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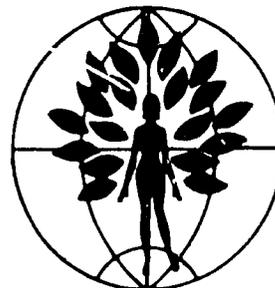
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## Tubal ligation at cesarean delivery in five Asian centers: a comparison with tubal ligation soon after vaginal delivery

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### Abstract

*Increasingly more tubal sterilizations are being performed at the time of cesarean section in the United States and probably also in developing countries. This descriptive study provides us with hitherto unavailable information on the impact of this combined procedure on the women undergoing it. Five Asian centers were included for study. In these centers, 618 women had concurrent tubal ligation at cesarean section in 1973 and 1974. During this period, 3399 women had tubal ligation soon after term vaginal deliveries. The much higher morbidity and mortality in the former group were judged to be attributable to the indications leading to, or the complications of, cesarean section and not to the concurrent tubal ligation. Women undergoing the combined procedure of tubal ligation and cesarean section were more likely to have characteristics associated with later regretting the sterilization.*

**Keywords:** Tubal ligation; Tubal ligation at cesarean section; Postpartum sterilization; Regret after sterilization.

### Introduction

According to Placek et al. [16] in the United States, 35,000 postpartum steriliza-

tions were performed at the time of cesarean section in 1970. The number increased to 61,000 in 1975. Precise national statistics in less-developed countries (LDCs) are not available but use of tubal ligation concurrent with cesarean section is probably also on the rise, as the number of hospital deliveries as well as the proportion of cesarean deliveries relative to vaginal deliveries are both on an upward trend [5,15]. In some parts of the developing world, women may even request a cesarean delivery in order to have a concurrent tubal ligation at the hospital [12].

Studies focusing exclusively on this combined procedure are virtually non-existent. The international postpartum sterilization database developed by Family Health International (FHI) contains data on a large number ( $N = 1142$ ) of women undergoing this combined cesarean section-tubal ligation (CSTL) procedure, most of them from developing countries. This data set gives us a unique opportunity to examine the impact of this female sterilization modality on the women who undergo it. Although intended as a descriptive study, we used women undergoing tubal ligation soon after vaginal delivery (VDTL) as the comparison group to afford us a better perspective.

### Materials and methods

In the FHI data set, 89% of postpartum sterilizations were performed by tubal

ligation (the Pomeroy or modified Pomeroy technique). We thus included for study only parturient women undergoing tubal ligation during their hospitalization for term delivery. For CSTL women, all ligations were performed at the time of cesarean section. For VDTL women, most had the tubal ligation performed via minilaparotomy/laparotomy within 48 h after vaginal delivery. For a center to be included in this study, it must have performed at least 50 CSTLs and performed more VDTL than CSTL procedures. In this way, centers inexperienced with the combined procedure and/or primarily performing them on a referral basis were excluded. Furthermore, women having had another incidental surgical operation(s) not medically related to the delivery/tubal ligation procedure (e.g. a concurrent appendectomy) were excluded. Patients with concurrent procedures resulting from the tubal ligation procedure, such as lysis of adhesion or repair of a bladder injury, however, were allowed in the study. Only five out of the 101 centers in the data set met these criteria; Centers A, B and C were located in India, Center D in the Philippines and Center E in Singapore. Altogether there were 618 CSTL and 3399 VDTL patients in our study. All the procedures were performed in the 2-year period of 1973 and 1974.

Identical data collection forms were used for the CSTL and VDTL patients. The one-page admission form contained information on the woman's socio-demographic characteristics, reproductive history, pre-existing medical conditions, anesthetic type used, difficulties and complications (and complaints) at surgery, during hospitalization, and soon after discharge as reported at the early follow-up visit, up to 6 weeks after discharge.

