Surgical therapy in infertile men with ejaculatory duct obstruction: technique and outcome of a standardized surgical approach

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In severe oligozoospermia or azoospermia, low ejaculate volume, low ejaculate pH and little or no fructose in seminal plasma suggest an obstruction of the seminal pathways at the level of the prostate gland, when vesicu aplasia and ejaculatory ducts are excluded. We report on our standardized surgical approach in 16 consecutive patients with this condition after clinical evaluation, semen analysis, endocrine assessment, testicular biopsy and transrectal ultrasonography. Pre-operatively, sperm analysis demonstrated typical low-volume ejaculates with azoospermia in 12 and severe oligozoospermia in four cases. Ultrasonography demonstrated seven central (Müllerian) and five lateral cystic lesions. Four cases with central obstruction revealed no ultrasonographic pathology. After intra-operative vasopuncture and vasography for definitive localization of the level of obstruction, transurethral incision and/or resection of ejaculatory ducts (TURED) was performed. Patency was proven in 15 out of 16 cases by ‘intra-operative chromotubation’. In nine out of 12 patients, spermatozoa could be harvested intra-operatively from the vas. During the follow-up of 12 months, post-operative ejaculates showed persistent patency in six out of seven Müllerian cysts with concomitant improvement of sperm quality. Only three of the other nine cases remained patent with the worst results in lateral cystic lesions. Only two of the patients with Müllerian cysts have fathered a child so far. The data provide evidence for the effectiveness of surgical treatment of ejaculatory duct obstruction, especially in the case of central cystic lesions. The combination of surgery, cryostoring of spermatozoa retrieved intraoperatively and the possible storage of ejaculated spermatozoa post-operatively creates the possibility of subsequently using reproductive techniques if pregnancy is not achieved.

Key words: azoospermia/ejaculatory duct obstruction/transurethral resection

Introduction

Ejaculatory duct obstruction is reported to be the cause of azoospermia in up to 5% of patients (Turek et al., 1996). Severe oligozoospermia and motility disorders have also been reported (Meacham et al., 1993; Goluboff et al., 1995b; Turek et al., 1996). Sometimes prostatitis-like symptoms, e.g. haemospermia, painful ejaculation and scrotal pain may be caused by this anomaly (Weintraub et al., 1993; Fowler et al., 1995; Dik et al., 1996). Aetologically speaking, ejaculatory duct obstruction may be congenital or acquired (Meacham et al., 1993; Goluboff et al., 1995b). Congenital causes include atresia or stenosis as well as cystic lesions, e.g. utricular, Müllerian and ejaculatory duct cysts (Goluboff et al., 1995b). Acquired causes may be of inflammatory or traumatic origin, including calculus formation and stenosis after transurethral resection of the prostate (Hellerstein et al., 1992; Rosen and Shabsigh, 1993; Goluboff et al., 1995b).

