Impact of the learning curve on term delivery rates following laparoscopic salpingostomy for infertility associated with distal tubal occlusive disease

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The objective of this study was to determine the impact of the learning curve of one surgeon on the term delivery rate following laparoscopic salpingostomy for tubal infertility. This was a retrospective audit of ongoing clinical practice, undertaken in two tertiary level infertility programmes. Subjects in this study were women undergoing surgery for total occlusion of the distal Fallopian tube. The main outcome measure was cumulative term delivery rates. On stepwise life-table analysis the length of infertility, primary and secondary infertility, tubal diameter and whether surgery was performed in the first or second half of the series were significantly associated with outcome. These data suggest that there is a learning curve in obtaining skills to perform laparoscopic salpingostomy, that patient selection may improve with experience, and that selection criteria should be emphasized during didactic teaching and the preceptorship process. 

Key words: experience/laparoscopy/outcome/salpingostomy/training

Introduction

Laparoscopic treatment of distal Fallopian tube occlusion has been well documented. A number of factors have been demonstrated to influence outcome following this procedure (Canis et al., 1991; Dubuisson et al., 1994). However, no previous study has examined the impact of surgical expertise and the learning curve on outcome following salpingostomy. A number of societies and colleges have recently produced guidelines which outline how initial endoscopic surgical expertise and training should be gained (Dunphy, 1993; Society for Reproductive Surgeons, 1994; Fraser and Petrucco, 1994). The purpose of our study was to examine the impact of the learning curve of one surgeon on outcome following laparoscopic salpingostomy. This initial experience antedated the widespread use of guidelines for training, and represents the impact of the learning curve without the intervention of a preceptor.

Materials and methods

Subjects

Over a four year period between January 10, 1991 and January 23, 1995, 46 consecutive patients had surgery for complete distal tubal occlusion (no patients had a distal tubal phimosis). All patients were ovulating and their partner’s semen profile was in the normal range (Dunphy et al., 1991). The mean age was 31.2 years (SD 5.19), the mean length of involuntary infertility prior to surgery was 51.4 months (SD 34.0) and the mean length of follow-up post-surgery was 23.4 months (SD 13.9). Nineteen women had primary infertility and 27 had secondary infertility; 26 women had bilateral distal occlusion; 20 women had previously undergone a salpingectomy (17 due to ectopic and three due to pain), and had distal occlusion in the remaining Fallopian tube. Seven women had no pelvic adhesions and 39 women had peritubal and/or peri-ovarian adhesions which were graded by severity. The mean tubal diameter was 2.0 cm (SD 0.64).

Surgery

All 46 procedures were performed by one surgeon (B.D.). Laparoscopic salpingostomy was undertaken as described by Canis et al. (1991), using either electrosurgery, an argon laser or a potassium titanyl phosphate laser. Surgery took place in the Jessop Hospital for Women, Sheffield, UK (n = 24), and the Foothills Hospital, Calgary, Canada (n = 22). Tuboplasty was carried out bilaterally except where one tube was absent, where a unilateral procedure was performed.

Adhesions were divided laparoscopically as required. Pelvic irrigation during and following each procedure was undertaken using lactated Ringer’s solution containing heparin. B.D. did not perform any conventional salpingostomies during the same period.

Follow-up

Two subjects were lost to follow-up at 14 and 15 months following the procedure. One couple was divorced. Six women underwent treatment by in-vitro fertilization (IVF). All of these subjects were treated as a censored observation for the purposes of life-table analysis, terminating follow-up when their status changed.

Statistics

Statistical analyses including frequency distributions, Wilcoxon rank sum W test, life-table analysis and Cox’s regression model of life-table analysis, were undertaken as implemented by Stata (Stata Corporation, College Station, TX, USA).

Results

Ten women had a clinical intrauterine pregnancy during the period of follow-up. Eight of these women have had a term delivery. Two women had a first trimester miscarriage and two women had a tubal pregnancy, one of whom subsequently had an intrauterine pregnancy which resulted in the delivery of a live infant at term. The cumulative intrauterine pregnancy rate was 6.8% [95% confidence intervals (CI) 2.3–19.7%] at 12 months follow-up, 9.9% (95% CI 3.8–24.7%) at 24 months follow-up, 28.3% (95% confidence intervals 14.6% to 50.4%) at 36 months follow-up and 40.3% (95% CI 22.8–64.1%) at 48 months follow-up. The cumulative term delivery rate was...
6.8% (95% CI 2.3–19.7%) at 12 months follow-up, 9.9% (95% CI 3.8–24.7%) at 24 months follow-up, 24.4% (95% CI 11.7–46.4%) at 36 months follow-up, and 30.9% (95% CI 15.7–55.2%) at 48 months follow-up. The cumulative tubal pregnancy rate was 6.2% (95% CI 1.5–23%) at 48 months follow-up.

For the purposes of comparison, subjects were coded from 1 to 46 by the order in which they had surgery in this series. The first pregnancy occurred in case 12. Patients 1–23 had a cumulative intrauterine pregnancy rate of 31.4% at 48 months follow-up (95% CI 14.3–60.1%), and a cumulative term delivery rate of 20.1% (95% CI 6.9–50.6%). Patients 24–46 had a cumulative intrauterine pregnancy rate of 41.9% at 32 months follow-up (95% CI 15.9–81.9%) and a cumulative term delivery rate of 41.9% (95% CI 15.9–81.9%). There was a statistically significant difference in the cumulative term delivery rate between the two groups ($\chi^2_1 = 3.7$, $P = 0.05$).

