Mullerian duct malformations delineate a miscellaneous group of congenital anomalies that result from arrested development, abnormal formation, or incomplete fusion of the mesonephric ducts. In many patients, uterine congenital anomalies have been related to infertility, recurrent pregnancy loss, prematurity and other obstetric complications which increase perinatal morbidity and mortality rates (Green and Harris, 1976; Heinonen et al., 1982; Golan et al., 1989; Swolin et al., 1996), whereas in others these uterine malformations are asymptomatic (Simon et al., 1991).

The true incidence of uterine anomalies in the general and the infertile population is not accurately known, albeit several sources of evidence indicate that these are not uncommon. The frequency varies, according to the source, from 1 out of 10 to 1 out of 1600 patients (Green and Harris, 1976; Heinonen et al., 1982; Golan et al., 1989). The discrepancy between previous reports is due to inaccurate diagnostic methods, the lack of a uniform system of classification, and because many of these defects are asymptomatic and therefore remain undiagnosed. Recently, the incidence of uterine anomalies in a fertile population [women undergoing tubal sterilization and hysterosalpingography (HSG) 5 months later to evaluate tubal patency] was found to be 3.2% (Simon et al., 1991).

We carried out a retrospective study of 3190 patients in whom HSG and laparoscopy or laparotomy were performed between 1980–1995 (F.Raga, C.Simon and A.Pellicer, unpublished observations). Three groups were included in the study population: (i) fertile population (n = 1289). These were patients with normal reproductive outcome who were treated at the family planning clinics. At 5 months after surgery, all patients underwent HSG to check tubal patency; (ii) infertile population (n = 868). These were patients attending the fertility clinic due to infertility problems ranging from recurrent spontaneous abortion to pre-term delivery. Only couples with two or more consecutive pregnancy losses were included as infertile; (iii) sterile population (n = 1024). These were patients who were also attending the fertility clinic due to failure to achieve pregnancy for >2 years. In these patients, HSG and diagnostic laparoscopy were performed during the infertility work-up. The uterine malformations were grouped and classified according to the clinical classification proposed by the American Fertility Society (1988).

We confirmed that the frequency of uterine malformations in fertile patients is 3.8%. In a previous study, we demonstrated that the reproductive performance of malformed uteri in women subjected to tubal sterilization was exactly the same as that in patients with normal uteri, providing the scientific basis for assuming that Mullerian defects can have a normal reproductive outcome (Simon et al., 1991). In the present retrospective analysis of our results, the highest incidence of uterine malformations was found in the infertile population (6.3%); this was significantly ($P < 0.05$) higher than that found in the fertile and sterile populations. However, the difference with fertile patients was not even double, suggesting that the actual reproductive potential of these uteri may not be as bad as suspected (Ansbacher, 1983; Acien, 1993). The sterile group showed the lower incidence (2.3%) of uterine malformations, and only eight of them (6.2% of all uterine anomalies) presented with primary sterility and no other associated problem.

We observed that septate and arcuate uteri represented ~75% of the malformations, while bicornuate, didelphys and unicornuate comprised the remaining 25%. This is of clinical interest, as the former (75%) can be easily managed by hysteroscopy, while the later need more complicated procedures (Pelosi and Pelosi, 1996) or have no surgical approach. The question is still whether a given malformation should or should not be operated. The answer to that will depend on the obstetric history of this particular patient and the general prognosis of a given malformation.

In this debate we have invited several leaders in the field to discuss their expertise and to draw their own conclusions on the need to operate Mullerian defects. Pedro Acien (1997) has analysed the incidence of such anomalies based on his experience and on a detailed review of the literature. Lisa Jacobsen and Alan DeCherney (1997) have discussed the advantages of the new metroplastic procedures and Jacques Donnez (1997) has documented his experience using modern tools for hysteroscopic metroplasty. We expect to get clear indications of who, when and how to operate when a uterine malformation is diagnosed.

**References**


Incidence of Mullerian defects in fertile and infertile women

Pedro Acien

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Although uterine anomalies have been reported in 0.1–2% of all women, in 4% of those with infertility and in up to 15% of those with recurrent abortion (March, 1990), their true incidence is not known. The more liberal use of hysterosalpingography and hysteroscopy, and the routine practice of ultrasonography, and more recently, transvaginal ultrasound scanning (TVS) and transvaginal three-dimensional ultrasound (TDU) have led to an apparent increase in the incidence and, currently, the figures cited above could be higher. In any case, there are no modern studies on the incidence of uterine anomalies in the general population, and those on fertile and infertile women, or with recurrent pregnancy loss (RPL), have reported conspicuously varied results. This variability in the reported incidence of uterine anomalies is due to the fact that it depends on the following variables: (i) the population studied (gynaecological patients, those referred for metroplasty, fertile, infertile or recurrent miscarriage women). In RPL patients, in whom the uterine malformations are more frequent, the incidence of anomalies depends on the inclusion criteria for RPL (two, three or more, late abortions, immature deliveries); (ii) the prospective or retrospective character of the investigation, directed search and physician interest and awareness to find or reject an uterine anomaly, because most of the uterine malformations are clinically silent; (iii) the diagnostic methods used. Hysterosalpingography (HSG) (and hysteroscopy) are the best general diagnostic tools for uterine anomalies, but they must be complemented with laparoscopy and/or others (magnetic resonance, pyelography) for a correct diagnosis in most classes of Mullerian anomalies. However, HSG and hysteroscopy are only indicated in infertility investigation, special clinical situations or suspected malformation. Currently, the routine transvaginal echography (TVS) evaluating the external shape of the uterus and, specifically, the presence of a median endouterine septum at any point along its longitudinal axis, is the best screening method (Nasri et al., 1990). More recently, three-dimensional ultrasound has also shown its usefulness in a clinical setting to diagnose and classify Mullerian anomalies (Jurkovic et al., 1995; Raga et al., 1996); (iv) the classes included as congenital uterine anomalies in the different reported series. Hypoplastic, T-shaped, diethylstilbestrol-exposed women (DES)-related anomalies and arcuate uterus are frequently not included. In the present communication they are included as ‘minor uterine anomalies’ in spite of many cases causing frequent fertility problems (Acien, 1996). However, with the screening methods used (TVS) their identification may not be straight forward, or (with HSG) many cases could be classified as normal or abnormal depending on the observer, apart from a dependance on exposure (Sorensen, 1981). Logically, the cases with Mullerian agenesia are excluded from the series where fertility problems are analysed; (v) the criteria and diagnostic tools used to classify the different types of uterine malformations clinically well recognized (e.g. subseptus–septate versus bicornuate uterus, or bicornis bicornis versus didelphys uterus), in spite of both following the American Fertility Society (AFS, 1988) classification of Mullerian anomalies, or the similar one from Buttram (Buttram and Gibbons, 1979; Buttram, 1983; Buttram and Reiter, 1985). We carefully observed the external shape of the uterus in laparoscopy, and if it had any visible depression on the middle part of the fundic uterine wall accompanied by an overall widening, it was classified as bicornuate uterus (Acien, 1993). Some of these cases are possibly classified as subseptus or septate uteri by other authors. Similarly, the distinction between arcuate and mildly subseptate or mildly bicornuate uterus is controversial (Sorensen, 1981).
Should we operate on Mullerian defects?