In the ejaculate analysis, typically low-volume azoospermia, low pH and missing or decreased fructose content suggest this kind of obstruction, after exclusion of ejaculatory disorders and congenital absence of the vas deferens (Silber, 1980). Follicle stimulating hormone (FSH) concentrations in serum as well as testicular volume and testicular biopsy results are normal (Hendry and Pryor, 1992). Usually, clinical examination is normal too. Occasionally there can be a prostatic tenderness, a palpable cystic prostatic lesion or palpable seminal vesicles (Meacham et al., 1993; Goluboff et al., 1995b). Transrectal ultrasonography (TRUS) has been suggested as the standard examination (Kuligowska et al., 1992) for evaluating the anatomy of seminal vesicles, ejaculatory ducts and prostate; this examination is considered by some authors to be obligatory (Meacham et al., 1993; Worischek and Parra, 1993; Gilbert, 1995). Distinction between cystic and non-cystic lesions during TRUS simplifies the diagnostic management (Popken et al., 1998). Alterations of seminal vesicles with dilatation do not necessarily relate to ejaculatory duct obstruction (Goluboff et al., 1995b). Cystourethroscopy suggests midline cysts and altered verumontanum anatomy (Goluboff et al., 1995b). Recently, magnetic resonance imaging with an endorectal coil has been proposed for more detailed evaluation (Weintraub et al., 1993).
Concerning the localization of the level of obstruction, intraoperative vasography after vasopuncture was the gold standard for several decades (Pryor and Hendry, 1991; Weintraub et al., 1993; Gilbert, 1995; Goluboff et al., 1995b). During vasography, the fluid from the testicular end of the vas can be examined for spermatozoa in order to exclude an additional epididymal blockage, a condition which has been observed in 15% of these cases (Pryor and Hendry, 1991). Other investigators see a limitation of this procedure in those patients in whom intra-operative TRUS provides enough information for the resection (Gilbert, 1995), e.g. in easily visualized cystic lesions. Otherwise, vasography is still recommended in those cases in which the level of obstruction cannot be evaluated clearly (Meacham et al., 1993; Cornel et al., 1999). Recently, ultrasound-guided transrectal or perineal vesiculography and vesicle aspiration have also been described as being useful in this context (Jarow, 1994), since the examination of the aspirates may reveal spermatozoa as a sign of peripheral patency of the vas.

Up to now, about 100 cases undergoing transurethral therapy have been reported world-wide. There are several different concepts in the surgical therapy of ejaculatory duct obstruction. In the case of cystic lesions, some authors prefer transurethral incision with an optical urethrotome (Pryor and Hendry, 1991) or a Turner–Warwick (Fowler et al., 1995; Dik et al., 1996) or Collins hook (Cornel et al., 1999) instead of primary transurethral resection of the lesions. In the USA, transurethral resection of the ejaculatory ducts (TURED) is now the recommended routine procedure for all cases of obstruction (Meacham et al., 1993; Gilbert, 1995; Goluboff et al., 1995b; Turek et al., 1996). Successful surgery results in an increase of ejaculate volume and especially semen quality in 38–79% (Pryor and Hendry, 1991; Hendry and Pryor, 1992; Meacham et al., 1993; Vazquez-Levin et al., 1994; Turek et al., 1996). Nevertheless, despite temporary patency, a substantial number of patients suffer obstruction again after an interval of patency (Popken et al., 1998), with the result that pregnancy rates in these partnerships only reach 29–33% (Hendry and Pryor, 1992; Meacham et al., 1993; Vazquez-Levin et al., 1994; Schlegel, 1997; Popken et al., 1998). On the other hand, urine reflux in the ejaculatory pathways (Goluboff et al., 1995a), with an increase of seminal plasma creatinine (Vazquez-Levin et al., 1994), may also affect sperm function negatively.

We started this type of surgery in 1990, following a report on successful surgical treatment of bilateral duct obstruction by direct vision urethrotome in a case of azoospermia (Dunetz and Krane, 1986). In the present study, we report on our concept of standardized diagnostic and surgical procedures, including TURED, in 16 cases of ejaculatory duct obstruction with low-volume oligozoospermia and azoospermia.

**Table I. Summarized results of 16 patients with central seminal pathway obstruction**

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Type of obstruction</th>
<th>Sperm count/ml (pre-operatively)</th>
<th>Sperm count/ml (post-operatively)</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EDO</td>
<td>azoospermia</td>
<td>&lt;200 000</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>MC</td>
<td>azoospermia</td>
<td>300 000</td>
<td>yes</td>
</tr>
<tr>
<td>3</td>
<td>EDC</td>
<td>azoospermia</td>
<td>azoospermia</td>
<td>no</td>
</tr>
<tr>
<td>4</td>
<td>MC</td>
<td>azoospermia</td>
<td>&gt;2×10^6</td>
<td>yes</td>
</tr>
<tr>
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<td>EDO</td>
<td>azoospermia</td>
<td>azoospermia</td>
<td>no</td>
</tr>
<tr>
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<td>&lt;250 000</td>
<td>&lt;250 000</td>
<td>no</td>
</tr>
<tr>
<td>7</td>
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<td>≤500 000</td>
<td>&gt;5×10^6</td>
<td>yes</td>
</tr>
<tr>
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<td>&lt;200 000</td>
<td>&lt;5×10^6</td>
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</tr>
<tr>
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<td>1×10^6</td>
<td>yes</td>
</tr>
<tr>
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</tr>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
<td>16</td>
<td>EDC</td>
<td>azoospermia</td>
<td>azoospermia</td>
<td>no</td>
</tr>
</tbody>
</table>

