soft catheter.

any hemodynamic or metabolic corrections or transfusional management. These are patients who are admitted to the delivery room or the operating room directly from the emergency service or from the ambulance that transports them from their home. In them, maternal and fetal complications are more serious with higher chances of multiple organ failure, maternal death, fetal death or both.<sup>1</sup>

### Vaginal delivery

Vaginal delivery is a good option for patients with small fetuses, especially those that are not viable, those that have died in utero, or products of a second trimester abortion because it has been associated with reduced blood loss and better control of bleeding from the placental bed. Vaginal delivery is also preferred in women who are multiparous and with larger fetuses or a term pregnancy because it offers a lower risk of uterine atony, hemorrhage, and retroperitoneal

Author, country and year of the report	Case studies	Complications % (n=)
Bergholt et al. Denmark 2003	929	12.1% (n = 143 complications) * Cervical laceration 3.6% (n = 33) Corporeal laceration 0.3% (n = 3) Vaginal laceration 1.2% (n = 11) Bladder laceration 0.5% (n = 5) Estimated bleeding > 1000 ml 9.2% (n = 77) Blood transfusion 1% (n = 9) Uterine rupture 0.3% (n = 3) Hysterectomy 0.2% (n = 2) Maternal death 0%
Nomura et al. Brazil 2004	998	2.64% (n = 26) ** Bleeding complications Uterine atony-hypotonia 0.71% (n = 7) Placental accreta 0.41% (n = 4) HELLP syndrome 0.10% (n = 1) Prolongation of hysterotomy 0.71% (n = 7) Hysterectomy 0.61% (n = 6) Bladder injury 0.10% (n = 1) Maternal death 0%
Umbeli et al. Sudan 2014	470	49.57% (n = 233/470) ** Intraoperative bleeding 23.2% (n = 109) Extensive uterine tear 22.7% (n = 107) Bowel injury 2.8% (n = 13) Bladder injury 0.6% (n = 3) Ureteral injury 0.2% (n = 1) Maternal death 0.7% (n = 1)
Jain et al. India 2016	685	43.35% (n=297/685) *** Operative hemorrhage 5.7 % (n = 17) Prolongation of hysterotomy 4% (n = 12) Couvelaire's uterus 1.4% (n = 4) Maternal death 0%
Vázquez et al. <sup>15</sup> Mexico 2021	100 patients with preeclampsia	12% Uterine atony 6% Uterine artery injury 2% Hysterorrhaphy commissure tear 1% Commissure hematoma 1% Broad ligament hematoma 1% Bleeding in layer 1% Maternal death 0%

\* Complications exceed the number of patients because some had more than one complication.  
 \*\* The authors reported as maternal complications those of an infectious type. They were not considered in this section because they do not necessarily they may have originated during surgery.  
 \*\*\* The authors included as intraoperative complications the alterations of the amniotic fluid, placenta and ovaries, which are not shown.

**Table 2.** Comparison of the frequency of maternal complications during cesarean section<sup>15</sup>

dissection, although some cases may present with these complications.<sup>1</sup> Vaginal delivery is most often performed by first- and second-level physicians, but not in highly specialized centers. The frequency may be different in each region because it depends on several factors such as maternal age, parity, gestational age, fetal condition, and available resources.<sup>1</sup>

**Cesarean section**

The practice of caesarean section in pregnant patients complicated with SP, HELLP syndrome, eclampsia or with hypertensive crisis is increasing in all countries, so that it has now been considered as the technique of first choice for termination of pregnancy.<sup>15</sup>

The indications for cesarean section have been specifically identified. In the last decade other indications have been added, such as the preference of the method by the obstetrician and the cesarean section at the request of the patient. In patients with SP, cesarean section is preferred over vaginal delivery



**Figure 2.** “Pneumatic packing” of a ruptured hepatic hematoma with a Seng-Staken-Blakemore catheter in a patient with HELLP syndrome.<sup>22</sup> Upper: Abdominal x-ray. Lower: Abdominal CT scan.

