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CLINICAL ARTICLE

Reproductive performance after conservative surgical treatment of postpartum hemorrhage

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ABSTRACT

Objective: To evaluate the impact of bilateral internal iliac artery ligation (BIL), bilateral uterine artery ligation (BUAL), step-wise uterine devascularization (SWUD), and B-Lynch on infertility, ovarian reserve, and pregnancy outcome. *Methods:* The study included 168 infertile or pregnant patients—recruited at outpatient clinics in Egypt—who had previously undergone uterine-sparing surgery (BIL [group I], n = 59; SWUD [group II], n = 65); BUAL [group III], n = 2; and B-Lynch [group IV], n = 42). One-way analysis of variance was used to compare the prevalence of infertility, the status of ovarian reserve, and the prevalence and type of relevant maternal and/or fetal obstetric complications between the groups. *Results:* Groups II and IV had the highest prevalences of infertility. The ovarian reserve was significantly lower in group II. Unexplained infertility was the predominant cause of infertility in group I, anovulation and premature ovarian failure in group II, and endometriosis and intrauterine adhesions in group IV. The frequency of obstetric complications, particularly placenta previa and preterm labor, was high in group IV. *Conclusion:* Of the 4 procedures, BIL had the least deleterious effect on reproductive performance; SWUD increased the risk of premature ovarian failure, and B-Lynch increased the risks of endometriosis, intrauterine adhesions, placenta previa, and preterm labor.

1. Introduction

Atonic postpartum hemorrhage (PPH) is the most common form of PPH, which is in turn the dominant cause of maternal morbidity and mortality worldwide [1]. The conventional primary management of atonic PPH includes uterine fundal massage, manual exploration of the uterus, and the use of various types of oxytocics [2]. For refractory cases, however, surgical interventions have been introduced to control the bleeding. Hysterectomy is the definitive surgery for controlling blood loss, but it is a radical procedure leading to permanent loss of fertility. Alternatively, several conservative surgical procedures (so-called uterine-sparing procedures) have become available.

Bilateral internal iliac artery ligation (BIL) was first described in 1960 [3]. However, the procedure still needs an experienced surgeon and fails to control the bleeding in many patients [4]. Bilateral uterine artery ligation (BUAL) has subsequently been reported to be as effective as BIL, and it has the merits of simplicity and saving time [5]. Unfortunately, the efficacy of BUAL for controlling PPH is lower than anticipated and approximately 20% of patients subsequently need a hysterectomy [6]. In 1994, step-wise uterine devascularization (SWUD)—including bilateral ligation of the uterine and ovarian vessels—was described [7] and reported to be highly effective for controlling the bleeding. More recently, a uterine compression procedure called B-Lynch technique was advocated [8] and proved to be simple, fast, and effective for treating atonic PPH.

Although these uterine-sparing procedures have the merit of preserving the uterus, data about the implications of these procedures for the patients' future reproductive performance (fertility and pregnancy outcome) are sparse. Moreover, the influence of these interventions—in particular SWUD—on the ovarian reserve has not been studied. Therefore, the present study aimed to evaluate the influences of the different uterine-sparing procedures on future fertility, ovarian reserve, and outcome of a subsequent pregnancy.

2. Materials and methods

The present cross-sectional multicentric study was conducted between September 1, 2008, and September 1, 2012, at the Departments of Obstetrics and Gynecology of the university hospitals in Sohag,

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Qena, Assiut, Al-Azhar, and Cairo, Egypt. During the study period, all patients (n = 293), whether infertile or pregnant, who had a history of a uterine-sparing operation for controlling intractable atonic PPH during the last delivery and who attended the outpatient clinic of a participating hospital were invited to participate in the study. The uterine-sparing procedures were carried out at any of the study hospitals, and the details of the previous surgery were obtained from the hospital records. The exclusion criteria were age of more than 35 years at the time of enrollment, obesity (body mass index [BMI, calculated as weight in kilograms divided by the square of height in meters] of more than 30), refusal to participate in the study, lost or incomplete operative documents, history of multiple uterine-sparing procedures, infertility with abnormal husband semen analysis, polycystic ovarian disease, thyroid dysfunction, hyperprolactinemia, history of pelvic inflammatory disease or pelvic surgery after the last delivery, and current pregnancy with unreliable menstrual dating, pre-existing medical illness, multiple pregnancy, previous abortion, or preterm delivery. Written consent was obtained from all participants and local institutional ethics committees provided approval.

The protocol for managing infertile patients included thorough history-taking followed by complete general and gynecologic examinations. Semen analysis was then performed and evaluated according to criteria from WHO [9]. All infertile participants underwent transvaginal sonography to detect any potential uterine or adnexal pathology, measure the ovarian volume, and count the number of antral follicles. A hormonal profile (basal follicle-stimulating hormone [FSH], basal luteinizing hormone [LH], basal anti-Müllerian hormone, midluteal serum progesterone, prolactin, and thyroid hormones [T_3, T_4]) was obtained for all participants. The FSH, anti-Müllerian hormone, antral follicle count, and ovarian volume values were used for assessment of the participants' ovarian reserve.

