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Tourniquet on the low segment of the uterus reduces blood loss in postpartum hemorrhage during hysterectomy for placenta accreta: Old but gold

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ABSTRACT

Objectives: To investigate the feasibility, safety, and efficiency after application of a cervical tourniquet during caesarian hysterectomy owing to placenta accreta

Study design: It was a monocentric prospective observational study for 3 years. Patients were allocated into two group: Group Tourniquet: (TG) in which a cervical tourniquet was systematically applied during hysterectomy, control group (CG) when the caesarian hysterectomy was performed without.

Results: 20 patients in the TG and 23 patients in the CG. Tourniquet application significantly reduced per operative estimated blood loss volume (TG: 530 ± 135 vs 940 ± 120 ml in the CG, p = 0.0074), ΔHB (0.6 [0.3–1.9] vs 2.5[2.5–3.6] g/dl in the CG, p = 0.006) RBC transfusion requirements' (TG: 2 ± 1.7 vs 4.3 ± 2.1 units in the CG, p = 0.046) procedure duration (TG: 98 ± 21 vs 137 ± 33 min in the CG, p = 0.015), clotting disorders (TG: 1 (5%) vs 6 (26,1%) in the CG, p = 0.013) and the incidence of bladder wounds (TG: 1 (5%) vs 5 (21,7%) in the CG, p = 0.048). There was no significant difference regarding ICU transfer rate (TG: 16 (80%) vs 20 (86.9%) in the CG, p = 0.53) or length of stay (TG: 1.4 [2,3] vs 2.3 [1–4] days in the CG, p = 0.615) and digestive wound (TG: 0 vs 2 (8,7%) in the CG, p = 0.641).

Conclusion: In case of a radical management of placenta accreta. A strategy that involves the application of a cervical Tourniquet should be considered as a feasible, safe and above all efficient alternative to prevent blood spoliation.

Why was this study conducted?

To investigate to feasibility, safety, and efficacy of a cervical tourniquet in hysterectomy owing to placenta accreta..

What are the key findings?

Cervical tourniquet application significantly reduced per operative estimated blood loss volume, hemoglobin variation, RBC transfusion requirements', procedure duration, clotting disorders, and the incidence of bladder wounds. Intensive care unit transfer rate, length of stay and digestive wound were similar..

What does this study add to what we already know?

Cervical tourniquet allowed to perform hysterectomy for placenta accreta in a safe and efficient way. It should be considered as front-line technique especially in limited resources settings.

1. Introduction

The incidence of placenta accreta is steadily increasing, especially in the setting of the uterus scar tissue. It is defined by an abnormal adhesion of the placenta to the uterine muscle and depict a specter with an uprising challenge from the accrete vera to the accreta percreta. The diagnosis, theoretically histological made by the absence of deciduas

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basalis between the placenta and the myometrium, is more often clinical, when the artificial delivery fails to find the usual cleavage plane, already in a hemorrhagic context [1–4] .Subsequent maternal morbidity and mortality is one of the major health care issues. Cesarean hysterectomy and massive blood transfusion remain the gold-standard for the management of placenta accreta [5,6]. Even though less radical and more preventive techniques are developing and preferred, [6] their access in low-income setting is still scarce. Several techniques were described through literature in order to prevent blood loss per operatively [7–10]. The application of cervical Tourniquet is a well-known procedure for the management of excessive blood loss during myomectomy [11–14]. Then, Ikeda et al. first described cervical Tourniquet in a case of uncontrollable haemorrhage due to a placenta accreta [15] which triggered the idea of conducting a larger trial in order to investigate the safety, feasibility and efficacy of this procedure during caesarian hysterectomy.

2. Materials and methods

We conducted a monocentric prospective observational case-control study in the Department "C" of Gynecology and Obstetrics in the Maternity and Neonatology Center of Tunis during three years from October 2014 to September 2017. Study protocol was submitted to the local ethic committee for approval and was approved (Approval number: 06102018). It is also registered in ClinicalTrials.gov (ID: NCT03707132).