Table I. Incidence of congenital Mullerian anomalies in women consulting for contraception, in women with recurrent miscarriage or subfertility, and infertile patients. Values in parentheses are percentages

<table>
<thead>
<tr>
<th>No. women studied</th>
<th>Women with Mullerian anomalies&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Minor uterine anomalies&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Uterine malformations clinically well recognized</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hypoplastic</td>
<td>Arcuate</td>
</tr>
<tr>
<td>Women without previous pregnancy (single or married)</td>
<td>72</td>
<td>13 (18)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>(1.4)</td>
</tr>
<tr>
<td>Women with previous pregnancies and live newborns</td>
<td>131</td>
<td>9 (6.9)</td>
<td>3 (2.3)</td>
</tr>
<tr>
<td>Women with live newborns and some reproductive loss</td>
<td>38</td>
<td>4 (10.5)</td>
<td>1 (2.6)</td>
</tr>
<tr>
<td>Total for contraception</td>
<td>241</td>
<td>26 (10.8)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5 (2.1)</td>
</tr>
<tr>
<td>Recurrent miscarriage and subfertility (infertility and miscarriage)</td>
<td>59</td>
<td>15 (25.4)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>6 (10.2)</td>
</tr>
<tr>
<td>Infertile women</td>
<td>200</td>
<td>32 (16)</td>
<td>12 (6)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Diagnosis was made by transvaginal echography in all women, plus hysterosalpingography in 188 women (37.6%) (75% in uterine anomalies), and laparoscopy or laparotomy in 79 women (15.8%) (28% in uterine anomalies).

<sup>b</sup>Ten cases suggesting DES syndrome.

<sup>c</sup>No cases of bicornis–bicollis uterus.

<sup>d</sup>P<sub>.05</sub> with respect to previous pregnancies.

<sup>e</sup>P<sub>.05</sub> between women for contraception and recurrent miscarriage or subfertility.

Table II. Incidence of congenital Mullerian defects in the general population, various obstetric and gynaecological indications, and in fertile women: review of the literature. Values in parentheses are percentages

<table>
<thead>
<tr>
<th>Reference</th>
<th>Population studied</th>
<th>No. women studied</th>
<th>No. Mullerian defects detected</th>
<th>Diagnostic methods</th>
<th>Minor Mullerian defects</th>
<th>Clear uterine malformations</th>
<th>Percentage uterine malformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunselman, 1959</td>
<td>General</td>
<td>–</td>
<td>– (1.5)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Strassman, 1961</td>
<td>General</td>
<td>–</td>
<td>– (0.1)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Strassman, 1966</td>
<td>No specified</td>
<td>6.888</td>
<td>– (1.1–3.5)</td>
<td>HSG</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Moore, 1941</td>
<td>All private patients</td>
<td>–</td>
<td>– (0.2)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Greiss and Maury, 1961</td>
<td>Women postpartum</td>
<td>–</td>
<td>– (3)</td>
<td>Manual exam</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Green and Harris, 1976</td>
<td>Premature and abnormal deliveries in the total of deliveries</td>
<td>31.836</td>
<td>80 (0.25)</td>
<td>HSG/exam</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Nasti et al., 1990</td>
<td>Varied indications</td>
<td>300</td>
<td>8 (2.7)</td>
<td>Transvaginal echography</td>
<td>–</td>
<td>8</td>
<td>2.7</td>
</tr>
<tr>
<td>Maneschi et al., 1995</td>
<td>Abnormal uterine bleeding</td>
<td>322</td>
<td>32 (10)</td>
<td>Hysteroscopy</td>
<td>21</td>
<td>11</td>
<td>3.4</td>
</tr>
<tr>
<td>Ashton et al., 1988</td>
<td>Transcervical tubal sterilization</td>
<td>840</td>
<td>19 (2.3)</td>
<td>Hysteroscopy HSG</td>
<td>3</td>
<td>16</td>
<td>1.9</td>
</tr>
<tr>
<td>Simon et al., 1991</td>
<td>Fertile, for tubal sterilization</td>
<td>679</td>
<td>22 (3.2)</td>
<td>Laparoscopy HSG</td>
<td>Excluded</td>
<td>22</td>
<td>3.2</td>
</tr>
</tbody>
</table>

HSG = hysterosalpingography.

recurrent miscarriage (Acien, 1996); not included were nine other cases with Mullerian agenesis (Rokitansky’s syndrome).

Incidence of Mullerian defects in the general population

There are few studies analysing the incidence of uterine anomalies in the general population of women, and to our knowledge, none of them in the last 30 years. In the literature (Buttram and Reiter, 1985; Coll et al., 1988; others) there are references to papers by Strassman (1961) with an incidence of 0.1%, or by Dunselman (1959) with an incidence of 1.5%, although the diagnostic methods used were not stated. Strassman (1966), who found Mullerian defects in 1.1–3.5% of 6888 women with hysterosalpingography, did not specify the studied population, either (Buttram and Reiter, 1985). Instead of representing the general population they seem to be gynaecological cases consulting because of specific symptoms and in this way Moore (1941) found uterine anomalies in 0.2% of all his private practice patients. These cases were collected using the diagnostic methods of that time and, in most cases, comprised only a physical examination (Table II).

If we consider that young women without a previous pregnancy who consult for contraception (generally pill) could be representative of the general population of menstruating
Incidence of congenital Müllerian defects in women with recurrent pregnancy loss (RPL) or infertility (I): review of the literature. Values in parentheses are percentages