Panel a: Abdominal x-ray. Panel b: Abdominal CT scan. because it avoids labor and thus the rise in arterial pressure that occurs with each period of uterine contractions, an identified cause of cerebral hemorrhage. It also has the advantage that during the surgical act the maternal oxygen supply and the regular perfusion of the placenta and fetus can be maintained constant through adequate vascular expansion and arterial pressure control.<sup>15-17</sup>

Caesarean section is preferred because it offers additional advantages: it is a rapid invasive procedure, readily available as an emergency resource, technically uncomplicated most of the time, and because blood loss can be relatively small and well tolerated without the need for transfusión. In addition, it allows the performance of other procedures during the same surgical act through the same operative field, such as tubal occlusion, hemostasis of medium and

Causes related to childbirth	
Labor induction	Prolonged labor
Use of oxytocin	Chorioamnionitis
Hasty delivery	Effect of some drugs
Uterine overdistention (uterine atony)	
Polyhydramnios	Multiple pregnancy
Fetal macrosomia	Effect of some drugs
Anesthesia	
General anesthesia with inhaled agents	
Iatrogenic trauma of the genital tract	
Caesarean section	Episiotomy
Use of fórceps	Vascular lesions
Urinary injuries	Intestinal lesions
Spontaneous trauma of the genital tract	
Lacerations	Uterine rupture
Uterine perforation	
Retention of placental remains and clots	
Coagulation disorders	
Disseminated intravascular coagulation	Placental abruption
Liver dysfunction	Amniotic fluid embolism
Fetal death in utero	Severe thrombocytopenia
Blood dyscrasias	von Willebrand disease
Anticoagulant therapy	Hemophilias
Placental alterations	
Abnormal insertion	Uterine inversion
Previous placenta	Placental accreta

**Table 3.** Guide of the causes of obstetric hemorrhage

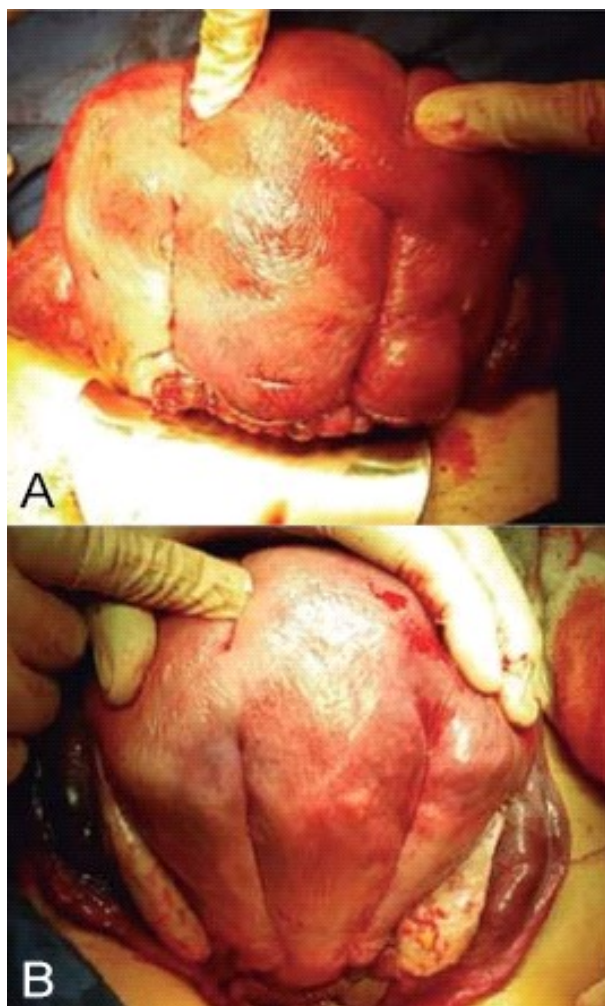
large caliber vessels, vascular ligatures, packaging, uterine sutures and urgent, elective or scheduled hysterectomy.<sup>15,16,18</sup>

In patients with acute kidney injury (AKI) due to obstetric hemorrhage or chronic renal failure who need dialysis, the same anesthetic-surgical time can be used to place a catheter and start dialysis in the immediate postoperative period. The method of first choice for pregnant or puerperal patients is haemodialysis using a Mahurckar-type venous catheter, the other less popular option is peritoneal dialysis using a Tenckhoff-type soft catheter or a temporary rigid catheter.<sup>9,19,20</sup> **Figure 1**

### Technical recommendations during cesarean operation

There are a series of recommendations of the intraoperative technique for patients with SP, HELLP syndrome and eclampsia who have complications related to the coagulation mechanism (thrombophilia, hemophilias, severe thrombocytopenia, disseminated intravascular coagulation, etc.) or with morbid obesity.<sup>15,16</sup>

The median infraumbilical incision is recommended and not the transverse suprapubic incision of Pfannenstiel-type because it produces less bleeding and allows better visualization of the operative field. In all cases, visual and manual inspection of the hepatic gland should be routine, the findings should be noted in the operative description. If available, the use of electrocautery for hemostasis of superficial tissues should be liberal. It is advisable to perform the hysterorrhaphy in two planes and not in one to reduce the possibility of a dehiscence.