As the next step, ovulation was assessed by transvaginal folliculometry and measurement of the midluteal serum progesterone level (a level of more than 31.8 nmol/L indicated normal ovulation). Absence of sonographic evidence of ovulation in association with a serum progesterone level of less than 3 ng/dL was indicative of anovulation. Progesterone levels of 9.5–31.8 nmol/L in the presence of sonographic evidence of ovulation and/or visualization of the corpus luteum were signs of a luteal-phase defect. Ovulatory patients were followed-up for at least 3 cycles, whereas anovulatory patients were treated with clomiphene citrate or gonadotropins.

Hysterosalpingography followed by combined laparoscopy and hysteroscopy—if indicated—was then carried out for patients who did not conceive. Patients with a normal semen analysis, regular ovulation, a normal hormonal profile, and normal hysterosalpingography, laparoscopy, and hysteroscopy results were considered to have unexplained infertility. The recruited pregnant patients and infertile patients who conceived during the follow-up period were booked according to WHO protocol [10].

The study participants, whether pregnant or infertile, were allocated into 4 groups according to the type of uterine-sparing procedure they had previously undergone: group I, BIL (n = 59); group II, SWUD (n = 65); group III, BUAL (n = 2); and group IV, B-Lynch (n = 42). The prevalence of infertility was determined, and for infertile patients the cause of infertility and the ovarian reserve were evaluated. Pregnant patients were assessed for the prevalence and type of obstetric complications, including abortion, preterm labor, abnormal placentation, intrauterine growth restriction, and PPH.

Statistical analysis was performed with SPSS version 11.5 (IBM, Armonk, NY, USA). Variables between the 4 groups were compared using 1-way analysis of variance (ANOVA) followed by post-hoc analysis of the results. $P < 0.05$ was considered statistically significant. The statistical analysis was performed on the per-protocol population. The required sample size for the study was difficult to calculate because of a lack of studies comparing the reproductive implications of different uterine-sparing procedures.

3. Results

During the 4-year study period, 293 patients (group I, n = 112; group II, n = 118; group III, n = 2; group IV, n = 61) were recruited (Fig. 1). The operative reports confirmed that all patients with SWUD underwent bilateral uterine and ovarian arteries ligation (step-5 SWUD). A total of 76 patients (group I, n = 30; group II, n = 34; group IV, n = 12) were excluded, whereas the remaining 217 patients were enrolled into the study. Only 2 patients underwent BUAL (group III); these patients were excluded from the study because of the small sample size. In addition, 49 patients (group I, n = 23; group II, n = 19; group IV, n = 7) dropped out during the follow-up period. The remaining 166 patients (group I, n = 59; group II, n = 65; group IV, n = 42) constituted the final study population. During the study period, 13 of the initial infertile participants (group I, n = 6; group II, n = 4; group IV, n = 3) conceived and were included in the analysis of pregnant patients (Fig. 1).

The prevalence of infertility was significantly higher in groups II and IV (43.1% [n = 28] and 35.7% [n = 15], respectively) than in group I (23.7% [n = 14]; $P < 0.01$) (Fig. 1). Among infertile patients, age, parity, duration of infertility, BMI, basal FSH, and ovarian volume were comparable between the 3 study groups. The basal anti-Müllerian hormone level and the antral follicle count were significantly lower in group II than in groups I and IV (Table 1).

In total, 48 infertile patients (11 in group I; 24 in group II; 13 in group IV) underwent combined laparoscopy and hysteroscopy. The causes of infertility were markedly different among the 3 groups. Unexplained infertility was the predominant cause in group I, anovulation and unexplained infertility in group II, and endometriosis and intrauterine adhesions in group IV (Table 1). Premature ovarian failure (FSH more than 40 IU/L in patients below the age of 40 years) was observed in 3 (10.7%) patients in group II. Their ages were 31, 29, and 26 years, respectively, their basal FSH levels were 46, 89, and 67 IU/L, and they all presented with secondary amenorrhea. Intrauterine adhesions were detected in 3 (23.1%) patients in group IV. The adhesions were grade II [11] in all patients and occupied mainly the fundal portion of the uterine cavity; they were divided hysteroscopically (data not shown).

For the pregnant women, age, parity, BMI, and mode of previous or current deliveries were comparable between the 3 groups (Table 2). Obstetric complications were more common (53.3%) in group IV than in groups I and II (19.6% and 34.1%, respectively). In group I, there was no trend for a particular complication to be more prevalent. Group II had a significantly higher rate of abortion than the other 2 groups, whereas placenta previa and preterm labor were significantly more common in group IV (Table 2).

4. Discussion

The surgical steps and the effectiveness of various uterine-sparing procedures for controlling atonic PPH are well established, but evidence on the implications of these procedures for subsequent reproductive performance is limited. There is a considerable lack of studies that compare the reproductive performances of patients after different uterine-sparing procedures. Moreover, the influence of uterine-sparing operations, particularly bilateral ligation of ovarian arteries, on the ovarian reserve has not been studied. The paucity of data around this issue may result from patient reluctance to conceive again for fear of PPH recurrence [12].

The present study assessed the reproductive implications of BIL, SWUD, and B-Lynch in a large study population. The prevalence of infertility was highest after SWUD followed by B-Lynch; the lowest prevalence—which was comparable to the prevalence of infertility in the general population [13]—was found among patients who had undergone BIL. A decreased ovarian reserve and a high rate (10.7%) of premature ovarian failure after SWUD were other interesting findings. Although cases with premature ovarian failure after