<table>
<thead>
<tr>
<th>Reference</th>
<th>Population studied</th>
<th>No. women studied</th>
<th>No. Mullerian defects detected</th>
<th>Diagnostic methods</th>
<th>Minor Mullerian defects</th>
<th>Clear uterine malformations</th>
<th>Percentage uterine malformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tho et al., 1979</td>
<td>RPL</td>
<td>100</td>
<td>14 (14)</td>
<td>HSG</td>
<td>4 (CI)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Harger et al., 1983</td>
<td>RPL</td>
<td>155</td>
<td>19 (12.3)</td>
<td>HSG/hysteroscopy</td>
<td>10</td>
<td>9</td>
<td>5.8</td>
</tr>
<tr>
<td>Coulam, 1986</td>
<td>RPL</td>
<td>110</td>
<td>11 (10)</td>
<td>HSG</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Makino et al., 1992a</td>
<td>RPL</td>
<td>1200</td>
<td>188 (15.7)</td>
<td>HSG</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Makino et al., 1992b</td>
<td>RPL</td>
<td>1000</td>
<td>147 (14.7)</td>
<td>HSG</td>
<td>95</td>
<td>52</td>
<td>5.2</td>
</tr>
<tr>
<td>Hatsaka, 1994</td>
<td>RPL</td>
<td>158</td>
<td>(6)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Razi et al., 1994</td>
<td>RPL</td>
<td>106</td>
<td>19 (18)</td>
<td>HSG/hysteroscopy</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Clifford et al., 1994</td>
<td>RPL</td>
<td>500</td>
<td>9 (1.8)</td>
<td>HSG/echo</td>
<td>9</td>
<td>1.8</td>
<td>–</td>
</tr>
<tr>
<td>Jurkovic et al., 1995</td>
<td>RPL</td>
<td>61</td>
<td>12 (19.7)</td>
<td>HSG/echo–TDU</td>
<td>9</td>
<td>3</td>
<td>4.9</td>
</tr>
<tr>
<td>Acien, 1996</td>
<td>RPL</td>
<td>189</td>
<td>71 (37.6)</td>
<td>HSG/other</td>
<td>33</td>
<td>38</td>
<td>20.1</td>
</tr>
<tr>
<td>Tulandi et al., 1980</td>
<td>I</td>
<td>2240</td>
<td>23 (1.03)</td>
<td>HSG</td>
<td>7</td>
<td>16</td>
<td>0.7</td>
</tr>
<tr>
<td>Sorensen, 1981</td>
<td>I</td>
<td>134</td>
<td>32 (23.9)</td>
<td>HSG</td>
<td>29</td>
<td>3</td>
<td>2.2</td>
</tr>
<tr>
<td>Raga et al., 1996</td>
<td>I</td>
<td>42</td>
<td>12 (26.2)</td>
<td>Echo–TDU HSG, lap</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*Minor Mullerian defects include arcuate, T-shaped and hypoplastic uterus.
CI = cervical insufficiency; TDU = tridimensional ultrasound; HSG = hysterosalpingography; echo = echography; lap = laparoscopy.

Incidence of Müllerian defects in fertile women

This incidence is quite similar to that observed in fertile women, at least with respect to clear uterine malformations. It agrees with previous references pointing out that the frequency of infertility is not significantly increased in uterine malformations (Acien, 1993). There seem to be more cases of ‘minor Mullerian anomalies’ related to infertility. Tulandi et al. (1980) found Mullerian defects in only 1% of 2240 infertile women by HSG, while Sorensen (1981) observed an incidence of 23.9%, although only 2.2% had major uterine malformations. Also Raga et al. (1996) observed Mullerian defects in 26.2% of 42 infertile women by transvaginal TDU, although it is possible that this was a selected group of patients (Table III).

Incidence of Mullerian defects in infertile women

Women (we do not know if they will be fertile or infertile in the future, although cases with Mullerian agenesis or gonadal disgenesis would be excluded), in those women we found a possible uterine anomaly (chiefly an arcuate uterus) in 18%. However, there were still 5.6% (4/72) with a clinically well recognized uterine malformation. Therefore, the incidence of Mullerian defects in the general population of women in our area must be ≥5%.

Incidence of Mullerian defects in fertile women

Green and Harris (1976) carried out physical examinations and HSG 6–8 weeks post-partum in 31 836 patients with premature labour or abnormal fetal presentation found 80 cases with an uterine anomaly (0.25%). However, later studies on fertile women for tubal sterilization found a higher incidence (Table II). Ashton et al. (1988) observed 2.3% (1.9% if the cases with arcuate uterus are excluded) of uterine anomalies in 840 women, with hysteroscopy and HSG, and Simon et al. (1991) found 3.2% of uterine malformations (minor classes excluded) in 679 women with laparoscopy for tubal sterilization and then HSG.

In 169 fertile women consulting for contraception (pill or intrauterine device), we have found 7.7% of uterine anomalies, although only 2.4% had evident uterine malformations (minor classes excluded). This incidence was higher when the women had some reproductive loss among the obstetric antecedents (see Table I).

In other gynaecological indications, 2.7% of uterine malformations have been observed with TVS (Nasri et al., 1990), and 10% with hysteroscopy (but 3.4% if the minor classes are excluded) (Maneschi et al., 1995). Therefore, ~3% of fertile women have an uterine malformation, but this figure is higher if the minor uterine anomalies are included.

Incidence of Mullerian defects in infertile women

This incidence is quite similar to that observed in fertile women, at least with respect to clear uterine malformations. It agrees with previous references pointing out that the frequency of infertility is not significantly increased in uterine malformations (Acien, 1993). There seem to be more cases of ‘minor Mullerian anomalies’ related to infertility. Tulandi et al. (1980) found Mullerian defects in only 1% of 2240 infertile women by HSG, while Sorensen (1981) observed an incidence of 23.9%, although only 2.2% had major uterine malformations. Also Raga et al. (1996) observed Mullerian defects in 26.2% of 42 infertile women by transvaginal TDU, although it is possible that this was a selected group of patients (Table III).

In 200 infertile women in our study population, we found uterine anomalies in 16%, but only 3% were evident uterine malformations, without significant differences from those women consulting for contraception (see Table I). Some authors (Ugur et al., 1995) have found a higher incidence of polycystic ovarian disease in women with uterine malformations, but we found no such relationship.
Incidence of Mullerian defects in women with recurrent miscarriage

In this group of patients uterine anomalies are diagnosed more frequently, the incidence being 1.8–37.6% (see Table III). However, clear uterine malformations have been reported in 1.8–20.1% of cases. This higher incidence has been found by us (Acien, 1996), but it is necessary to point out that: (i) cases of late abortion and immature delivery, in which the incidence of uterine malformations is higher (43%), were included, and (ii) that incidence was 14.7% considering only cases with complete study for RPL and including arcuate uterus. In all, 36% of the uterine malformations had an associated cervical insufficiency. The conclusions were that the uterine malformations, specially arcuate and bicornuate uterus, are observed in more than 15% of patients with RPL, and even more frequently when late abortions or immature deliveries are included. But these findings were also related to cervical incompetence that is frequently associated with uterine malformation. In other cases of congenital uterine anomalies with early abortions, these were more probably caused by other associated factors (e.g. luteal insufficiency, immunological) that seem to be more common in patients with Mullerian anomaly.

In the 59 cases of recurrent miscarriage or subfertility analysed in Table I, uterine anomalies comprised 25.4%, including hypoplastic and arcuate uterus, but only 5.1% if these minor anomalies were excluded.

From a different viewpoint, patients with Mullerian defects have miscarriages among their obstetric antecedents more frequently than women with a normal uterus (56 versus 21.4%; Acien, 1996). In Table IV it can be seen that in the 500 cases of fertile and infertile women analysed in Table I, the women with uterine anomalies had antecedents of reproductive losses significantly more frequently than women with a normal uterus, and therefore, a lower percentage of live newborns. Therefore, either directly or indirectly, Mullerian defects are a cause of miscarriage, and the incidence of Mullerian defects among women with recurrent abortions is increased compared with fertile women. That incidence seems to be ~25% although clear uterine malformations (excluded hypoplastic and arcuate uterus) are observed in only 5–10% of cases (and >25% in cases with late abortions and/or immature deliveries).