The data collection system was designed to study voluntary sterilization and not the obstetric indications for cesarean section. Thus, it was sometimes difficult to separate complications into those due to delivery and those due to tubal ligation. While

information on the occurrence of serious complications related to CSTL are available, information on indications for cesarean delivery in the CSTL group was not. Only complications which occurred from the time of surgery through early follow-up were examined.

Anticipating inter-center variations in definitions and in completeness of reporting of complications, we limited the outcome variables for comparison to those of an objective and clear-cut nature, such as death, shock, excessive blood loss requiring transfusion, febrile morbidity requiring antibiotics, technical failures, operation time and hospitalization length.

The chi-square test of association was used for intra-center comparisons between the CSTL and VDTL women. For rare complications (those involving less than 5 women), Fisher's exact test was used to compare differences between the two groups of women. The Mantel-Haenszel method [14] was used to examine the inter-center consistencies of findings for categorical data. For quantitative data, analysis of variance (ANOVA) was used to test for differences in means controlling for center. A *P*-value (two-tailed) < 0.05 was considered statistically significant.

## Findings

### 1. Socio-demographic characteristics of the women (Table 1)

The average age of the CSTL patients in the five centers ranged from 29.3 years to 32.7 years. They were approximately 1–2 years older than their counterpart VDTL patients in all centers except Center D (*P* < 0.001). The average number of live births (not including the index delivery) of the CSTL patients ranged from 3.0 to 4.2 and on the average was about one fewer than the average parities of their VDTL counterparts in all centers except Center E (*P* < 0.001). Also, in all centers, consistently more CSTL women than the VDTL women had living children of only one sex, again not including the index delivery (*P*

**Table I.** Demographic characteristics of women undergoing cesarean section-tubal ligation (CSTLs) and those undergoing minilaparotomy/laparotomy tubal ligation soon after vaginal delivery (VDTLs) in five Asian centers.

	Center A		Center B		Center C		Center D		Center E		P-value
	CSTL	VDTL									
No. of women at admission	142	250	68	718	93	653	167	754	148	1024	
Mean age in years (S.D.)	29.3 (5.0)	28.3 (4.2)	29.9 (4.0)	29.1 (3.8)	29.4 (5.1)	28.3 (4.3)	32.0 (5.8)	33.2 (4.6)	32.7 (5.2)	30.7 (4.8)	< 0.001 <sup>b</sup>
No. of live births <sup>a</sup> (S.D.)	3.5 (1.8)	4.3 (1.4)	3.5 (1.2)	3.8 (1.2)	3.0 (2.1)	4.0 (1.8)	4.2 (2.4)	5.7 (2.4)	3.5 (2.6)	3.6 (1.9)	< 0.001 <sup>b</sup>
% with:											
no male child <sup>a</sup>	14.8	2.8	14.7	1.9	32.3	10.1	15.6	3.4	14.9	6.3	< 0.001 <sup>c</sup>
no female child <sup>a</sup>	18.3	4.8	19.1	13.4	23.7	13.8	14.4	4.5	23.0	17.4	< 0.001 <sup>c</sup>
child loss <sup>a</sup>	26.1	17.2	20.6	6.0	35.5	28.0	26.9	25.6	5.4	5.2	0.002 <sup>c</sup>
Mean education in years (S.D.)	4.1 (3.6)	5.3 (3.5)	5.0 (3.6)	4.8 (3.4)	4.0 (4.1)	4.6 (3.7)	8.4 (3.5)	8.7 (3.3)	3.4 (3.9)	3.2 (3.4)	0.92 <sup>b</sup>
% living in urban areas	66.2	79.2	100.0	98.5	75.3	83.4	82.0	84.9	68.9	65.8	0.25 <sup>c</sup>

<sup>a</sup>Excluding index delivery.

<sup>b</sup>Controlling for center by two-way analysis of variance.

<sup>c</sup>Controlling for center by Mantel-Haenszel Chi-square.

**Table II.** Pre-existing conditions of women undergoing cesarean section-tubal ligation (CSTLs) and those undergoing minilaparotomy/laparotomy tubal ligation soon after vaginal delivery (VDTLs) in five Asian centers.