*Pregnancy cannot definitely be ascribed to TURED as there were spermatozoa present prior to the operation and the partner was relatively young (33 years).
Post-operative sperm counts are given 6 weeks after the procedure.
MC = Müllerian cyst, EDC = ejaculatory duct cyst, EDO = ejaculatory duct obstruction without cystic lesion.

Materials and methods

**Diagnostic procedures**

From 1990–1999, 16 consecutive patients (mean age 34.7, range 27–42 years) with low-volume (<1.5 ml, one patient 1.6 ml), severe oligozoospermia (<500 000 spermatozoa/ml), or azoospermia were evaluated (Table I). In all patients, aplasia of the vas deferens was excluded by careful palpation of the scrotum and again during testicular biopsy. Ejaculates were examined according to WHO criteria (WHO, 1993) on two separate occasions. Retrograde ejaculation was ruled out by analysing post-ejaculation urine in every case. Serum FSH and luteinizing hormone (LH) were analysed twice.

To evaluate the prostate and seminal vesicles, TRUS was performed using a 7.5 MHz scanner (Combison 330®, Kretz, Wiesbaden, Germany) in transverse and longitudinal planes. For routine work-up, midline (central) prostatic lesions and lateral cystic alterations

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were documented as sonographic indicators for prostatic obstruction of the seminal pathways (Worischek and Parra, 1993; Popken et al., 1998). Changes in the configuration of the seminal vesicles were noted, but these findings did not influence the operative strategy.

Testicular biopsy was performed under local anaesthesia 2–4 months before operation. Spermatogenesis was evaluated using a semi-thin technique according to a modified Johnson score (Johnson, 1970); scores >8 were deemed to be normal.

Operative procedures

All operations were done under general anaesthesia. For the microsurgical part, the patient was in a supine position. Initially, a microsurgical vasotomy was performed on one side. As from 1994, fluid was aspirated from the testicular side of the vas with a 24 gauge catheter and examined for motile spermatozoa using a phase-contrast microscope (×400 magnification). All intra-operative aspirates were cryopreserved for intracytoplasmic sperm injection (ICSI) (nine out of 16) if microscopic examination showed motile spermatozoa and the volume was sufficient for harvesting. For the exact localization of the level of the central prostatic obstruction and for the documentation of patency after surgical therapy, a small catheter (24 gauge) was inserted into the abdominal end of the vas, and vasography was performed using a mixture of saline/iopamidol (Solutraste®; Byk Gulden, Konstanz, Germany/methylene blue) (Figure 1a). Then, for the transurethral operation, the patient was brought into a dorsal lithotomy position. Using a transurethral resection set, rethrocystoscopy was performed and cystic and non-cystic lesions were opened with a Turner–Warwick hook, until methylene blue dye injected into the vas gushed out into the urethra (Figure 2). At that point, the lateral area was resected as far as the wall. Generally, a resectoscope loop was used to extend the opening. In cases of extended cysts, the complete roof was primarily resected to the level of the verumontanum. After opening up, a second vasography documented the success of the operative procedure demonstrating the distal filling of the urethra (Figure 1b). Finally, the vas incision was microsurgically closed with two to three stitches with a 9–0 suture. A transurethral catheter (16 Ch) was placed in position for 24 h. All patients left the hospital the day after the operation. Standardized semen analysis was performed 6 weeks post-operatively and then at 3 month intervals for 12 months follow-up.