Distribution of Mullerian defects

Table V shows this distribution in different reported series, and the mean percentage among them, for each type of uterine anomaly. The class most frequently diagnosed was bicornis–unicollis uterus (37%), followed by arcuate (15%), subseptate (13%), didelphys (11%), bicornis–bicornis (9%), complete septate (9%), and unicornuate uterus (4.4%). The frequency of Mullerian agenesis was ~4%.

Conclusions

From the review of the literature and our own cases, we can conclude that if the minor uterine anomalies (hypoplastic, arcuate uterus) are included, the incidence of Mullerian defects varies currently between 7–8% of the normal fertile population and >25% of women with recurrent miscarriage. However, clear uterine malformations are observed in 5% of the general population, in 2–3% of fertile women, in 3% of inferte women, and in 5–10% of patients with recurrent miscarriage, being >25% in cases with late abortions and immature deliveries. The uterine malformation most frequently diagnosed is the bicornuate uterus, although particularly in patients with
abruptions, minor uterine anomalies are probably diagnosed more frequently.

Acknowledgements

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References


Results of conventional and hysteroscopic surgery

Lisa Jane Jacobsen1,3 and Alan DeCherney2

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...Mullerian anomalies usually come to medical attention when they become problematic and require treatment. Most of these complications require surgical correction. The most commonly presenting anomaly is the double uterus which can be the source of recurrent abortion and preterm deliveries. The Strassmann, Jones and Tompkins metaplasties have been shown to greatly improve the rate of successful deliveries in these patients. Hysteroscopic metaplasty, using either scissors, resectoscope or laser is now the recommended treatment for most septic uteri
Obstructing Mullerian anomalies

Patients with a transverse vaginal septum, uterine didelphys with an obstructed hemivagina, or a non-communicating uterine horn containing functioning endometrial tissue, often present with pain from a haematometra. In these situations, the vaginal septum or rudimentary horn needs to be excised to remove the obstruction. These are often emergent situations where surgery needs to be performed expeditiously to relieve discomfort and lessen the chance of retrograde seeding of endometrial tissue into the pelvis. Endometriosis from an obstruction can significantly lower the chance of attaining a pregnancy in the future. In a study of 26 patients who underwent surgery for complete transverse vaginal septa, only seven out of 19 patients attempting pregnancy eventually had children (Rock et al., 1982). The surgery did, however, establish vaginal patency and coital function in all.

Congenital absence of the vagina

Several successful therapies have been used to create a neovagina in patients with congenital absence of the uterus and vagina (Jacobsen and DeCherney, 1996). Many young women are good candidates for non-surgical treatments, such as the Frank dilator technique (Frank, 1938), which has been shown to successfully create an adequate vagina in 4–6 months in patients who are compliant with treatment (Wabrek et al., 1971; Copeland, 1993). In those patients who do not want to undergo this time-consuming regimen, surgical options exist. Although bowel (Turner-Warwick and Kirby, 1990; Hendren, 1994), myocutaneous grafts (Hatch, 1984; Copeland et al., 1989) and reconstruction of the vulva to create an external pouch (Williams, 1964) have been used to create a neovagina, gynaecologists have found most success with the McIndoe procedure (McIndoe, 1950). This technique involves covering a soft, oblong mold with a split-thickness skin graft and placing it into a cavity which has been surgically created between the bladder and rectum. Success rates of 75–93% have been reported with this procedure (Counsellor, 1948; McIndoe, 1950; Evans, 1967; Cali and Pratt, 1968).

In rare cases where there is an absent vagina but a functioning uterus is present, the traditional advice has been to perform a hysterectomy at the time the neovagina is created (Maciulla et al., 1978; Rock, 1996). Many attempts to connect a surgically-created vagina to a uterus containing endometrium have resulted in recurrent stenosis of the tract, sepsis, repeated surgical procedures and eventual hysterectomy. However, a small number of pregnancies have been reported (Solomons, 1956; Singh and Devi, 1983; Bates and Wiser, 1985; Hampton et al., 1990), which has led some to believe that this procedure may be successful in select circumstances. Rock (1995) has proposed that in cases where there is cervical dysgenesis, but not complete agenesis, women may benefit from a reconstruction operation.

Metroplasty for the ‘double uterus’

The most frequently encountered Mullerian anomalies are symmetrical uterine defects such as the uterine didelphys, bicornuate uterus or septate uterus. Although the majority of patients with uterine anomalies are able to conceive and carry a pregnancy to term without difficulty, 20% of these patients have reproductive problems (Rock and Jones, 1977). The incidence of spontaneous abortions and premature birth are clearly increased when a uterine anomaly is present (Rock, 1992). Since the first surgery to remove a septum in the late 1800s, several different surgical techniques have been developed to convert a ‘double uterus’ into a single uterine cavity. These procedures have been well evaluated and demonstrate impressive success rates. Hysteroscopic techniques for the resection of septa have demonstrated equally good results in the future. In a study of 26 patients who underwent surgery for complete transverse vaginal septa, only seven out of 19 patients attempting pregnancy eventually had children (Rock et al., 1982). The surgery did, however, establish vaginal patency and coital function in all.

Abdominal metroplasty

The first report of a technique to repair an anomalous uterus was by Ruge (1884) who described a blind transcervical division of a septum in a patient with pregnancy wastage. This woman had undergone two abortions prior to surgery but subsequently carried a pregnancy to term. In 1907, Paul Strassman introduced his operation for excision of a septum or unification of a bicornuate uterus using either a vaginal or abdominal approach. His technique involved a fundal transverse incision that extended from one cornua to the other and exposed the uterine cavities. This was followed by a vertical closure which often brought the two cornua together. His first patient had experienced eight premature deliveries or miscarriages prior to the operation. After the metroplasty, she had six full-term vaginal deliveries. His son, Erwin Strassman, revived the procedure in 1952 when he wrote about his own experience using the abdominal approach as well as a review of 123 cases collected from the world literature. After surgery, the percentage of deliveries carried to term rose from 4 to


Table I. Fetal survival rates before and after abdominal metroplasty. Figures in parentheses are percentages

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Type of uterus</th>
<th>Type of surgery</th>
<th>Indications for surgery</th>
<th>Pre-operative fetal survival rate live births/pregnancies (%)</th>
<th>Post-operative fetal survival rate live births/pregnancies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candiani et al., 1990</td>
<td>144</td>
<td>septate 73</td>
<td>Tompkins 42</td>
<td>55</td>
<td>71</td>
</tr>
<tr>
<td>Ayhan et al., 1992</td>
<td>89</td>
<td>septate 49</td>
<td>Tompkins 89</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>Helm and Sorensen, 1988</td>
<td>22</td>
<td>septate 17</td>
<td>Tompkins 6</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Kessler et al., 1986</td>
<td>17</td>
<td>septate 4</td>
<td>Tompkins 1 secondary</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Kusuda, 1986</td>
<td>25</td>
<td>arcuate 2</td>
<td>Tompkins 3 one</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Mercer et al., 1981</td>
<td>17</td>
<td>septate 15</td>
<td>Jones 4</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Musich and Behrman, 1978</td>
<td>21</td>
<td>arcuate 3</td>
<td>Tompkins 1 anomaly</td>
<td>12</td>
<td>1</td>
</tr>
</tbody>
</table>

SAB = spontaneous abortion; PTD = preterm delivery.