	Center A		Center B		Center C		Center D		Center E		P-value
	CSTL	VDTL									
No. of women at admission	142	250	68	718	93	653	167	754	148	1024	
% with:											
previous abdominal/ pelvic surgery	25.4	3.6	32.4	4.9	59.1	4.7	66.5	8.0	50.7	7.5	< 0.001
adhesion at operation	2.1	0.4	2.9	0.7	41.9	0.3	46.1	2.3	7.4	1.8	< 0.001

<sup>a</sup>Controlling for center by Mantel-Haenszel chi-square.

< 0.001 for males and females). This difference does not change for male children when parity was taken into account. Child loss had occurred somewhat more often in the CSTL women than in the VDTL women ( $P < 0.01$ ). No consistent differences in educational levels or in proportions living in urban regions between the two groups were detected among the five centers.

## 2. Pre-existing conditions (Table II)

In all five centers, markedly more CSTL than VDTL women reported having had previous abdominal/pelvic surgery ( $P < 0.001$ ). The validity of this finding is supported by a consistently higher prevalence of adhesion at tubal ligation in the CSTL than in the VDTL women ( $P < 0.001$ ).

## 3. Ancillary procedures, technical failures, operation time, and hospitalization length (Table III)

(a) *Prophylactic antibiotics.* Virtually all patients in Centers A, B and C, whether undergoing a CSTL or a VDTL procedure, were given antibiotics prior to the tubal ligation procedure. In Center D, three-quarters of the CSTL patients but fewer than 10% of the VDTL patients were given prophylactic antibiotics. In Center E, fewer than 10% of the CSTL patients and virtually none of the VDTL patients had received antibiotics.

(b) *Anesthesia type.* As would be expected, in all five centers, virtually all CSTL procedures were performed under either regional or general anesthesia. In centers where regional anesthesia was used for CSTL

**Table III.** Prophylactic antibiotic given, type of anesthesia, technical failures, operation time and hospitalization length, for women undergoing cesarean section-tubal ligation (CSTL) and those undergoing minilaparotomy/laparotomy tubal ligation soon after vaginal delivery (VDTL) in five Asian centers.

	Center A		Center B		Center C		Center D		Center E	
	CSTL	VDTL								
No. of women at admission	142	250	68	718	93	653	167	754	148	1024
% given prophylactic antibiotic	98.6	100.0	94.1	81.6	98.9	98.9	74.9	8.5	8.1	1.1
% distribution by anesthesia type										
local/analgesia/others	0.0	99.6	0.0	1.5	0.0	78.7	0.0	2.7	2.7	92.2
regional	2.1	0.0	94.1	97.9	0.0	0.0	97.6	96.4	0.0	3.0
general	97.9	0.4	5.9	0.1	100.0	21.3	2.4	0.9	97.3	4.8
% ending in technical failure	0.0	0.4	0.0	0.3	3.2	0.3	0.6	2.0	0.7	2.4
Operation time in minutes*										
Mean	59.0	19.4	46.5	21.3	58.3	13.1	62.8	19.1	45.2	15.9
(S.D.)	(9.6)	(4.6)	(9.7)	(4.8)	(6.0)	(2.9)	(18.4)	(9.2)	(13.7)	(6.9)
Hospitalization in number of nights <sup>b</sup>										
Mean	8.9	7.8	12.0	5.0	11.2	7.9	7.6	1.7	8.1	2.3
(S.D.)	(2.8)	(2.5)	(3.4)	(0.9)	(6.4)	(2.1)	(1.0)	(0.8)	(3.6)	(1.9)

\*Excluding the 50 patients whose procedures ended in technical failure.

<sup>b</sup>Excluding the nine CSTL deaths.

patients (Centers B and D), VDTL procedures were also performed under regional anesthesia. But in centers where general anesthesia was used for CSTL patients (Centers A, C and E), the great majority of VDTL procedures were performed under local anesthesia with analgesia.