Results

The pre- and post-operative sperm-count findings of all 16 men are summarized in Table I. The diagnostic management demonstrated azoospermia in 12 patients, a further four men suffered from severe oligozoospermia (sperm count ≤500 000 per ml) with a high percentage of immotile spermatozoa. Ejaculate volume was between 0.5 and 1.6 ml (mean 0.95 ml) and seminal pH was below 6.4 in every case; fructose was absent or below 13 µmol/ejaculate. Testicular volumes, serum FSH and spermatogenesis (Johnson score >8) were normal in all cases.

The level of obstruction was defined by pre-operative TRUS results, vasography and endoscopic inspection during the operation (Table I). In seven cases, a central cystic lesion was resected as a ‘Mullerian cyst’. In five of the other nine cases the ejaculatory duct was dilated unilaterally or bilaterally. In the other four cases, we did not find a cystic lesion. Three of these four patients (nos 5, 6 and 12) had a history of prostatitis, one patient (no. 1) had a history of bladder neck ‘vapourization’ by laser treatment 2 years previously due to recurrent haematospermia. One further patient (no. 15) had been unsuccessfully treated by unroofing 6 weeks previously in another clinic. Intra-operatively, the examination of the aspirates from the

Figure 1. Vasography (a) before and (b) after opening of the ductus. The arrow marks the filling of the urethra after surgery.

Figure 2. Transurethral view of methylene blue, gushing out from the opened ductus ejaculatorius (intra-operative chromotubation).
testicular vas remnant showed motile spermatozoa in all patients. Since 1994, it was possible to cryopreserve aspirates of nine of the 16 patients. Intra-operatively, patency was evaluable after transurethral surgery in 15 of the 16 cases. In the one special case, with a history of failed treatment (no. 15), a very small, scarred and only partially cystic area was demonstrable around the verumontanum; the operation was stopped after a two-loop deep resection to avoid damage to the external sphincter.

Post-operative ejaculates showed patency in all patients with Müllerian cysts except for one (no. 15), and in three (nos 1, 6 and 12) of the other nine patients. There was an improvement in sperm counts in all Müllerian cyst patients with successful opening but only an improvement in two patients without cystic lesions (nos 1 and 12), and an unchanged sperm count in patient no. 6. In all patients with sperm count improvement, ejaculate volume and fructose content in seminal plasma increased. The seminal pH was not evaluated in all patients post-operatively. The worst results were obtained in all patients with lateral cystic lesions of the ductus ejaculatorius. Only two of our patients (with a Müllerian cyst) have fathered a child so far in the natural way.

Discussion

In infertile men, central obstruction of the seminal pathways at the prostatic level is one major cause of low-volume azoospermia or severe oligozoospermia. Ejaculate volumes <1.5 ml (Meacham et al., 1993), acid pH and absent or low fructose contents in seminal plasma are indicative of the condition (Meacham et al., 1993; Gilbert, 1995; Goluboff et al., 1995b). In our series, all these conditions were present and after scrotal palpation and exclusion of retrograde ejaculation, ejaculatory duct obstruction became the clinical diagnosis (Silber, 1980; Gilbert, 1995).

For therapeutic strategy, the identification of the level of obstruction is decisive (Hendry and Pryor, 1992). TRUS is certainly the easiest way to detect cystic lesions at the verumontanum level as well as dilatations of the internal ductal diameter and of the seminal vesicles (Gilbert, 1995; Goluboff et al., 1995b; Popken et al., 1998). Furthermore, pre-operative sonography allows the opportunity to predict the outcome with a higher success rate, especially in cystic lesions (Hendry and Pryor, 1992; Meacham et al., 1993; Popken et al., 1998). Traditionally, the localization of the stenotic level was done after microsurgical vasotomy and vasography (Weintraub et al., 1993; Gilbert, 1995), as already suggested (Hendry and Pryor, 1992). Using a vasal injection of a dye during resection, this technique allows intra-operative confirmation of patency. Recently, the injection of methylene blue during ‘chromotubation’ vasography followed by cystoscopy was once again confirmed as being the best diagnostic tool (Wu et al., 1999).

