

Is laparoscopic surgery safe in patients with an elevated shock index due to ruptured ectopic pregnancy?

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Summary

Purpose: To evaluate the effectiveness of laparoscopic surgery in patients with elevated shock index (SI), which is a unique determinant of acute hemorrhage. **Materials and Methods:** A retrospective chart review of all patients treated for ectopic pregnancy (EP) in the present gynaecology department between January 2007 and March 2011 was performed. For each measurement of heart rate (HR) and systolic blood pressure (SBP), a SI was calculated by dividing HR by SBP (normal, 0.5 - 0.7). **Results:** One hundred sixty patients were selected as SI above 0.7. There were 111 (69.4%) patients in the laparotomy group and 49 (30.6%) patients in the laparoscopy group. The postoperative hemoglobin (Hb) level was 8.46 ± 1.56 (g/dl) in the laparotomy group and 9.37 ± 1.52 (g/dl) in the laparoscopy group, with lower postoperative levels in the laparotomy group. The mean duration of postoperative hospital stay was 2.37 ± 0.74 days in the laparotomy group and 2 ± 0.84 days in the laparoscopy group. **Conclusion:** The availability of suitable operative equipment, nursing teams, and advanced laparoscopic skills, all justify operative laparoscopy for the surgical treatment of EP in women with elevated SI.

Key words: Ectopic pregnancy; Haemoperitoneum; Laparoscopic surgery; Laparotomy; Shock.

Introduction

Ectopic pregnancy (EP) is described as a condition in which the gestational sac is implanted outside the uterus. The prevalence of EP is two percent out of all pregnancies in the United States, and it is one of the leading causes of pregnancy-related deaths during the first trimester in women of childbearing age [1]. Technical advancement in the field of minimal access surgery has greatly enhanced the possibility of both diagnosing and treating this condition effectively [2]. Laparoscopic surgery is usually performed to treat EP when the patient is hemodynamically stable, beta-human chorionic gonadotropin (β -hCG) is $< 6,000$ IU/l, history is suggestive of minimal pelvic adhesions, and pregnancy is confined within the tube [3]. However, there are studies reporting laparoscopic surgery as a treatment also in hypovolemic patients [4, 5]. There are still some conflicting results regarding performing laparoscopies and describing quantitative hemoperitoneum in patients with a ruptured EP. As we know, most cases of ectopic pregnancy present with massive bleeding in a relatively short time. However, in the case of gradual bleeding, patients remain hemodynamically stable despite a hemoperitoneum of 1,000 to 1,500 ml [6]. According to this data, the authors used the shock index (SI) which is a composite of heart rate (HR) and systolic blood pressure (SBP) (HR/SBP) in lieu of using predictors of hemoperitoneum to determine hemodynamically unstable patients.

Materials and Methods

Before the onset of data collection, approval was obtained from the institutional review board to perform a chart review of all patients treated for EP in the present gynaecology department

between January 2007 and March 2011. The study population was divided into two groups according to their surgical treatment, laparoscopy or laparotomy. A retrospective chart review was then performed with the use of medical and ultrasound records and the laboratory database. The parameters analyzed were: age, gravidity, parity, gestational week, type of delivery, educational status, menstrual delay, history of EP, sonographic blood accumulation in the pouch of Douglas (PoD), the mean size of ectopic focus, β -hCG measurements, preoperative and postoperative hemoglobin (Hb) and hematocrit levels. All charts were reviewed for HR and SBP at the time of the initial emergency department triage, and initial operative intervention, as well as Hb levels, quantity of hemoperitoneum, and the condition of fallopian tube at removal. For each measurement of HR and SBP, a SI was calculated by dividing HR by SBP (normal, 0.5-0.7). The patients with $SI > 0.7$ were included into the study population.

The statistical analysis was performed by using NCSS (Number Cruncher Statistical System) 2007 Statistical Software. among the two groups, and ruptured and unruptured EP. Statistical analysis included the Pearson's chi-square test and Mann-Whitney rank test.