**Figure 3.** Final result of the B-Lynch suture modified by Mendoza et al.<sup>25</sup> A. Anterior view. B. Posterior view.

Dissection of the urinary bladder should be avoided whenever possible to prevent active bleeding or hematoma formation that could be a late cause of fever or abscess.<sup>15,16</sup> The suture of the peritoneum must be complete to avoid bleeding from the small vessels at the edges into the subfascial space. The hermetic suture of the peritoneum without a drainage device in the abdominal cavity allows immediate peritoneal dialysis.<sup>19</sup> It is recommended to place a drainage device (Penrose type) in the subfascial space and another drainage in the subcutaneous cellular tissue preferably in those patients with SP and severe thrombocytopenia, HELLP syndrome, acute fatty liver, coagulation disorders, abundant adipose tissue or with morbid obesity. There is no set time, drains should be removed when bleeding stops. It is more appropriate to suture the skin with separate points or with staples, even when a Pfannenstiel-type incision has been made, since it facilitates partial removal of the sutures when a superficial hematoma forms thus avoiding opening the entire wound. Finally, when preeclampsia remains active in the postpartum period, the possibility of retained placental remnants should

Uterine massage	
Management with drugs	
	Oxytocin Carbetocin Ergonovine Misoprostol Calcium
Surgical management	
	Repair of genital tract lacerations Uterine curettage Tamponade with balloons Uterine sutures Ligation of arteries and veins Obstetrics hysterectomy Pelvic packing

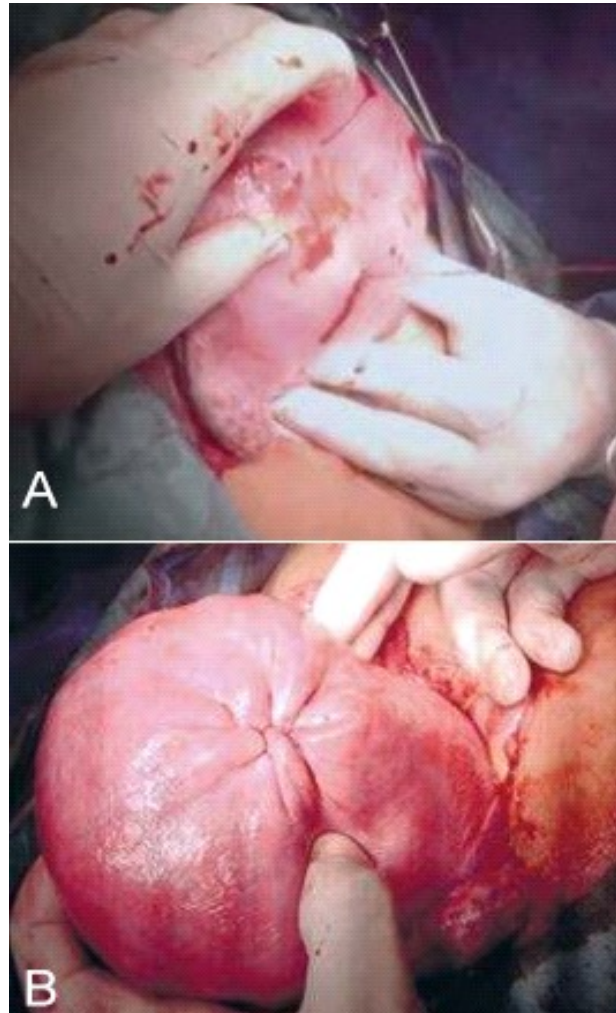
**Table 4.** Available alternatives to conservative and interventional management in patients with obstetric hemorrhage.