Table II. Fetal survival rates before and after hysteroscopic metroplasty. Figures in parentheses are percentages

<table>
<thead>
<tr>
<th># Pts</th>
<th>Method</th>
<th>Indication</th>
<th>Pre-operative fetal survival rate live births/pregnancies (%)</th>
<th>Post-operative fetal survival rate live births/pregnancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeCherney et al., 1986</td>
<td>72</td>
<td>resectoscope 72</td>
<td>recurrent SABs</td>
<td>not reported</td>
</tr>
<tr>
<td>Valle and Sciarra, 1986</td>
<td>12</td>
<td>scissors 12</td>
<td>recurrent SABs</td>
<td>3/42 (7)</td>
</tr>
<tr>
<td>Perino et al., 1987</td>
<td>24</td>
<td>scissors 16</td>
<td>recurrent SABs</td>
<td>3/27 (11), SAB group</td>
</tr>
<tr>
<td>Daly et al., 1989</td>
<td>55</td>
<td>scissors 55</td>
<td>recurrent SABs or PTD</td>
<td>not reported</td>
</tr>
<tr>
<td>Choe and Baggish, 1992</td>
<td>19</td>
<td>laser 12</td>
<td>recurrent SABs</td>
<td>4/38 (11)</td>
</tr>
<tr>
<td>Fayez, 1986</td>
<td>19</td>
<td>scissors 12</td>
<td>recurrent SABs</td>
<td>not reported</td>
</tr>
</tbody>
</table>

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85.6% and the percentage of miscarriages dropped from 69 to 12%.

In 1953, Jones and Jones described a method which used a wide wedge-shaped incision at the fundus to excise the septum. It was thought that this technique resulted in less bleeding and less deformation of the uterine fundus than the Strassman procedure. Commencing in 1936, 43 patients with a septate uterus and poor reproductive histories underwent the Jones metroplasty and the term pregnancy rate increased from 0 to 73%. A total of 77% patients had a living child after surgery. A more recent series by Jones (Muasher, et al., 1984) confirmed the previous findings; 67% of patients with a history of recurrent abortions had living children or pregnancies in the third trimester compared with the preoperative fetal wastage rate of 94%.

In 1959, Bret and Guillet introduced an operation which involved incising rather than excising the septum. No uterine tissue was removed so that the size of the uterine cavity could be maintained. Tompkins separately proposed a similar operation in 1962 and the procedure was given his name. This simple technique resulted in very little blood loss and left the muscle of the uterus intact. McShane et al. (1983) reported
that 71% of habitual aborters had viable pregnancies after this procedure. Gray et al. (1984) found that the pregnancy salvage rate rose from 6.2 to 77.8%.

Although other series have been published which report the results of abdominal metroplasty, most do not distinguish between the various techniques. Patients undergoing the Strassman, Jones or Tompkins technique are grouped together so that it is not possible to ascertain whether one procedure is superior to another. It is also difficult to evaluate whether surgery improves the outcome for one anomaly more than another because most series do not differentiate between patients with septate uteri, bicornuate uteri and uterus didelphys. In addition, some studies include infertility patients as subjects which can complicate the interpretation of results. Infertility is not a uniformly accepted indication for abdominal metroplasty. These patients are usually only included when a thorough work-up has revealed no other aetiology for their infertility or in an effort to avoid the risk of fetal loss if a pregnancy is ever achieved. The important outcome evaluated in these patients is whether pregnancy rates are improved after surgery. However, this is not the concern in patients with recurrent fetal loss who are able to conceive without difficulty but cannot maintain the pregnancy. Infertility patients who become pregnant should be less likely to suffer a fetal loss given that only 20% of patients with a double uterus have obstetric complications.

Table I summarizes results from several series (Musich and Behrman, 1978; Mercer et al., 1981; Kusuda, 1982; Kessler et al., 1986; Helm and Sorensen, 1988; Candiani et al., 1990; Ayhan et al., 1992). These studies included different types of uteri and various surgical techniques. Although most studies had histories of recurrent fetal loss, some were infertility patients and some had a history of only one prior loss. The percentage of successful pregnancies in these studies increased from a pre-operative range of 0–14.3% to 65–93% post-operatively. The two studies that differentiated between separated out patients with septate versus bicornuate uteri showed similar results after metroplasty in the two groups (Candiani et al., 1990; Ayhan et al., 1992).

Hysteroscopic metroplasty

Transcervical therapy for the septate uterus was first described by Hirsh (1919) and Luikart (1936). The cervix was dilated and the septum was then identified and incised with scissors. In each of the case reports, the patients conceived, carried to term and delivered vaginally. This procedure is still performed today using ultrasound and endoscopic scissors, and proponents of this method cite the easy estimation of fundal thickness, the potential resection regardless of the stage of the menstrual cycle and avoidance of costly equipment (Ohl and Bettalar-Lebugle, 1996). Edstrom described the first hysteroscopic resection of a septum in 1974 and used biopsy forceps to resect the septum piecemeal. In 1981, Chervenak and Neuwirth reported two successful hysteroscopic resections using very fine scissors. In 1983, DeCherney and Polan described the surgical ablation of uterine septa with the use of the resectoscope and reported successful pregnancies in nine out of 11 patients treated in this manner. Several other large series were reported during the 1980s which demonstrated success rates equivalent to those of the established abdominal procedures. Valle and Scala (1986) performed 12 hysteroscopic resections in women with a history of repetitive pregnancy loss and, of the 10 that conceived post-operatively, eight delivered live infants at term. In a study by Perino et al. (1987), reported 11 out of 16 women with a history of recurrent abortions conceived after surgery, 10 of whom delivered at term. DeCherney et al. (1986) reported that 86% of pregnancies after hysteroscopic resection resulted in live births, while Daly et al. (1989) reported a rate of 80%. Fayez (1986) compared the Tompkins procedure with hysteroscopic metroplasty and found a 70% term pregnancy rate in his patients who had abdominal surgery in comparison with 87% in the other group. The results were not significantly different. Recently, the laser has been used in hysteroscopic resection with good results (Choe and Baggish, 1992). Table II summarizes the results of these series.