Results

One hundred eighty-eight patients were diagnosed with EP during the time period reviewed; 160 of these patients were selected as SI 0.7. There were 111 (69.4%) patients in the laparotomy group and 49 (30.6%) patients in the laparoscopy group. There was no conversion to laparotomy during laparoscopy. The mean age was 33.02 ± 6.31 years in the laparotomy group and 30.24 ± 5.15 years in the laparoscopy group ($p = 0.008$). The laparoscopy group was younger than the laparotomy group. The gravidity in the laparotomy and laparoscopy groups was 2.91 ± 2.35 and 2.57 ± 1.85 , respectively. The mean parity in the laparotomy group was 1.84 ± 1.75 , and in the laparoscopy group it was 1.27 ± 1.1 ($p = 0.036$). The parity was lesser

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in the laparoscopy group compared with the laparotomy group. Characteristics of the patients are listed in Table 1. There was no significant difference in the previous type of delivery between the two groups. There was a statistical significance in the history of EP, with a lower level seen in the laparotomy group: five (4.50%) and 15 (30.60%). Preoperative Hb was 9.72 ± 1.6 g/dl in the laparotomy group ($p = 0.001$) and 10.24 ± 1.9 g/dl in the laparoscopy group ($p = 0.0001$). There was no significance in preoperative Hb values; the postoperative Hb level was 8.46 ± 1.56 g/dl in the laparotomy group, and 9.37 ± 1.52 g/dl in the laparoscopy group, with lower postoperative levels in the laparotomy group. There was no statistical significance in the mean size of the ectopic mass confirmed by transvaginal ultrasonography, HR, and β -hCG values between the two groups. The sonographic blood accumulation in the PoD was 46.12 ± 21.44 mm in the laparotomy group, and 32.83 ± 19.39 mm in the laparoscopy group (higher in laparotomy group). Preoperative abdominal blood was 582.78 ± 355.29 cc and 398.33 ± 275.94 cc in the laparoscopy group (lower in the laparoscopy group). The preoperative SBP was 94.59 ± 12.19 mmHg in the laparotomy group, and 101.63 ± 9.43 mmHg in the laparoscopy group. There were 88 (79.30%) tubal ruptures in the laparotomy group, and 29 (59.20%) in the laparoscopy group (such that laparotomy was preferred in the ruptured group). Thirty-nine (35.10%) patients in the laparotomy group had postoperative blood transfusions, and only eight (16.30%) in the laparoscopy group. The mean duration of postoperative hospital stay was 2.37 ± 0.74 days in the laparotomy group and 2 ± 0.84 days in the laparoscopy group (Table 2).

Discussion

EP remains the leading cause of death in the first trimester of pregnancy. Approximately one to two percent of all pregnancies in Europe and the United States are ectopic, and in the Western world, tubal EP remains the most common cause of maternal mortality in the first trimester of pregnancy [7]. The occurrence of tubal rupture in EP ranges from 18.0% to 64.5% as reported in previous large population-based studies [8].

The patients in reproductive age tend to be younger and have an excellent physiologic reserve and capacity to accommodate blood loss. Regarding this, patients with significant hemoperitoneum can be misdiagnosed. There is a necessity to use a quantitative predictor to determine in patients with massive hemorrhage. The SI, which is an easily calculated composite of HR and SBP (HR/SBP), has proved to be useful in the identification of acute hemorrhage in trauma patients [9]. There is an inverse relationship to left ventricular stroke work and SI. The left ventricular stroke work depends on cardiac output and cardiac volume and SI is affected directly by decreased left ventricular function and hypovolemia [9]. The normal range of SI was reported between > 0.5 and < 0.7 [10]. In this study, the authors used the SI as a predictor of hemoperitoneum and 160 patients were found to have an SI above 0.7.

Table 1. — Characteristics of patients in the laparotomy and laparoscopy groups.

	Laparotomy	%	Laparoscopy	%	χ^2	<i>p</i> value
Age	33.02 ± 6.31		30.24 ± 5.15			0.008
Gravidity	2.91 ± 2.35		2.57 ± 1.85			0.372
Parity	1.84 ± 1.75		1.27 ± 1.1			0.036
Patients with ruptured tubes	88	79.30	29	59.20	6.99	0.008
Previous ectopic pregnancy	5	4.50	15	30.60	21.19	0.0001
Type of delivery						
Nulliparous	22	19.80	10	20.40	2.25	0.523
VB	57	51.40	26	53.10		
C/S	23	20.70	12	24.50		
VB + C/S	9	8.10	1	2.00		

* VB: vaginal birth; C/S: cesarean section.

Table 2. — Laboratory, sonographic, preoperative, and postoperative evaluation results of the patients.