be taken into account, a uterine curettage may be helpful.<sup>15,16,20</sup>

In our environment, following these recommendations has had successful results. Maternal complications during cesarean section in 100 patients with SP admitted to the host hospital were reported in 2021. The frequency was 12% and the distribution was as follows: uterine atony 6%, uterine artery injury 2%, hysterorrhaphy commissure tear 1%, commissure hematoma 1%, broad ligament hematoma 1%, bleeding in layer 1% and maternal death 0%. The frequency of complications was low, perhaps because these patients underwent surgery in a high specialty hospital.<sup>15</sup> **Table 2**

**Anesthetic technique**

The anesthetic technique of first choice is regional anesthesia (epidural block, subarachnoid block) rather than general anesthesia because patients have fewer hemodynamic and metabolic changes during anesthesia and in the postpartum period. In addition, tracheal intubation and the side effects of intravenous anesthesia drugs are avoided.<sup>21</sup> Under conditions of controlled arterial pressure, adequate vascular expansion, normal coagulation times, platelet count  $\geq 100,000$  platelets/ $\mu$ L and without seizures, patients with preeclampsia tolerate regional anesthesia

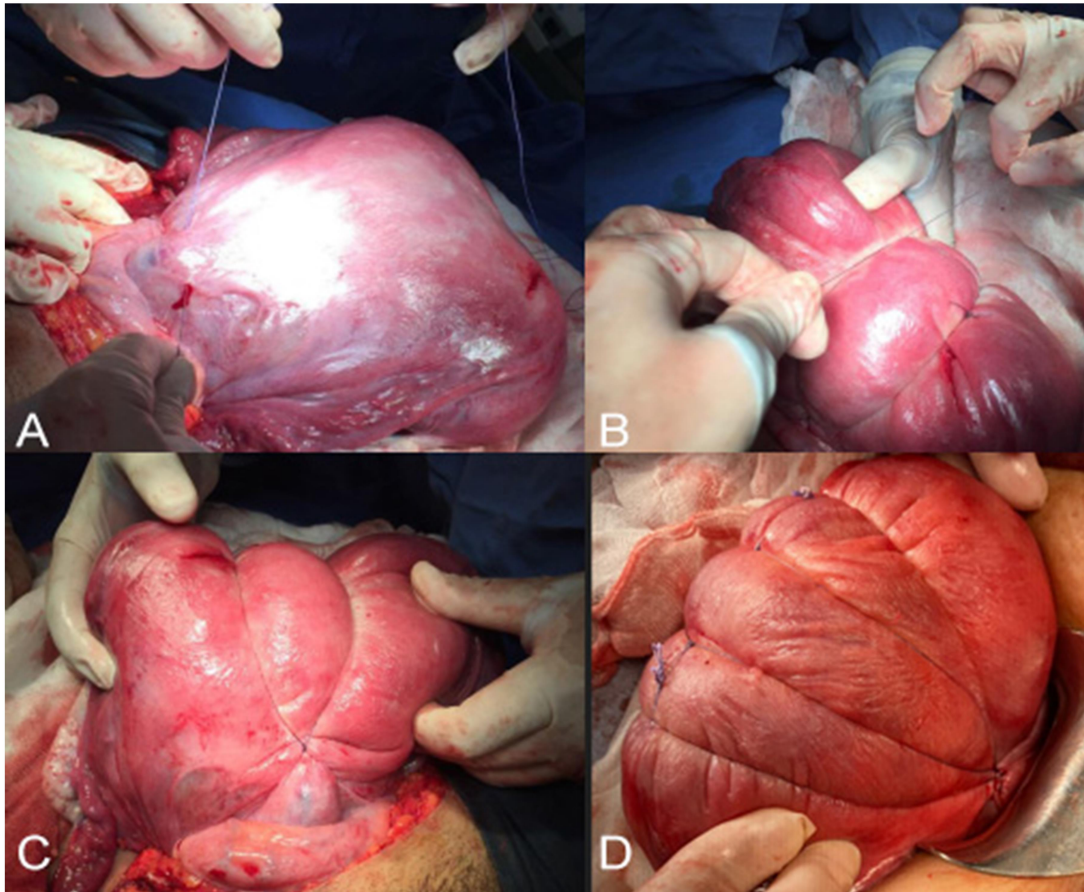


**Figure 4.** Inverting uterine suture. Technique of Trejo et al.<sup>26</sup>  
A. Stitches placed on the posterior uterine aspect, prior to traction.  
B. Final result.

well and the chances of side effects or complications are lower. A regional block has been suggested from the time of admission to the delivery room or ICU, since the reduction of vascular resistance due to the spinal effect of drugs lowers blood pressure and provides controlled analgesia that continues during delivery care.