Hysteroscopic metroplasty has demonstrated several advantages over the conventional abdominal procedures. The primary advantage is the avoidance of a laparotomy. Anaesthesia time is shortened since the procedure, even with concomitant laparoscopy, can be completed within 20–60 min (Fayez, 1986; Choe and Baggish, 1992). Perino et al. (1987) reported that 23 out of 24 cases were completed in <20 min. The risk of infection is greatly reduced. Pelvic adhesions, which have been reported to occur after abdominal metroplasty, are not a concern. There is no significant blood loss as there sometimes is with the abdominal procedures. Recovery time is shortened substantially; most patients return to their usual activities within 1–2 days. After surgery, couples can attempt pregnancy after one cycle instead of having to wait 3–9 months as with abdominal metroplasty. A uterine incision is avoided with hysteroscopic metroplasty which means that women who subsequently become pregnant may attempt a vaginal delivery rather than undergoing a Caesarean section.

Daly et al. (1989) compared abdominal metroplasty with hysteroscopic metroplasty to see which procedure was more cost-effective. The initial hysteroscopic procedure was 60% less expensive than an abdominal metroplasty because it was performed as ambulatory surgery. Each term gestation that followed was 32% less expensive because the majority of deliveries were vaginal. In addition, the time lost from work was only 2–4 days instead of the 4–6 weeks after an abdominal metroplasty, which lowered costs to the employers.

Choosing the appropriate metroplasty procedure

With its numerous advantages, hysteroscopic metroplasty has become the most widely used procedure to repair uterine septa in women with no other pelvic pathology requiring surgery. As it is minimally invasive, some groups advocate its use in patients with primary infertility, in addition to those with recurrent fetal loss, in order to decrease potential obstetrical complications should a pregnancy be achieved. There are some drawbacks to the procedure, however, including uterine perforations and the need for availability of costly hysteroscopic equipment. Sometimes a repeat hysteroscopy is needed.
if bleeding obscures the operative field prior to completion of the incision, or if post-operative hysterosalpingography reveals that the septum is not completely resected. Some septa, such as complete septa or septa with a broad base, are more difficult to resect hysteroscopically and may benefit more from the abdominal approach. Daly et al. (1983) described a technique for hysteroscopic resection of the complete septum by creating a window at the level of the internal os with an ancillary probe inserted from the opposite cervical canal. This procedure produced as good an anatomical result as that obtained with a Jones or Tompkins metroplasty.

Patients who have other pelvic pathology contributing to their infertility in addition to their uterine septum may benefit from an abdominal metroplasty. If endometriosis, uterine fibroids, tubal occlusion or pelvic adhesions are present and require surgical correction via laparotomy, both procedures should be performed through an abdominal incision (Khalifa et al., 1993). Those skilled in operative laparoscopy, however, may be able to perform both procedures endoscopically.

For those patients with septa requiring abdominal metroplasty, the Jones and Tompkins procedures are most frequently used. The Strassman technique is the only operation described to treat the bicornuate uterus or uterus didelphys, but it is rarely used to treat the septate uterus because of increased bleeding and a wedge-shaped deformation of the fundus that often occurs. In addition, the procedure brings the tubal ostia very close together in an unnatural position on the fundus of the uterus. The Tompkins procedure is preferred by some over the Jones technique because no myometrium is removed which results in a larger uterine cavity. It also maintains the most anatomically normal position of the tubal ostia, it is relatively bloodless and technically simple. With this method, the septum is simply incised and not excised as in the Jones procedure. Some believe that removing all of the septum is important so that the endometrium will be reaproximated and there will be no fibrous septal tissue on the wall of the uterine cavity. Both techniques are used frequently and the decision as to which to perform depends mostly on which procedure the surgeon has acquired competence in.

Conclusion

 Mullerian anomalies usually come to medical attention when they become problematic and require treatment. Most of these complications require surgical correction. The most commonly presenting anomaly is the double uterus which can be a source of recurrent abortion and preterm deliveries. The Strassman, Jones and Tompkins metroplasties have been shown to greatly improve the rate of successful deliveries in these patients. Hysteroscopic metroplasty, using either scissors, resectoscope or laser is now the recommended treatment for most septate uteri due to its relative simplicity, low morbidity and excellent reproductive outcome.

References


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Endoscopic laser treatment of uterine malformations

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*To whom correspondence should be addressed

Hysteroscopic resection of an intrauterine septum may benefit patients suffering from infertility or recurrent pregnancy loss. A partial or complete uterine septum can be easily resected using a Nd–YAG laser. If present, the vaginal septum may also be removed during the same procedure. The reproductive outcome of women treated by operative hysteroscopy for an intrauterine septum is reviewed. To avoid pregnancy in a non-communicating rudimentary horn, the removal of the horn and the homolateral tube may be performed by either bipolar coagulation or a CO2 laser.

Key words: endoscopy/hysteroscopy/intrauterine septum/Nd–YAG laser/resection

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Many Mullerian fusion defects are amenable to hysteroscopic treatment. Several different procedures have been adopted, with more or less similar results. The basic concept involves the transcervical observation of the uterine septum by means of hysteroscopy, followed by its resection (Chervenak and Neurwirth, 1981; Valle and Sciarra, 1986; Gallinat, 1993). The use of an operative hysteroscope permits the passage of surgical instruments.

Uterine septum: partial and complete

Prevalence and diagnosis

Uterine septum is the most common Mullerian fusion defect. Its incidence in the general population is estimated to be 1.8% (Ashton et al., 1988).

Between 1986 and 1996, in our department, 170 patients underwent a hysteroscopic septoplasty with the help of the Nd–YAG laser (Table I). In 83% of cases (141/170), the uterine septum was partial (Figure 1) and in 17% of cases (29/170), the uterine septum was complete with cervical duplication. A vaginal septum was noted in 15 cases (9%). The diagnosis of a complete uterine septum may be delayed, particularly if a vaginal septum is associated (Nisolle and Donnez, 1995). Indeed, the vaginal septum can easily be misdiagnosed by gynaecological examination, and at hysterosalpingography, the uterus appears to be unicornean, unless there is a fistula between the two uterine cavities (Figure 2). However, in the absence of a vaginal septum, the diagnosis is simple because two distinct external cervical orifices are clearly visible. The opacification through these two orifices allows the diagnosis of a septate uterus with cervical duplication.

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Figure 1. Partial uterine septum: hysterography.

Table 1. Hysteroscopic septoplasty (1986–1996)

<table>
<thead>
<tr>
<th>Partial uterine septum</th>
<th>Complete uterine septum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = 141$ (83%)</td>
<td>$n = 29$ (17%)</td>
</tr>
<tr>
<td>14 (8%) no vaginal septum</td>
<td>15 (9%) vaginal septum</td>
</tr>
<tr>
<td>10 cases (1986–1993)</td>
<td>Nd–YAG laser septoplasty in</td>
</tr>
<tr>
<td></td>
<td>two steps</td>
</tr>
<tr>
<td></td>
<td>one step</td>
</tr>
</tbody>
</table>

dextran 70 or a solution of 5% dextrose; however, glycine is now preferred by most authors. This medium is not viscous, permits a clear visual field and is not a conductor of electricity. If electricity is not used, saline or Ringer’s lactate can be employed. These are well tolerated when absorbed into the system and represent an advantage of the use of the laser.

