Ovum transmigration after salpingectomy for ectopic pregnancy

Jackie A. Ross1,*,†, Amelia Z. Davison1,†, Yasmin Sana2, Adjoa Appiah1, Jemma Johns1, and Christopher T. Lee2

1Early Pregnancy and Gynaecology Assessment Unit, Suite 8, Golden Jubilee Wing, King’s College Hospital, Denmark Hill, London SE5 9RS, UK 2Princess Royal University Hospital, Farnborough Common, Orpington, Kent BR6 8N0044, UK

*Correspondence address. E-mail: jackie.ross1@nhs.net

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STUDY QUESTION: What proportion of pregnancies are a result of ovum transmigration after salpingectomy for ectopic pregnancy?

SUMMARY ANSWER: Approximately one-third of spontaneously conceived pregnancies are a result of pick-up of the ovum from the ovary contralateral to the remaining tube in women with a history of salpingectomy.

WHAT IS KNOWN ALREADY: The corpus luteum has been found contralateral to tubal ectopic pregnancies in 32% of reported cases. The rate of contralateral ovum pick-up in intrauterine pregnancies is not known.

STUDY DESIGN, SIZE, DURATION: We conducted a retrospective cohort study of clinical and ultrasound records collected over a 12-year period 1999–2010. Ten per cent of cases identified were excluded from the final analysis due to incomplete data or bilateral corpora lutea.

PARTICIPANTS/MATERIALS, SETTINGS, METHODS: Included were 842 pregnancies in 707 women with a history of unilateral salpingectomy for ectopic pregnancy and subsequent spontaneous pregnancy. The study was set in the Early Pregnancy Unit of a large UK inner city teaching hospital. The outcome measure was the side of the corpus luteum in relation to the side of the remaining tube.

MAIN RESULTS AND THE ROLE OF CHANCE: The corpus luteum was located in the ovary contralateral to the remaining tube in 266/842 pregnancies (31.6%; 95% CI 28.5–34.8%). There was no significant difference in this proportion between intrauterine and ectopic pregnancies [246/769 (32.0%) versus 21/73 (28.8%), P = 0.60].

LIMITATIONS, REASONS FOR CAUTION: This was a retrospective study and so did not address the conception rate according to the laterality of ovulation.

WIDER IMPLICATIONS OF THE FINDINGS: Our findings were very similar to the frequency of ectopic pregnancies found contralateral to the corpus luteum described in previous studies. Ovum pick-up from the cul-de-sac probably occurs reasonably frequently and is unlikely to have a causative role in the pathogenesis of ectopic pregnancy. It is not known how often this phenomenon occurs in women with intact Fallopian tubes.

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Key words: corpus luteum / salpingectomy / ovum pick-up / peritoneal transmigration / ultrasonography

Introduction

At the time an ectopic pregnancy is diagnosed and when faced with the prospect of losing a Fallopian tube, many women question not only whether they will be able to conceive in the future, but also how this will happen when they only have one remaining tube, yet ovulate from both ovaries. The typical coronal section of the uterus, tubes and ovaries that is frequently used to illustrate the anatomy of the female pelvic organs shows their relative positions as they would appear stretched out on a dissecting board rather than in vivo. This anatomical representation facilitates the theory that the ovulated oocyte is picked up by a sweeping motion of the fimbriae of the ipsilateral tube over the surface of the ovary (Germann and Stanfield, 2007). However in vivo, the fimbrial ends of the tubes are located posterior to the uterus within the pouch of Douglas, beneath the ovaries. Picturing the anatomy in this way makes it easier to understand how...
oocytes can be extruded into the cul-de-sac within the follicular and peritoneal fluid where they may be picked up by either Fallopian tube. In the past, contralateral ovum pick-up was postulated to be an aetiological factor in ectopic pregnancy due to a delay in transport of the conceptus toward the endometrial cavity (Berlind, 1960; Berry et al., 1985; Insunza et al., 1988). Ziel and Paulson reviewed the data in the literature relating to ovum transmigration in ectopic pregnancies in 2002, and found that of the 52% of cases that reported the side of the corpus luteum, 204/629 (32%) of ectopic pregnancies were located in the tube opposite to the ovary containing the corpus luteum. They used this relatively high frequency, along with evidence that assisted reproductive techniques utilizing late placement of the gametes or embryo into the Fallopian tubes did not increase the risk of ectopic pregnancy, to conclude that ovum transmigration is likely to be a frequent event occurring in both intrauterine and ectopic pregnancies.