All parturient were informed about the possibility of performing a hysterectomy if placenta accreta was clinically confirmed preoperatively. After obtaining written formal consent. all patients who underwent scheduled or emergency cesarean section for placenta accreta were included. Either it was highly suspected or confirmed by obstetrical imaging. MRI was always performed in cases of scheduled cesarean delivery. However, in cases of delayed transfer or if parturient was already in labor, only ultrasonography was done and considered as sufficient. Delivery was usually scheduled at 36 weeks of gestation. Primary endpoints were safety and efficacy assessed by a main composite outcome including estimated blood loss, hemoglobin balance (ΔHB), RBC units' transfusion requirement, procedure duration and intensive care unit (ICU) transfer. Secondary endpoints were ICU length of stay, incidence of intravascular disseminated coagulopathy and incidence of intraoperative complications such as digestive and bladder wounds.

Patients were allocated into two group: Group TG in which a tourniquet was systematically applied on the lower segment of the uterus during emergent hysterectomy, control group CG when the emergent caesarian hysterectomy was performed without a tourniquet. Allocation depended on the technique and the decision of the surgeon in charge.

After appropriate conditioning and monitoring, the cesarean section was performed under general anesthesia. The laparotomy was performed through a midline incision from the umbilicus to the pubic symphysis. Hysterotomy was made far from the placental insertion which was previously located by ultrasonography. The placenta accreta was clinically checked immediately after delivery but no attempt was made to manually remove the placenta. The umbilical cord was ligated to its insertion and the uterus was quickly sutured with the placenta kept in place. Careful detachment of the bladder-uterus peritoneum (BUP) was then carried out to lower the bladder and reduce the risk of bladder wounds. Tourniquet application procedure is described in Fig. 1. A Foley catheter (CH18) is rolled over the lower segment after removal of the BUP. A double node is placed on the front side. The tourniquet was immediately removed after finishing hysterectomy. All cases are operated on by the same surgeon.

The expected result is a reduction in blood loss of 750 ml, a hypothesis consistent with the literature [16,17]. Thus, to detect a difference of 0.75 l between the means of blood loss for a power of 90% and an alpha risk of 5%, the size of each group must be 22 patients [18,19].

Data was set and analyzed anonymously via SPSS software version 20.0. Quantitative data was presented in means (SD) or medians (IQR) and compared, as suited, by Student's t test or Mann Whitney-*U* test. χ^2 Pearson test and Fisher's exact test were used to compare proportions. A

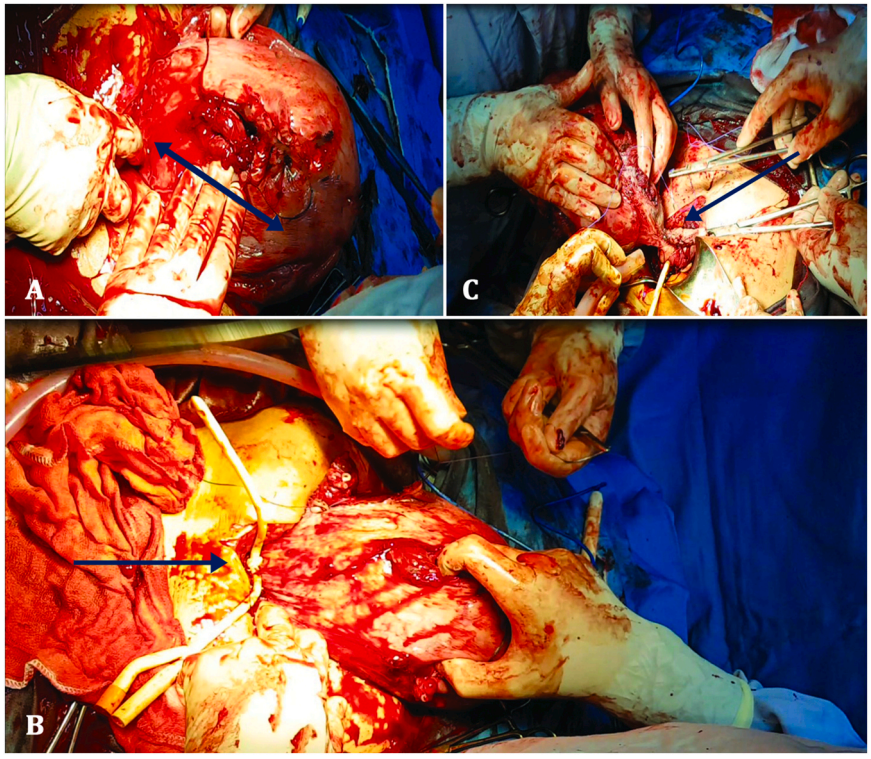

Fig. 1. Tourniquet application main steps (A) Suturing hysterotomy (blue arrow) with placenta kept in place. (B) Hysterectomy started with the Foley catheter as tourniquet in the lower segment of the uterus (blue arrow). (C) Last steps before completing hysterectomy (blue arrow).

p-value < 0.05 was needed for statistical significance.