(c) *Technical failures.* A technical failure was defined as a sterilization procedure which was abandoned or completed by changing to a tubal occlusion technique other than the one originally planned. Five procedures (0.8%) among the CSTL and 45 procedures (1.3%) among the VDTL women resulted in technical failures.

(d) *Operation time.* Operation time was calculated as minutes from incision to closure. The mean operation time ranged from 45 to 63 min for the CSTL procedures (including time spent on abdominal delivery) and from 13 to 21 min for the VDTL procedures among the 5 centers. Also, 90% of CSTLs, but only 2% of VDTL procedures required 40 or more minutes to complete. Procedures resulting in technical failures were excluded from these calculations.

(e) *Length of hospitalization.* The average number of nights of hospitalization ranged from 7.6 to 12.0 for the CSTL women and from 1.7 to 7.9 for the VDTL women. Length

of hospitalization was calculated as the number of nights spent in the hospital between tubal ligation procedure and discharge. Lengths of hospitalization varied markedly for the VDTL women among centers. This may be due to the differences in proportions using the laparotomy or the minilaparotomy approaches and in the timing between vaginal delivery and tubal ligation, although we do not have the data to confirm this. For all five centers, virtually all (92.7%) CSTL patients stayed in hospital for seven or more nights while in Centers B, D and E, fewer than 50% of the VDTL women stayed in the hospital for such a long period. The nine CSTL deaths were excluded from this calculation.

#### 4. Maternal deaths

A total of nine maternal deaths were reported; all were CSTL patients (eight from Center A and one from Center D). Details of these nine deaths including their underlying cause are presented in Table IV. None of the nine CSTL reported deaths were judged to be attributable to the tubal ligation procedure. Four deaths were judged to be caused by shock due to blood loss (three of them had ruptured uteri). Two patients died of sepsis (one with a history of epilepsy). One diabetic patient died of aspiration pneumonia, and

**Table IV.** Causes of deaths for the nine maternal deaths in women undergoing cesarean section-tubal ligation (CSTL) in five Asian center study.

Deaths	Center	Age (years)	Indication for cesarean section	Interval between CSTL procedure and death	Probable cause of death
1	A	30	Hypertension	4 days	Sepsis
2	A	25	Epilepsy	17 days	Sepsis
3	A	30	Ruptured uterus	< 24 hours	Hypovolemic shock
4	A	28	Ruptured uterus	1 day	Hypovolemic shock (transfusion reaction)
5	A	33	Sepsis and prolonged labor	10 days	Ileus
6	A	32	Cephalopelvic disproportion	2 days	Aspiration pneumonia*
7	A	27	Ruptured uterus	6 days	Severe hypovolemic shock*
8	A	33	Unknown	13 days	Hypovolemic shock
9	D	36	Breech	14 days	Anesthetic accident or septic emboli

\*Patients were discharged in a moribund state against medical advice.

one death was attributable to post-operative ileus. The remaining patient died of either an anesthesia accident or septic emboli.

### 5. Other major complications

For both the CSTL and the VDTL procedures, some major complications occurred very rarely. Others occurred with a similar relative frequency among the centers. For these reasons, we pooled the data from the five centers data for comparison.

(a) *During operation and hospitalization (Panel A, Table V).* The nine deaths and 50 patients with technical failures were included for study. Among the 618 CSTL patients, two (0.3%) suffered anesthesia-related shock, one (0.2%) bladder injury, and 13 (2.1%) surgery-related shock. Also 91 patients (14.7%) were given blood transfusion and 33 (5.4%) required antibiotics for febrile morbidity. Among the 3399 VDTL patients, none

suffered anesthesia-related shock, bladder injury or surgery-related shock. Only 9 patients (0.30%) were given transfusion, and 16 patients (0.5%) required antibiotics.