A stepwise Cox’s regression model of life-table analysis was undertaken entering the following variables: case order allowing for chronological separation of cases dealt with in the UK and Canada, surgical modality (laser or electrosurgery), length of infertility before surgery, age, primary or secondary infertility, adhesions ranked by severity, tubal diameter, and the number of remaining Fallopian tubes. The following variables approached or achieved the 5% level of significance when term delivery was the end point: length of infertility ($Z = -2.78, P = 0.006$), primary or secondary infertility ($Z = 2.51, P = 0.012$), tubal diameter ($Z = -1.86, P = 0.06$), and the order in which cases were undertaken ($Z = 1.53, P = 0.12$). A variable was then generated to identify whether cases were performed in the first or second half of the series, and introduced into a second stepwise analysis with term delivery as the end point. This analysis was performed to determine whether the difference in term delivery rate between the two halves of the series was independent of other predictive variables. The following variables approached or achieved the 5% level of significance: length of infertility ($Z = -2.46, P = 0.014$), primary or secondary infertility ($Z = 2.45, P = 0.014$), tubal diameter ($Z = -2.23, P = 0.026$) and first or second half of the series ($Z = 2.11, P = 0.035$).

The distribution of all variables entered into the Cox’s model was then compared between cases 1–23 and cases 24–46, by undertaking a paired Wilcoxon test. Tubal diameter was significantly higher in cases 1 to 23 ($Z = 2.23, P = 0.026$). Age approached the 10% level of significance ($Z = 1.56, P = 0.12$), with cases 1–23 having a higher incidence of older women. No other variable approached the 10% level of significance.

Discussion
There is an increasing emphasis on appropriate training including a preceptorship prior to undertaking complex endoscopic procedures (Dunphy, 1993; Society for Reproductive Surgeons, 1994; Fraser and Petrucco, 1994). In many endoscopic procedures it is difficult to relate surgical experience to outcome in the absence of clear outcome measures. Therefore, performance is usually related to experience in terms of complication rates. In the case of laparoscopic salpingostomy, the term delivery rate is an outcome measure which can be clearly related to surgical experience.

This is the first study to demonstrate an association between the experience of one surgeon and the term delivery rate following laparoscopic salpingostomy, as outcome in the second half of the series was significantly better independent of other prognostic factors. Moreover 12 cases were undertaken before an intrauterine pregnancy was achieved. The surgeon who undertook these cases (B.D.) initiated laparoscopic salpingostomy when it was a new procedure at our centre. B.D. attended an appropriate course. However, in contrast to conventional microsurgery (Singhal et al., 1991), no preceptor was readily available to supervise B.D.’s initial laparoscopic salpingostomy cases. It is unknown what impact a preceptor would have had on outcome for the initial cases, and this study did not directly evaluate the role of a preceptor. However, the learning curve might have been shortened and intervention by the preceptor could have altered certain technical aspects of surgery.

There was a well established IVF and subspeciality infertility programme in each area prior to this series. Therefore it is unlikely that referral patterns changed during the study. Historical outcomes have been published for conventional salpingostomy from the Jessop Hospital for Women (Singhal et al., 1991). These data suggest that after appropriate expertise, outcome following laparoscopic salpingostomy is comparable to that following conventional salpingostomy.

There is a clear difference in the term delivery rate between the first and second half of this series which is independent of other prognostic variables. However, surgical expertise is not the only factor which may be responsible for the difference in term delivery rates. Case selection has been demonstrated to influence outcome following both conventional (Singhal et al., 1991) and laparoscopic salpingostomy (Canis et al., 1991). Distal tubal diameter was significantly larger in the first half of this series. Tubal diameter has been documented as a prognostic factor following salpingostomy (Shirodkar, 1966), and achieved significance as a prognostic factor in our final stepwise analysis. Therefore it would appear that case selection improved by the second half of this series. Case selection is partly a function of experience, particularly in selecting cases which are best suited to a laparoscopic approach. However, another potential explanation is that cases anticipated to have a poor prognosis may be more readily selected when undertaking a new procedure. It is unknown which of these factors predominated in our series, as we did not formally record our selection criteria for each case. However, it is clear that when planning surgical training, attention should be paid to selecting cases with a good prognosis in addition to undertaking a preceptorship. Indeed, teaching appropriate case selection may be an essential part of a preceptorship, and should be emphasized during didactic teaching at courses.

In summary, these data support the concept of a learning curve for laparoscopic salpingostomy, the potential value of a preceptorship and the need for appropriate case selection even in the initial stages of surgical training. Therefore, this study supports the value of recently introduced guidelines for training.
in gynaecological laparoscopic surgery. Furthermore, these data reaffirm that with appropriate case selection, outcome following laparoscopic salpingostomy is comparable to that following conventional microsurgery (Gomel, 1977; Canis et al., 1991; Dubuisson et al., 1994).

References


Received on December 12, 1996; accepted on March 25, 1997.