3. Results

A total of 43 patients were enrolled during the study period among them 20 patients in the TG and 23 patients in the CG. Both study groups were comparable regarding baseline characteristics including demographic data, obstetrical, medical, and surgical history (Table 1). Regarding primary outcomes: estimated blood loss volume was significantly lower in TG compared to CG. Hemoglobin variation was in favor of TG compared to CG. Patients within TG were less likely to be transfused as CG got twice more red blood cell units transfused. ICU transfer rate was comparable between study groups. Surgery duration was significantly shorter when tourniquet was performed (Table 2).

Tourniquet application significantly reduced the incidence bladder wounds but not the digestive ones. TG patients had dramatically fewer clotting disorders during and after the surgery. Length of stay in the ICU was similar in both groups. It was particularly longer in patients with clotting disorders and massive blood transfusion (Table 2). No related maternal deaths were noted either in the early or in the late post-operative period.

4. Discussion

Our prospective case control study found that the use of a Foley catheter as a tourniquet on the lower segment of the uterus during emergent hysterectomy for placenta accreta was technically feasible, safe, and efficient. In fact, the use of the tourniquet reduced blood loss substantially and so as the need for blood transfusion and the number of transfused RBC. It was also associated with less clotting disorders, less bladder wounds. Tourniquet application shortened the surgery duration but not ICU length of stay. Interestingly, the overall impression of operating in "stress-less" mode has been reported by all surgical team members.

The placenta accreta is a real obstetric emergency. The incidence of this pathology has been steadily increasing, along with the increase in caesarean section rates [20]. This concerns Tunisia as well as many countries in the world despite the unavailability of national data on the incidence of placental insertion abnormalities (PIA) and the subsequent rate of cesarean section.

The prenatal diagnosis of PIA allows the health care team to schedule childbirth as adequately as possible to reduce maternal morbidity and mortality. However unexpected childbirth with a placenta accreta may be encountered in cases of delayed transfer from level 1–2 to our center or in case of sudden labor onset. Unscheduled management of placenta accreta in birth ward or in operating room without prior appropriate human and logistic cautions may result a dramatically higher maternal morbidity and mortality [21]. The blood loss observed during the management of placenta accreta comes mainly from the placental insertion. Surgical bleeding control come along with reducing the uterus blood flow [5,6]. In current state of practice, many procedures are developed to reduce blood loss preoperatively such as Tsirulnikov arterial ligation, Internal iliac ligation, [22,23] B-Lynch sutures, [24] and arterial embolization [25,26]. Recently Intra iliac balloon occlusion has been reported and seems to have promising outcomes [27,28]. Emergent hysterectomy still remains the ultimate, radical and life-saving treatment [5,6]. Severe bleeding usually occurs while performing the procedure and may constitute a life-threatening condition with multiple factors: First, the volume of blood loss and subsequent hemodynamic and organ failure. Second, clotting disorders which needs rapid and efficient surgical hemostasis control. Third, surgery site conditions that could be directly affected by the factors above and finally prolonged ICU stay due to massive blood transfusion and surgery complications. The use of tourniquet is an ancient technique that helps control hemostasis in orthopedic and traumatology procedures and proved its safety and efficiency [29,30]. In gynecology, the use of tourniquet was initially described in myomectomies [11–14]. The use of this method in obstetrical acts seems attractive and easily applicable. The goal is to temporarily suspend a significant portion of the uterine vascularization which allows to achieve the cesarean hysterectomy in better circumstances and with less blood spoliation. The technique was recently reported by some teams on small samples [31–33] and case reports. [15,34] The tourniquet application technique was used mainly in a conservative approach [32–34] but as well in radical treatment. [15, 31] It can though be presented as the corner stone of a relatively complex and dangerous procedure. Whatever the target is, tourniquet technique offers time and optimal operation site conditions which can be valuables in such stressful situation as API. The significant difference in blood loss and transfusion uses between the group without tourniquet and the tourniquet group suggested the efficiency of this technique. The success of the procedure can be explained by the reduction of blood flow from uterine arteries, uterine sacral ligaments, but also small collateral arteries with direct vascularization of the uterine corpus, which differs with the bilateral elective ligation of small pelvic arteries. Our study also showed a decrease in the occurrence of intraoperative complications such as bladder wound and hemostasis disorders. That can be explained by" better visibility" during the procedure.