**Surgical management of ruptured subcapsular liver hematoma**

The frequency of hepatic hematoma in patients with preeclampsia has been reported between 0.9 and 2%. This is a very serious complication that endangers the lives of patients. The main clinical clue to suspect its presence is intense pain in the right hypochondrium. It can be fixed or with irradiation in the right hemibelt that does not yield with the usual analgesics and that intensifies with fist-percussion. It may or may not be accompanied by hepatomegaly. The clinical findings of shock, acute anemia, and



**Figure 5.** Compressive uterine suture with the Tovar-Montiel technique.<sup>27</sup> A. Stitches placed on the anterior surface of the uterus before traction. B. Controlled traction to tie the ends while the assistant presses to invaginate the uterus. C. Final result. D. Additional sutures.

peritoneal irritation portend a poor prognosis if the patient does not undergo immediate surgery to control bleeding from the rupture.

In the host hospital, surgical techniques in the territory of the hepatic artery, such as ligation and embolism with an autologous clot or with foreign materials, have been restricted due to their technical difficulty and the limited availability of resources given the urgency of the maneuver. The dissection and manipulation (clipping) of the portal vein is equally difficult at the time of bleeding. It is preferred to drain the accumulated blood, identify the site of hepatic rupture and place surgical satin, foam, special meshes or packing directly with material textile such as compresses or using a plastic bag containing the compresses. Placement of a Seng-Staken-Blakemore tube with the inflated gastric balloon has also been successfully practiced to control bleeding, the technique has been called "pneumatic packing" of the liver.<sup>22</sup> Figure 2

#### Surgical management of obstetric hemorrhage, vascular and visceral injuries.

For timely detection and quantification of abnormal postpartum bleeding, the gravimetric method is recommended and not visual estimation.<sup>23</sup> Patients complicated by obstetric hemorrhage and/or vascular injuries frequently develop some degree of shock or

AKI. The maternal impact depends on the amount of blood lost, causes of the bleeding, duration of the cardiovascular collapse, presence of prior organ dysfunction, time taken to control it, and the certainty that the site of the hemorrhage has been repaired.<sup>15,16,20</sup>

The causes of obstetric hemorrhage are shown in Table 3. In patients with preeclampsia, the causes are similar. As can be seen, the list includes cases with massive hemorrhage from the antepartum period, during delivery care and in the postpartum period. Most causes are closely related to pregnancy, but may also be related to iatrogenic trauma or incidental surgical complications from vascular or visceral injuries. Patients with preeclampsia undergoing cesarean section share these data.

Conservative management may be used initially. A variety of options have been published that can be applied in most patients. Table 4. Interventional measures or radical techniques should be carefully selected only in the most severe cases. There is no general rule to perform a specific surgery. The surgical team may perform multiple techniques during the same surgical act as another complication is discovered or develops. A complicated surgery may require the participation of the general surgeon, vascular surgeon, urologic surgeon, or gastroenterology surgeon to resolve the case.<sup>24</sup> The skills and experience of the surgeon and his team, as

well as the mastery of innovative techniques that are generated in each specialized care center, can be important factors in obtaining successful results.<sup>25-27</sup> Damage control surgery and subsequent reinterventions are subject to the same guidelines.<sup>16,28</sup>

Although the surgical management of bleeding in preeclamptic patients undergoing cesarean section is correct and timely, morbidity and the risk of death in the short and long term are increased. Continued management in an ICU is recommended because the chances of survival of patients increase significantly.<sup>29</sup> Preeclampsia activity does not end when the pregnancy resolves. In addition, it is recommended to continue the postoperative period and postpartum management in the ICU to ensure a favorable outcome. In this scenario, an old idea of providing high-quality services to the population by region is still valid.

## Conclusion

Multidisciplinary management of patients with preeclampsia is necessary. Surgeons and specialists in Emergency and Critical Medicine form a useful team to recover patients with serious complications.

## Conflicts of interests

The authors declare no conflict of interest.

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