(b) *Reported at early follow-up (Panel B, Table V).* For those patients who came back to the clinics for a follow-up visit 1–6 weeks after discharge (72.2% of the 609 CSTL patients and 91.5% of the 3399 VDTL patients), similar proportions of women from both groups reported fever requiring antibiotics, incision wound infection and/or separation, and re-admissions. Reasons for re-admissions for the two CSTL patients were wound sepsis (4 nights) and pelvic infection (17 nights). The 11 VDTL patients were re-admitted for the following reasons: three women for unspecified fever, all of whom were given antibiotics; and one woman each with wound sepsis, wound separation and tubo-ovarian abscess. For the remaining five

**Table V.** Incidences of anesthesia-related shock and other major complications during operation and hospitalization and at early follow-up (1–6 weeks after discharge) for women undergoing cesarean section-tubal ligation (CSTL) and those undergoing minilaparotomy/laparotomy tubal ligation soon after vaginal delivery (VDTL). Pooled data of five Asian centers.

	CSTL (N = 618)	VDTL (N = 3399)	P-values
<b>A. No. of women at admission*</b>			
No. (and %) with:			
anesthesia-related shock	2 ( 0.3)	0 (0.0)	0.02 <sup>c</sup>
bladder injury	1 ( 0.2)	0 (0.0)	0.15 <sup>c</sup>
surgery-related shock <sup>b</sup>	13 ( 2.1)	0 (0.0)	< 0.0001 <sup>d</sup>
blood transfusion given	91 (14.7)	9 (0.3)	< 0.0001 <sup>d</sup>
fever requiring antibiotics	33 ( 5.4)	16 (0.5)	< 0.0001 <sup>d</sup>
	(N = 446)	(N = 3109)	
<b>B. No. of women with early follow-up</b>			
No. (and %) with:			
fever requiring antibiotics	6 ( 1.3)	57 ( 1.8)	0.46 <sup>d</sup>
incision wound infection/separation	50 (11.2)	333 (10.7)	0.75 <sup>d</sup>
re-admission	2 ( 0.4)	11 ( 0.4)	0.67 <sup>c</sup>
Not assuming full household work	311 (70.0)	1165 (37.5)	< 0.0001 <sup>d</sup>
Follow-up rate (%)	72.2	91.5	

\*Including the nine CSTL deaths and the 50 subjects with technical failures from both groups.

<sup>b</sup>Although reported as surgery-related shock, it was inseparable from shock due to blood loss prior to surgery.

<sup>c</sup>By Fisher's exact test.

<sup>d</sup>By the Chi-square test.

women, information on the reason for re-admission was not available. The women undergoing CSTL were much more likely than those undergoing VDTL to have not resumed full household work by this early follow-up (70% vs. 38%). Although the average time from discharge to early follow-up was also shorter for the CSTL patients (14 days) than for the VDTL patients (18 days), the magnitude of the difference for resumption of work was not substantially reduced when the visit week of the early follow-up was controlled.

### Discussion

Many immediate postpartum sterilizations may be performed for reasons of convenience. The woman is already in the hospital, and a CSTL procedure can be performed with only one incision and one exposure to anesthesia. In developing countries, these reasons are especially compelling because many women have limited access to a surgical sterilization procedure [12,13].

Rochat et al. [19], using the total FHI female sterilization database including the data sets used in this study, asserted that all 20 deaths occurring in women undergoing CSTL in their study were attributable to either the indications leading to cesarean section or the cesarean section operation per se (e.g. ruptured uterus leading to sepsis or hemorrhage), and none were attributable to the concurrent tubal ligation. Although in our study the reported complications were not specified as whether they were due to cesarean section or due to tubal ligation for the CSTL women, most of the major complications were judged to be due to the cesarean section. The morbidity rate was higher during hospitalization for CSTL patients, but became comparable at early follow-up between the CSTL and the VDTL groups. Studies from the Western countries, providing a cesarean section-only group for comparison, have consistently shown that concurrent tubal ligation does not add to the morbidity of cesarean

section [2,17,21]. The relative cost factors of the CSTL procedures are reflected in Table III in which the ancillary procedures, operation time and hospitalization lengths of this combined procedure are presented together with those of the VDTL procedures.