As far as we are aware, our study is one of the largest to date of cervical tourniquet in radical management of placenta accreta. A low-cost tool was used as a tourniquet, in fact, the Foley catheter is commonly available in maternities and surgery rooms. The only obvious risk that must be avoided is latex allergy. Unfortunately, we have not tried latex-free tourniquets. Custom latex-free tools may be specially designed for this kind of procedure. Further investigations are needed, particularly in low-income countries since access to the other alternative techniques is expensive and not always available [35]. Still, performing randomized trial on this issue remains ethically controversial. This technique has been generalized among the interns of our department as a standby technique while waiting for a senior obstetrician to perform appropriate treatments. It allowed, in cases of abundant postpartum hemorrhage due to other causes then placenta accreta, to reduce blood

Table 1
Baseline Characteristics.

	TG* (n = 20)	CG†(n = 23)	*p*
Age means (SD), y	38.2 ± 4.1 [34–42]	37 ± 3.12 [35–41]	NS§
Parity median (IQR)	3.8 ± 2[2–5]	3.6 ± 1.8[2–5]	NS
Diabetes, No. (%)	5(20%)	2(8.7%)	NS
Chronic arterial hypertension, No. (%)	3(15%)	1(4.3%)	NS
Ovarian cystectomy, No. (%)	0	1(4.3%)	NS
History of cesarean sections, No. (%)	20(100%)	23(100%)	NS
Number of cesarean sections mean (SD)	2.8 ± 1	2.4 ± 1	NS
History of uterine aspiration, No. (%)	6(30%)	14(60.8%)	NS
Baseline Hb‡ median (IQR), g/dl	11.4[10.5-14.6]	11.2[10.5-13.9]	NS

* Tourniquet group† Control group‡ Hemoglobin§ non-significant

Table 2
Primary outcomes.

	TG* (n = 20)	CG†(n = 23)	*p*
Estimated blood loss, mean (SD), ml	530 ± 135	940 ± 120	0.0074
Lowest per operative Hb, median (IQR), g/dl	10.8[10.2-12.7]	8.7[8-10.3]	0.032
Δ Hb‡, median (IQR), g/dl	0.6[0.3-1.9]	2.5[2.5-3.6]	0.006
Transfused RBC§, mean (SD), units	2 ± 1.7	4.3 ± 2.1	0.046
Surgery duration, mean (SD), minutes	98 ± 21	137 ± 33	0.015
ICUII transfer, No. (%)	16(80%)	20(87%)	0.53

* Tourniquet group † Control group ‡ Hemoglobin variation § Red Blood cell II Intensive care unit

loss and to make emergent hysterectomy easier and safer. A corollary is that our results may be generalizable to a broad range of clinical situations.

A limitation of the study was the fact that group assignment was not randomized and was left to the discretion of the surgeon. It is true that this is a major source of bias but given the vital prognosis of this pathology and the particularities of the intraoperative findings for each patient especially peritoneal adhesions, we cannot decide regarding the use of the tourniquet until after the evaluation of the surgeon.

Also, severity of illness could have influenced assignment; for example, suspected placenta percreta involving the bladder could prompt hysterectomy to speed up treatment. Another limitation of the study was the relatively small sample size. Other comparative studies have found the same problem and imaging cannot help [36].

5. Conclusion

Our study found that the use of a Foley catheter as a tourniquet on the lower segment of the uterus during emergent hysterectomy for placenta accreta was technically feasible, safe, and efficient.

Ethics

Our work was submitted to the ethics committee of the maternity and neonatology center of Tunis and was approved, approval number: 06102018. Our work has been registered in clinicaltrials ClinicalTrials.gov Protocol Registration and Results System (PRS) Receipt Release Date: October 12, 2018 (ID: NCT03707132). we obtained informed and voluntary written consent from patients for publication.

Disclosures

The authors declare they have nothing to disclose.

CRediT authorship contribution statement

Frikha Hatem: Investigation. **Hammami Rami:** Software. **Channoufi Mohamed Badis:** Supervision. **Maghrebi Hayen:** Validation. **Abouda Hassine Saber:** Conceptualization. **B Marzouk Sofiene:** Formal analysis. **Boussarsar Yecer:** Methodology. **Aloui Haithem:** Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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