**Instruments**

Various instruments can be used for the resection of the septum: miniature scissors or semi-rigid miniature scissors permit the required pressure, but are small enough to pass through the hysteroscopic operating sheath and along the cervical canal with no difficulty or risk. The blades can be opened sufficiently wide to allow resection of even thick septa. Other surgeons (De Cherney et al., 1986; Corson and Batzer, 1986; Hamou, 1993) prefer to use the resectoscope. High frequency electric sources are advised for safety reasons.

The resectoscope has several advantages: it is inexpensive and readily available in most operating rooms, as well as being simple to operate and highly efficient at removing the septum. Finally, others (Daniell et al., 1987; Donnez and Nisolle, 1989) have suggested the use of lasers for this type of hysteroscopic surgery.

Argon, krypton, KTP 532 and Nd–YAG lasers have all been successfully employed in the resection of uterine septa; however, certain limiting factors must be taken into consideration. Firstly, hyskon should not be used because caramelization can prove troublesome and may damage the laser fibre, resulting in delay while fibres are replaced or repaired. Secondly, the surgeon must be thoroughly acquainted with the physics of the particular laser being used. Thirdly, only bare fibres should be used: CO$_2$-conducting fibres may cause bubbling of the medium which may lead to gas embolism, cardio-vascular compromise and even death.

The Nd–YAG laser uses a solid-state rig (garnet) in which the neodymium atoms play the active lasing role. The energy of the Nd–YAG laser beams propagated extraneously is supplied by a flashlight lamp which illuminates the rod. Both are housed in a container called the resonator. The shape of the resonator is ellipsoidal and its inner surface is coated with a highly reflective material. The lamp and the rod are placed at the two focal points of the ellipsoid. The light emitted by the lamp is reflected by the internal coating of the resonator and is collected, almost in its entirety, by the rod positioned at the opposite focal point.

In contrast to the CO$_2$ laser, Nd–YAG laser beams propagate well through commercially available glass fibres, very much like visible light. The propagation is effected by a chain of internal reflections occurring at the boundaries of the glass fibre. Hence, the delivery devices used in Nd–YAG lasers are a variety of fibres (see below) equipped with a connector that attaches to the output port of the laser system.

Manufacturers offer Nd–YAG laser units featuring different maximum powers of 40–100 W. Nd–YAG laser systems are composed of: (i) laser head or resonator; (ii) a power supply, which furnishes the flashlight lamp with the necessary electrical energy; (iii) a closed-circuit water-cooling system, further chilled by a radiator which removes excess heat from the resonator; (iv) a control system, based on a microcomputer; (v) a He–Ne laser tube; and (vi) an output-port optical assembly to which the external glass fibre is attached.

The accessories offered with Nd–YAG systems are almost exclusively fibres. They fall into two categories: (i) non-contact fibres, whose distal end is flat and highly polished. They operate at a short distance from the tissue, in order to create deep coagulation. A well-known example of their use is in the treatment of superficial bladder tumours, where the fibres are inserted through a cystoscope. Non-contact fibres have no incision capability. These fibres are usually reusable. However, after a limited number of surgical procedures, they must be repolished with the aid of a special polishing kit; and (ii) contact fibres, featuring a sharpened sculpted conical tip.
The laser radiation is concentrated at the very narrow tip and the fibre functions like a hot knife, capable of performing fine incisions when in contact with the tissue. Moreover, the tapered fibre prevents the rays from progressing forwards, while enabling their exit through the sides of the tip. The end result is that the forward penetration is reduced, similar to that of the CO\textsubscript{2} laser. The side radiation, on the other hand, produces a haemostatic effect on the lateral surfaces of the wedge created by the incision. Contact fibres are used in a variety of configurations for freehand and endoscopic applications. They feature different shapes (conical, hemispherical) and different diameters (400, 600, 800 and 100 µm). They are offered as disposable, single-use, sterilized fibres.

Recently, new types of fibres have been introduced onto the market. These fibres possess a polished distal face which is inclined with respect to the fibre axis. This angle enables the fibre to emit the laser beam at right angles to its long axis. Employed transurethrally, these fibres are used to treat benign prostatic hypertrophy by coagulating the adenoma. Another type of fibre, emanating lateral diffusive radiation from an elongated segment located at its distal end, is used for the interstitial laserthermia of benign and malignant lesions.

**Partial uterine septum**

With the help of the ‘bare fibre’ the surgeon begins the resection of the septum (Figure 3), continuing until it has been resected almost flush with the surrounding endometrium. Regardless of the type of medium employed, the surgeon must be able to see the right and left cornual regions completely and keep the septum in view at all times. Concurrent laparoscopy at the time of hysteroscopic resection is recommended to confirm the diagnosis but is not mandatory if the diagnosis has previously been confirmed.

The septum is cut using the ‘touch technique’ (Figure 3A,B). The hysteroscope with the laser fibre is advanced and melts away the septum, while visual contact is maintained with the right and left uterine ostia. The mean time of hysteroscopic resection is <15 min. The risk of fluid overload is therefore minimal.

The most delicate part of the procedure is probably deciding exactly when the resection is sufficient, and when continuation is likely to cause damage to the myometrium, together with either immediate complications such as perforation, or more delayed complications such as uterine rupture during pregnancy. Almost all surgeons stop resection when the area between the tubal ostia has become a line (Figure 3C). Simultaneous laparoscopic control is extremely useful for this purpose, especially for beginners. Querleu et al. (1990) used echography to distinguish the septum from the myometrium, and thus the decision to stop the resection was easily made.

**Complete uterine septum**

For many years, only partial septal defects were treated hysteroscopically and wide (>2 cm) or complete septal defects were corrected via an abdominal metroplasty. However, Donnez and Nisolle (1989) and Nisolle and Donnez, (1995, 1996), described a method that allows even complete septal defects to be managed hysteroscopically. Rock et al. (1987) proposed the use of the resectoscope for the lysis of a complete uterine septum by means of a new method which makes it possible to leave the cervical septum intact, thus avoiding any subsequent cervical incompetence. To treat a complete uterine septum, they described a one-stage method where the other cervical os is occluded with the balloon of a Foley catheter, in order to
prevent loss of the distending medium. They believe that it is better not to remove the cervical canal, since this might lead to subsequent cervical incompetence. We do not agree with this hypothesis, and all complete uterine septa are removed using the following surgical procedure, previously done in two steps, but now in one.

