Endoscopic laser treatment of uterine malformations

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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

Introduction

The endoscopic technique for the management of uterine septa was first proposed by Edstrom and Fernstrom (1970), but the method has become widely used only in recent years. In the past, whenever a patient presented with a Mullerian fusion defect that was thought to be the cause of recurrent pregnancy loss, a Jones, Strassman, or Tomkins procedure would be performed by laparotomy. These procedures required lengthy anaesthesia. Surgery could be complicated by infection or haemorrhage, necessitating antibiotic treatment and blood transfusions. Also, because the full thickness of the uterine fundus was surgically damaged, the patient would require Caesarean section for future deliveries. Some women became infertile as a result of adhesions or tubal occlusion, which developed secondarily to the procedure itself.

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 uniconuate, 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.

The traditional liquid distension medium was formerly
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: CO₂-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 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 CO₂ 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 above) 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.
Should we operate on Mullerian defects?

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 \(\mu\)m). 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\textsubscript{2} laser or unipolar coagulation (Figure 4B). The cervical septum is then incised with the scissors (Figure 5A) or with a CO\textsubscript{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 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.

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 intruterine 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 1385
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can lead to dysmenorrhea and should then be laparoscopically
removed.

A Foley catheter is inserted during surgery to empty the
bladder. Four laparoscopic puncture sites including the umbil-
icus 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 coagula-
tion 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.

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