One important factor of this combined sterilization procedure which deserves careful consideration is the women's long-term satisfaction. Previous studies from the West have reported a higher regret and/or reversal request rate in divorced/widowed women, low-parity women, women sterilized immediately after pregnancy and women for whom doctors recommended the procedures, hence more likely needing the procedure for medical reasons [3,8,9,20,22]. A number of studies [1,4,10,18,20] specifically mentioned a higher likelihood for women undergoing tubal sterilization accompanied by cesarean section to regret or actually request reversal than women who had a postpartum sterilization soon after vaginal delivery, who, in turn, have a higher regret risk than women having an interval procedure. Our data also show that women undergoing CSTL, as compared to those undergoing VDTL, were more likely to have demographic characteristics associated with regret, such as lower parity and having children of only one sex. It is noteworthy that in these countries generally known to have a son-preference [7], from 15% to 32% of the CSTL patients did not have a male child at admission (Table I). The fact that more CSTL women have had previous abdominal/pelvic surgery also suggests that, besides the convenience reasons, medical considerations such as the avoidance of repeated cesarean section(s) were probably also a factor for the decision of the concurrent sterilization procedure. The FHI data were collected in such a way as to allow us to easily separate women with or without previous abdominal/pelvic surgery. To identify the type of these surgeries, however, would be a time-consuming task. We have, thus, randomly selected a sample of the CSTL and VDTL women who reported hav-

ing previous abdominal/pelvic surgery and examined their individual records. The samples were selected by center. Aggregately, 26% of the CSTL and VDTL women were selected for review. The majority, 65%, a weighted proportion, of these surgeries were previous cesarean sections. A previous cesarean section was usually reported as an abdominal surgery in Centers A, C and D, as a pelvic surgery in Center E and as either an abdominal or a pelvic surgery in Center B. More of the VDTL women, on the other hand, had the sterilization operation for multiparity. These findings did not change substantially when women with previous child loss were excluded from analysis.

Of course, long-term satisfaction of a generally irreversible surgical procedure should bear much more importance than convenience. The asserted connection between CSTL and regret, if true, will have important implications in practice. First, cesarean hysterectomy probably should never be advocated for the purpose of sterilization but only if strictly indicated for medical reasons. Second, all couples having a sterilization need thorough counseling. If, as is often the case in LDCs, the cesarean section is performed as an emergency, there seems to be no valid reason to perform a concurrent tubal ligation. For elective cesarean section, selection of patients should be careful, and the counseling should be given in plenty of time to allow the women to make a thoughtful and well-balanced decision of the contraceptive options, especially for women with characteristics associated with a higher likelihood of later regret. On the other hand, as Placek et al. [16] pointed out, "the most important health benefit for women having postpartum sterilization is that they are removed from a high-risk group predisposed to future maternal health complications." This is especially true for LDC women, who usually have less access to hospital care. By undergoing CSTL procedures, they would be able to avoid the need for any repeated cesarean-sections in the future. We, thus, feel that

for LDC women who are admitted for an elective cesarean section, with characteristics not associated with regret (e.g. high parity) and with a strongly expressed desire to limit family size (after careful and thorough counseling), a concurrent tubal ligation procedure is a justifiable consideration. Use of a more reversible tubal occlusion technique such as a clip may be more appropriate in this situation [3], and Hulka suggested that the clip can be directly put on the Fallopian tubes by hand without an applicator at the time of cesarean section [11]. A clip is, however, somewhat less effective in preventing accidental pregnancies [6].

It is recognized that only five centers among the FHI network were included in this study and may lack representation. They were, however, the more experienced centers with regard to the CSTL procedure and the findings were remarkably consistent among the centers. Our study results may be extrapolated to other centers with a similar level of experience with the CSTL procedure.

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