	Laparotomy	Laparoscopy	<i>t</i>	<i>p</i> value
Mean size of the ectopic mass (mm)	38.92 ± 17.28	34.55 ± 15.71	1.52	0.132
β -hCG (IU/l)	5272.66 ± 7247.9	6861.82 ± 10426.7	-1.11	0.268
Menstrual delay (days)	4.21 ± 1.32	3.71 ± 1.54	2.07	0.04
Sonographic blood accumulation in the PoD (mm)	46.12 ± 21.44	32.83 ± 19.39	3.47	0.001
Intra-abdominal free blood volume (cc)	582.78 ± 355.29	398.33 ± 275.94	3.03	0.003
SBP/mmHg	94.59 ± 12.19	101.63 ± 9.43	-3.59	0.0001
HR/per min	83.93 ± 8.23	83.08 ± 8.8	0.59	0.558
Preoperative Hb (g/dl)	9.72 ± 1.6	10.24 ± 1.9	-1.80	0.074
Postoperative Hb (g/dl)	8.46 ± 1.56	9.37 ± 1.52	-3.42	0.001
Preoperative hematocrit (%)	30 ± 4.77	31.16 ± 5.41	-1.37	0.174
Postoperative hematocrit (%)	26.14 ± 4.65	28.96 ± 5.1	-3.44	0.001
Duration of hospitalization (days)	2.37 ± 0.74	2 ± 0.84	2.79	0.006

The management of EP can be expectant, medical, or surgical. The choice depends on clinical circumstances, site of EP, and serum β -hCG levels. In those patients who require surgery, laparoscopy or laparotomy are the choices [11]. In the present study, there were 111 (69.4%) patients in the laparotomy group, and 49 (30.6%) in the laparoscopy group. Compared with laparotomy, the laparoscopic approach has many advantages, including shorter hospital stay, lower cost, decreased morbidity, shorter operation times, less intraoperative blood loss, lower analgesic requirements and less adhesion formation than reported in other gynaecologic operations [12, 13]. In the present study, the authors also had the same results with the literature in the laparoscopy group.

There is a major concern about performing laparoscopy in hemodynamically unstable patients presenting hemoperitoneum. Some studies have compared laparoscopy and laparotomy cases and indicate that hemodynamic stability, diameter of the tubal ectopic pregnancy, and easy visualisation of pelvic organs are the requirements for the laparoscopic surgery [14, 15]. On the other hand, there are

also studies that report laparoscopy in hypovolemic patients [4, 5, 16].

Concerns regarding the performance of laparoscopy in bleeding patients relate to the creation of pneumoperitoneum and possible delays in bleeding control [2]. Previous studies have concluded that direct cannula insertion is not only safe, but can significantly shorten the time required to insert the cannula into the abdomen to create a pneumoperitoneum, thereby reducing operating time by 2.2 to 4.3 minutes [17, 18]. One limitation in the present retrospective study was the fact that the authors could not obtain the duration of time it took to reach the abdominal cavity in either the laparoscopy or in the laparotomy group, but they used verres insertions to create pneumoperitoneum instead of direct cannula insertion.

Although the major problem with laparoscopy is visualisation of the pelvic organs (which are covered by blood), this difficulty can be overcome by using a uterine manipulator to facilitate anteflexing of the uterus and to more easily identify the fallopian tube [19]. Once the bleeding is controlled, evacuation of the blood can subsequently be performed. In their daily practice the authors also use an uterine manipulator when there is a restriction in visualization of the pelvic organs.

The sonographic blood accumulation in the PoD was 46.12 ± 21.44 mm in the laparotomy group and 32.83 ± 19.39 mm in the laparoscopy group (higher in the laparotomy group). These results show that preoperative sonographic blood accumulation in the PoD is evidence for the preference of laparotomy among surgeons. In this stage, the experience of surgeons has also been noted to be a significant factor in the preference for laparoscopy [20, 21].

In conclusion, the SI is a quantitative predictor of massive haemoperitoneum and can be used in patients with ruptured EP. The availability of suitable operative equipment, surgical, and nursing teams, optimal anaesthesia, advanced cardiovascular monitoring, and the ability to convert rapidly to an open procedure if required, as well as advanced laparoscopic surgical skills and experience, all justify operative laparoscopy for the surgical treatment of EP, even in women with elevated SI.

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References

- [1] Houry D.E., Salhi B.A.: "Acute complications of pregnancy". In: Marx J.A. (ed). Rosen's Emergency Medicine: Concepts and Clinical Practice, 7th ed. Philadelphia, PA, Mosby Elsevier, 2009, chap 176.
- [2] Yao M., Tulandi T.: "Current status of surgical and nonsurgical management of ectopic pregnancy". *Fertil. Steril.* 1997, 67, 421.