How often this phenomenon occurs in intrauterine pregnancies has not been studied, though there have been isolated case reports of contralateral pick-up resulting in intrauterine pregnancies (Kamrava et al., 1982; Motta et al., 1993). The aim of this study was to determine how frequently the corpus luteum was visualized in the ovary opposite to the remaining tube in women who spontaneously conceived to the side of the salpingectomy or no histopathological record of the side of the salpingectomy was available. They further wished to thereby estimate the proportion to the remaining tube in women who spontaneously conceived to the side of the salpingectomy and to thereby estimate the proportion of pregnancies with a history of salpingectomy for ectopic pregnancy and visualization of both ovaries on ultrasound. Pregnancies included on-going pregnancies, early embryonic demise or haemorrhagic appearance (Durfee and Frates, 1999).

The primary outcome measure was the side of the corpus luteum in relation to the side of the remaining Fallopian tube.

### Statistical analyses

Confidence intervals of proportions were calculated using the Wald method and the $\chi^2$ test was used to compare observed and expected frequencies.

### Ethical approval

The study was considered by the Chair, King’s College Hospital Research Ethics Committee, National Research Ethics Service, who advised that the project did not require ethical review under the terms of the Governance Arrangements for Research Ethics Committees in the UK 08/01/2009.

### Results

There were 936 pregnancies in 707 women that met the inclusion criteria for the study. The demographic and clinical data of the study population are shown in Table I. The final diagnosis was an on-going singleton intrauterine pregnancy in 702/936 women (75.0%; 95% CI 72.1–77.7%), early embryonic demise in 139 (14.9%; 95% CI 12.7–17.3%), ectopic pregnancy in 89 (9.5%; 95% CI 7.8–11.6%), twin pregnancy in 3 and Caesarean scar or cervical implantation in 3.

Figure 1 shows a flow chart of the cases through the study. Ninety-four pregnancies were excluded from further analysis as either the side of the corpus luteum was not recorded or there were bilateral corpora lutea, leaving 842 cases in 635 women. There was no significant difference between the proportion of pregnancies with a history of left salpingectomy and those with a right salpingectomy ($P > 0.05$), nor was there any significant difference between the laterality of ovulation ($P = 0.78$). Overall, the corpus luteum was located in the ovary on the side of the salpingectomy in 372/842 cases (44.1%; 95% CI 40.4–47.8%).

### Materials and Methods

#### Study population and participants

This was a retrospective analysis of clinical data collected prospectively at the Early Pregnancy Unit of King’s College Hospital from 1999 to 2010. The records were held on an electronic database (Viewpoint PIA database, Vienna). Our unit serves a racially mixed, mobile, inner city population with high levels of socioeconomic deprivation. Women who have had an ectopic pregnancy in the past have open access to the unit in order to screen for a recurrent ectopic pregnancy. Ultrasound scans are performed by gynaecologists with a special interest in gynaecological ultrasound using a standardized, systematic approach. It is the policy in our unit that the adnexa are examined in every patient and the site and number of corpora lutea are documented. During the study period, ultrasound scans were performed using a 5-MHz transvaginal probe (Aloka SSD 5500, Aloka, Japan or Voluson 730 Expert, GE Systems), supplemented by a transabdominal approach if the pelvic anatomy was not visualized completely with the transvaginal approach. The ultrasound features which were used to diagnose an intrauterine pregnancy were those described by Jurkovic et al. in 1995. The presence of an intrauterine pregnancy was confirmed by visualization of a gestation sac, with or without visible embryonic cardiac activity. An ectopic pregnancy was defined as a non-cystic or inhomogeneous adnexal mass separate to the ovaries (Brown and Doubilet, 1994). The corpus luteum was identified as a well-circumscribed, vascular, thick-walled area within the ovary of solid, cystic or haemorrhagic appearance (Durfee and Frates, 1999).

The inclusion criteria were spontaneous conception, history of previous salpingectomy for ectopic pregnancy and visualization of both ovaries on ultrasound. Pregnancies included on-going pregnancies, early embryonic demise and recurrent ectopic pregnancy. The exclusion criteria were assisted conception, pregnancy of unknown location and uncertainty as to the side of the salpingectomy or no histopathological record of the salpingectomy.

### Table I Demographic and clinical features of the study population.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total number of pregnancies ($n = 936$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (years)*</td>
<td>31.8 (5.8)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Black (%)</td>
<td>375 (40.1)</td>
</tr>
<tr>
<td>White (%)</td>
<td>293 (31.3)</td>
</tr>
<tr>
<td>Other (%)</td>
<td>65 (6.9)</td>
</tr>
<tr>
<td>Not known (%)</td>
<td>203 (21.7)</td>
</tr>
<tr>
<td>Gravidity b</td>
<td>4.0 (2.0)</td>
</tr>
<tr>
<td>Parity b</td>
<td>1.0 (1.0)</td>
</tr>
<tr>
<td>More than one previous ectopic (%)</td>
<td>58 (8.0)</td>
</tr>
<tr>
<td>Asymptomatic (screening for recurrent ectopic pregnancy)</td>
<td>654 (69.9)</td>
</tr>
<tr>
<td>Abdominal pain only</td>
<td>136 (14.5)</td>
</tr>
<tr>
<td>Vaginal bleeding ± pain</td>
<td>119 (12.7)</td>
</tr>
<tr>
<td>Dating</td>
<td>27 (2.9)</td>
</tr>
</tbody>
</table>