In some cases, not only may a double cervical canal be observed, but a vaginal sagittal septum may also be present in the upper vagina or throughout its length (Figure 4A). Firstly, the vaginal septum (if present) is resected using a CO$_2$ laser or unipolar coagulation (Figure 4B). The cervical septum is then incised with the scissors (Figure 5A) or with a CO$_2$ laser connected to a colposcope, until the lower portion of the uterine septum is seen. In the past, the second step was performed 2 months after the first operation. Now, however, Nd–YAG laser resection of the uterine septum is subsequently carried out (Figure 5C). The hysteroscope is advanced while visual contact is maintained with the right and left uterine

**Figure 4.** (A) Vaginal sagittal septum. (B) Resection of the vaginal septum using unipolar coagulation.

**Figure 5.** (A) The cervical septum is incised with the scissors. (B) The external cervical os is completely normal. (C) Dilatation of the cervical canal before the uterine septum resection.
Hamou (1993) performs a hysteroscopic procedure 1 month after surgery in order to separate any adherent tissue. A hysterosalpingography is carried out 1 month after surgery in order to separate synechiae, if necessary.

Almost all authors agree that a follow-up examination should be performed 1–2 months after the operation, irrespective of the postoperative management. Inspection can be performed either by means of hysterosalpingography or hysteroscopy. Hamou performs a hysteroscopic inspection 1 month after resection of the septum; in his opinion, this is early enough to prevent the development of synechiae.

In our department, the postoperative morphology of the uterine cavity is systematically evaluated 4 months after the resection. A hysterosalpingography is carried out 1 month after the removal of the IUD; the morphology of the uterine cavity almost always resembles an arcuate uterus. Indeed, it is preferable not to resect the septum too much, but to leave a sufficient depth of myometrium at the top of the uterus. A hysteroscopy has been performed in a first series (Donnez and Nisolle, 1989) to confirm that re-epithelialization of the resected endometrial area has occurred. Nowadays, this procedure is not systematically carried out.

### Pre- and postoperative management

Following excision of very wide septa, the surgeon’s vision may be obscured by pieces of resected tissue and, at times, by uterine bleeding. The Nd–YAG laser produces no debris and carries a reduced risk of bleeding. Several authors have suggested preoperative treatment with Danazol or luteinizing hormone-releasing hormone (LH-RH) agonists; others (Hamou, 1993) inject a solution of pitressin into the cervix. Neither pitressin nor hormone administration is required with laser therapy.

Although preoperative hormonal therapy causes atrophy of the endometrium and reduces vascularization and intraoperative bleeding, it also reduces the depth of the myometrium and therefore increases the risk of perforation and/or myometrial damage. It is suggested that surgery be performed immediately after the end of menstrual bleeding.

Postoperatively, a broad-spectrum antibiotic is administered for 3–4 days.

In order to avoid the risk of synechiae, an intrauterine device (IUD Multiload®; Organon, Oss, The Netherlands) is inserted into the uterine cavity. Hormone replacement therapy with oestrogens (100–200 µg of ethinyl oestradiol) and progestogens (5–15 mg lynestrenol, Orgametri®; Organon) is given for 3 months. De Cherney et al. (1996), however, used neither hormone replacement therapy nor IUDs. Formerly, Perino et al. (1987), administered both oestrogens and medroxyproges-

### Results and complications

DeCherney et al. (1986) reported the successful use of the urological resectoscope in 72 women, with a term pregnancy rate of 89%. The full-term pregnancy rate reported in various studies of hysteroscopic treatment for uterine septum ranges is 81–89% (Table II), the average pregnancy rate being 86%. Hysteroscopic resection of an intrauterine septum may benefit patients suffering from infertility or recurrent pregnancy loss (Goldenberg et al., 1995).

Operative hysteroscopy is a safe and effective method of management of uterine septa associated with recurrent pregnancy loss, and makes future vaginal delivery possible. In one of a series of 17 complete uterine septa treated by hysteroscopy, 10 out of 17 women became pregnant and no signs of cervical incompetence were observed (Nisolle et al., 1996). The last patient is still being treated with a combination of oestrogens and progestogens. Prophylactic cerclage was never performed after resection of a complete cervical and uterine septum. Following hysteroscopic metroplasty, Caesarean section should be performed only for obstetric reasons.

In our series, peroperative and postoperative complications were encountered in only 3 cases (1.8%). Classic peroperative complications such as fluid overload, haemorrhage or perforation could result from the hysteroscopic procedure itself. In our series of 170 patients, no fluid overload or haemorrhage was encountered and a perforation was noted in only one case. This was due to the fact that the patient had already undergone a uterine septum resection a few months before, which was considered to be insufficient. The postoperative hysterosalpingography revealed a persistent uterine septum which needed to be resected a second time. Upon diagnosis of the perforation, laparoscopy enabled us to exclude serious complications such as bowel damage or haemorrhage. Recently, Fedele et al. (1996) suggested that a remaining uterine septum of...
can lead to dysmenorrhoea and should then be laparoscopically removed.

A Foley catheter is inserted during surgery to empty the bladder. Four laparoscopic puncture sites including the umbilicus are used: 10 mm umbilical, 5 mm right, 5 mm medial and 5 mm left lower quadrant sites.

These are placed just above the pubic hairline and the lateral incisions are made next to the deep epigastric vessels. A cannula is placed in the single cervix for appropriate uterine mobilization. A bipolar forceps is used to compress and desiccate the fibrous tissue between the horns. The tissue is then cut with scissors and with a CO₂ laser. Bipolar coagulation is used to coagulate the pedicle. Scissor division is carried out close to the line of desiccation to ensure that a compressed pedicle remains. The mesosalpinx is then cut. If necessary, the peritoneum of the vesico–uterine space is grasped and elevated with forceps, while the scissors dissect the vesico–uterine space. Aquadissection may be used to separate the leaves of the broad ligament, distending the vesico–uterine space and defining the tendinous attachments of the bladder in this area, which are coagulated and cut. The tube of the affected horn is then removed.

The external tubal vessel is identified and exposed by applying traction to the adnexa with an opposite forceps. The dissection of the two horns is performed as follows: if there is true separation of the two horns, the fibrous tissue is coagulated with bipolar coagulation and then cut with scissors or with the CO₂ laser. If there is no external separation of the two horns, the dissection is more difficult; after coagulation, the myometrium must be cut in order to allow the removal of the rudimentary horn. For this purpose, bipolar coagulation and the CO₂ laser or the Nd–YAG laser fibre can be used to achieve coagulation and resection of the myometrium.

In the past, the rudimentary horn was removed either through the trocar of the laparoscope, or through a posterior colpotomy in cases of larger rudimentary horns.

For the last 2 years, the removal of large rudimentary horns has been carried out with the help of a morcellator (Steiner morcellator) (Storz, Tuttlingen, Germany) previously described for the removal of the uterus in laparoscopic supracervical hysterectomy (Donnez et al., 1993).

This procedure has been successfully performed in our department on 14 women to date. Of the eight who desired pregnancy, six became pregnant and had a normal vaginal delivery (>36 weeks), except one woman on whom Caesarean section was performed for fetal reasons.

References


Should we operate on Mullerian defects?