- [3] Ghosh S., Mann C., Khan K., Gupta J.K.: "Laparoscopic management of ectopic pregnancy". *Sem. Laparosc. Surg.*, 1999, 6, 68.
- [4] Soriano D., Yefet Y., Oelsner G., Goldenberg M., Mashiach S., Seidman D.S.: "Operative laparoscopy for management of ectopic pregnancy in patients with hypovolemic shock". *J. Am. Assoc. Gynecol. Laparosc.*, 1997, 4, 363.
- [5] Lundorff P., Thorburn J., Hahlin M., Källfelt B., Lindblom B.: "Laparoscopic surgery in ectopic pregnancy. A randomized trial versus laparotomy". *Acta Obstet. Gynecol. Scand.*, 1991, 70, 343.
- [6] Mohamed H., Maiti S., Phillips G.: "Laparoscopic management of ectopic pregnancy: a 5-year experience". *J. Obstet. Gynaecol.*, 2002, 22, 411.
- [7] Varma R., Gupta J.: "Tubal ectopic pregnancy". *Clin. Evid.* (Online), 2009, Pii:1406.
- [8] Bickell N.A., Bodian C., Anderson R.M., Kase N.: "Time and the risk of ruptured tubal pregnancy". *Obstet. Gynecol.*, 2004, 104, 789.
- [9] Birkhahn R.H., Gaeta T.J., Van Deusen S.K., Tloczkowski J.: "The ability of traditional vital signs and shock index to identify ruptured ectopic pregnancy". *Am. J. Obstet. Gynecol.*, 2003, 189, 1293.
- [10] Mol B.W., Hajenius P.J., Engelsbel S., Ankum W.M., van der Veen F., Hemrika D.J., Bossuyt P.M.: "Can noninvasive diagnostic tools predict tubal rupture or active bleeding in patients with tubal pregnancy?". *Fertil. Steril.*, 1999, 71, 167.
- [11] Agdi M., Tulandi T.: "Surgical treatment of ectopic pregnancy". *Best. Pract. Res. Clin. Obstet. Gynaecol.*, 2009, 23, 519.
- [12] Hsu S., Mitwally M.F., Aly A., Al-Saleh M., Batt R.E., Yeh J.: "Laparoscopic management of tubal ectopic pregnancy in obese women". *Fertil. Steril.*, 2004, 81, 198.
- [13] Rizzuto M.I., Oliver R., Odejinni F.: "Laparoscopic management of ectopic pregnancy in the presence of a significant haemoperitoneum". *Arch. Gynecol. Obstet.*, 2008, 277, 433.
- [14] Vu K., Gehlbach D.L., Rosa C.: "Operative laparoscopy for the treatment of ectopic pregnancy in a residency program". *J. Reprod. Med.*, 1996, 41, 602.
- [15] Royal College Obstetricians and Gynaecologist (RCOG). The management of tubal pregnancy Guideline N°21. RCOG press, London, 2004.
- [16] Murphy A.A., Nager C.W., Wujek J.J., Kettel L.M., Torp V.A., Chin H.G.: "Operative laparoscopy versus laparotomy for the management of ectopic pregnancy: a prospective trial". *Fertil. Steril.* 1992, 57, 1180.
- [17] Byron J.W., Markenson G., Miyazawa K.: "A randomized comparison of Verres needle and direct trocar insertion for laparoscopy". *Surg. Gynecol. Obstet.*, 1993, 177, 259.
- [18] Nezhat F.R., Silfen S.L., Evans D., Nezhat C.: "Comparison of direct insertion of disposable and standard reusable laparoscopic trocars and previous pneumoperitoneum with Veress needle". *Obstet. Gynecol.*, 1991, 78, 148.
- [19] Tulandi T., Kabli N.: "Laparoscopy in patients with bleeding ectopic pregnancy". *J. Obstet. Gynaecol. Can.* 2006, 28, 361.
- [20] Akhan S.E., Baysal B.: "Laparotomy or laparoscopic surgery? Factors affecting the surgeons choice for the treatment of ectopic pregnancy". *Arch. Gynecol. Obstet.*, 2002, 266, 79.
- [21] Li Z.G., Leng J.H., Lang J.H., Liu Z.F., Sun D.W., Lan Z.: "Laparoscopic surgery in patients with hypovolemic shock due to ectopic pregnancy". *Chin. Med. Sci. J.*, 2005, 20, 40.

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