*Normally distributed data given as mean (standard deviation).

bNon-normally distributed data given as median (interquartile range) and discrete data shown as percentage (%) of each population.
contralateral to the remaining tube in 266/842 cases (31.6%; 95% CI 28.5–34.8%). In case rotation of the uterus had an effect, we also looked at the proportion of cases with contralateral pick-up according to whether the right or left tube remained, but there was no significant difference between the two groups ($P = 0.70$).

There was no significant difference between the proportion of pregnancies with evidence of contralateral ovum pick-up between the intrauterine and ectopic pregnancy groups [246/769 (32.0%) versus 21/73 (28.8%), $P = 0.60$].

In order to exclude the possibility that some women had a propensity to either contralateral or ipsilateral pick-up and had more than one pregnancy post-salpingectomy, potentially biasing the data, we also performed an analysis by the first pregnancy in individual women and the results are shown in Table II. The results were not significantly different with 208/635 women with contralateral ovulation (32.8%; 95% CI 29.2–36.5%). There were no significant differences found between the demographic or clinical features of the women with ipsilateral pick-up and contralateral pick-up (Table III).

**Figure 1** Flow chart of cases through the study.

**Table II** Analysis by first pregnancy post salpingectomy in individual women.

<table>
<thead>
<tr>
<th></th>
<th>Intrauterine pregnancy ($n = 576$)</th>
<th>Ectopic pregnancy ($n = 59$)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left salpingectomy</td>
<td>275 (47.7)</td>
<td>31 (52.5)</td>
<td>0.48</td>
</tr>
<tr>
<td>Right salpingectomy</td>
<td>301 (52.3)</td>
<td>28 (47.5)</td>
<td>0.48</td>
</tr>
<tr>
<td>Left corpus luteum</td>
<td>295 (51.2)</td>
<td>24 (40.7)</td>
<td>0.12</td>
</tr>
<tr>
<td>Right corpus luteum</td>
<td>281 (48.8)</td>
<td>35 (59.3)</td>
<td>0.12</td>
</tr>
<tr>
<td>Contralateral corpus luteum</td>
<td>194 (33.7)</td>
<td>14 (23.7)</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Discrete data shown as percentage (%) of each population.

**Discussion**

Our study has shown that approximately one-third of pregnancies result from transperitoneal migration of ova in women with one Fallopian tube. The literature relating to this phenomenon is scant. In 1960, Berlind noted the presence of a corpus luteum on the contra-lateral side to a tubal ectopic pregnancy in 24 of 48 cases (50%), compared with an occurrence rate of 1 in 12 for intrauterine pregnancies (8.3%). This different rate of occurrence was used as the basis for the theory that transmigration of the ovum to the contralateral fallopian tube may...
play an important role in the aetiology of tubal ectopic pregnancy (Insunza et al., 1988). The thinking was that during the slower transit to the contra-lateral tube, the fertilized ovum may enlarge by cellular division to such an extent that 'its passage through the tube is obstructed, resulting in a tubal gestation'. However, this study pre-
ceded the widespread use of high-resolution ultrasound in the first tri-
merister of pregnancy and so the corpus luteum could only be examined in women with on-going intrauterine pregnancies, when the pregnancy was complicated by a condition necessitating a laparot-
yomy. Indications for laparotomy included torsion of an ovarian cyst, acute appendicitis, cholelithiasis and ureteral lithotomy with an intra-
peritoneal approach. The study was limited by the small number of women with intrauterine pregnancies and the inclusion of women with a history of oophorectomy and an intrauterine pregnancy (rather than a salpingectomy) and so they did not demonstrate whether contra-lateral ovum pick-up had occurred, as the ovum may have reached the uterine cavity via either tube.

Ziel and Paulson reported on the occurrence of a contra-lateral corpus luteum in women with a tubal ectopic pregnancy. They sum-
morized the published data on this subject, and found that of a total of
1197 women with tubal ectopics undergoing surgery, the location of the corpus luteum was only recorded in 629 cases. The corpus luteum was noted to be on the contra-lateral side to the ectopic pregnancy in 204/629 (32%) of these cases. However, although this figure represents the rate of occurrence of a tubal ectopic pregnancy on the contra-lateral side to the corpus luteum, this may not actually reflect the true rate of ovum pick-up by the contra-lateral Fallopian tube, as there is an alternate route to the site of implantation within the Fallo-
opian tube via the ipsilateral tube by a trans-uterine route as opposed to the assumed trans-peritoneal route. Our figure for contra-lateral pick-up is the same as theirs for contra-lateral ectopic pregnancy. According to our inclusion criteria, all women in our study had a history of ectopic pregnancy and so it could still be argued that a ten-
dency to contra-lateral pick-up predisposes to ectopic pregnancy. It may be though, that the incidence of contra-lateral pick-up is equally as high in women with two tubes. What we cannot account for are rare cases of patent tubal remnants after salpingectomy. Indeed, there have been reported cases of intrauterine pregnancy after bilateral salpingectomy (Bollapragada et al., 2005).

As postulated by Ziel and Nielsen, the presence of fluid in the pouch of Douglas that is often seen post-ovulation may facilitate pick up of the ova by the contra-lateral tube. No model currently exists that would enable this to be studied easily in women with intact Fallopian tubes. Historically, there was a physiological study in-
vestigating the timing of the passage of oocytes though the Fallopian tubes (Croxatto et al., 1978). They used hysterectomy specimens from 23 women who had their LH surge timed in the cycle leading up to their surgery, but no mention was made of the side of ovulation in relation to the side of the tube in which the 19 oocytes were found. If a similar study were replicated today, it could examine the incidence of contra-lateral ovum pick-up, but not whether it is compatible with intrauterine rather than ectopic pregnancies.

One of the limitations of our study is that we did not prospectively track the cycle of each woman attempting to conceive to confirm that all the ultrasound diagnosed corpora lutea corresponded to the side of follicular development. However, our study numbers were far higher than we could have achieved with a prospective study recruiting prior to conception, and sonographic identification of the corpus luteum is an established and well-documented technique (Rowan et al., 2008).

Another potential limitation of our study is that systematic bias could have been introduced by our standardized approach to ultra-
sond examination of the adnexae, starting with the left ovary. Once a corpus luteum has been seen in the left ovary, the operator may look less closely at the right and so it was reassuring to find no statistical difference between the sides of ovulation. We do not know how many women had only one ovary identified during the study period, as visualization of both was an inclusion criterion, but we do know that the corpus luteum was identified in 92.6% of our cases, similar to previous studies where the ovaries were routinely examined in clinical practice (Rowan et al., 2008).

Our estimated figure of approximately one-third of pregnancies resulting from the pick-up of the oocyte from the ovary opposite to the remaining tube may be quoted when counselling women faced with a tubal ectopic pregnancy or talking to women who have previ-
ously undergone a unilateral salpingectomy. Although this pheno-
menon does not have any impact on their fertility after a salpingectomy, knowledge of it improves their understanding of repro-
ductive physiology and women may find it reassuring to know that when they ovulate from the ovary opposite to the remaining tube it is not a ‘wasted’ cycle, as many women assume to be the case.

**Authors’ roles**

J.A.R. made substantial contributions to conception and design, acqui-
sition of data, analysis and interpretation of data, drafting the article and revising it critically for important intellectual content and final approval of the version to be published. A.Z.D. made substantial contri-
butions to the acquisition of data, analysis and interpretation of data, drafting the article and final approval of the version to be published. Y.S. made substantial contributions to the analysis and interpretation of data, revising the article critically for important intellectual content and final approval of the version to be published. A.A. made substantial contributions to the analysis and interpretation of

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**Table III** Demographic and clinical features of individual women according to ovum pick-up.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ipsilateral corpus luteum (n = 427)</th>
<th>Contralateral corpus luteum (n = 208)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (years)</td>
<td>31.3 (5.8)</td>
<td>31.1 (5.8)</td>
<td>0.70</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black (%)</td>
<td>169 (39.6)</td>
<td>85 (40.9)</td>
<td>0.76</td>
</tr>
<tr>
<td>White (%)</td>
<td>124 (29.0)</td>
<td>68 (32.7)</td>
<td>0.35</td>
</tr>
<tr>
<td>Gravidity</td>
<td>4.0 (1.9)</td>
<td>4.1 (1.9)</td>
<td>0.60</td>
</tr>
<tr>
<td>Parity</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>More than one previous ectopic (%)</td>
<td>34 (8.0)</td>
<td>14 (6.7)</td>
<td>0.58</td>
</tr>
</tbody>
</table>

*aNormally distributed data given as mean (standard deviation).
*Non-normally distributed data given as median (interquartile range) and discrete data shown as percentage (%) of each population.*
data, revising the article critically for important intellectual content and final approval of the version to be published. J.J. made substantial contributions to the analysis and interpretation of data, revising the article critically for important intellectual content and final approval of the version to be published. C.T.L. made substantial contributions to conception and design, acquisition of data, drafting the article and revising it critically for important intellectual content and final approval of the version to be published.

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**Conflict of interest**

None declared.

**References**