Vasography prior to resection also identifies the level of obstruction (Gilbert, 1995). Transrectal ultrasound-guided fine-needle aspiration and seminal vesiculography were also used to localize the obstructive level (Jarow, 1994; Goldstein, 1995) with the hypothetical advantage of protecting the vas. The argument that vasography may itself trigger consecutive vasal obstruction has been ruled out by experimental data (Alefelder et al., 1991), if a microsurgical closure of the vasotomy is performed (Goldstein, 1995). On the other hand, vasotomy also allows the exclusion of an additional epididymal obstruction, which has been reported in 15% of the cases with central cysts (Hendry and Pryor, 1992). Furthermore, if the number of motile spermatozoa is sufficient, direct storage of vasal aspirates, which was possible in nine out of the 16 patients of our series, allows a further treatment option with ICSI similar to vasal aspiration during vasectomy reversal (Belker and Bergamini, 1997) and during direct seminal vesicle aspiration (Cytron et al., 1996).

Our transurethral procedure is standardized (Schroeder-Printzen et al., 1996) and included a combination of transurethral incision and resection (TURED). In midline cysts, the first step was always the opening by a Turner–Warwick hook, until the methylene blue dye, simultaneously injected into the vas, gushed out into the posterior urethra. Subsequently, we extended the procedure by resecting the area, creating a huge opening to avoid an early restenosis (Hendry and Pryor, 1992; Gilbert, 1995). With this technique, we were able to unroof all the central cysts with one exception, which corresponded to positive results of other groups (Hendry and Pryor, 1992; Popken et al., 1998). We think that negative experiences with unroofing (Cornel et al., 1999) may mainly be explained by not using the extended resection described above. In all other patients with and without non-central cystic lesions as a cause of ejaculatory duct obstruction, surgery consisted of an opening up of the lesion, documented by confirmation of the outflow of the dye. This intra-operative control of patency including post-operative vasography is the essential point of our procedure: other techniques, such as the visualization of sperm efflux from the ductal openings (Turek et al., 1996) and the comparison of pre- and post-operative TRUS findings, may also be helpful (Gilbert, 1995; Popken et al., 1998).

A further point worth debating is the depth and extent of resection (Weintraub et al., 1993; Gilbert, 1995). Normally, we resect the area of the verumontanum as far as the opening is evident, especially in cases with midline cysts and non-cystic lesions. In lateral cystic lesions, we also try to go laterally and to widen the opening as previously suggested (Weintraub et al., 1993), even though the ejaculatory ducts are deemed midline structures in this region (Goluboff et al., 1995b) and lateral resection has not been accepted as being useful by others (Popken et al., 1998). In our study we had trouble with bleeding in three of these lateral cystic lesions requiring fulguration. This may be one reason for the worse later results in those cases despite proven patency directly after surgery (Goluboff et al., 1995b). Schlegel (1997) describes a balloon dilatation technique for avoiding such complications.

Concerning patency in the follow-up, our post-operative data demonstrate a persistent efficacy in five out of six patients with central (Müllerian) cysts and a worse outcome in the patients with lateral cystic and non-cystic lesions at the verumontanum. The positive outcome in the case of central cystic lesions is absolutely in accordance with many other reports (Meacham et al., 1993; Goluboff et al., 1995a,b) excluding the experience of one group with deroofing (Cornel...
et al., 1999). On the other hand, the positive long-term results also in non-cystic post-inflammatory lesions is surprising, although in this respect only limited information has been published so far, involving just a few cases (Goluboff et al., 1995b). Functionally, inflammatory or post-operative scarring is equivalent: resection of this area removes the altered tissue covering the duct openings (Dik et al., 1996).

Nevertheless, the overall improvement in sperm concentration following surgery in our series is in the range given in the literature (Meacham et al., 1993; Vazquez-Levin et al., 1994; Turek et al., 1996; Schlegel, 1997), with the best data regarding patency being about 60% (Popken et al., 1998). In all cases of patency, cryopreservation of ejaculate is suggested in the follow-up, giving the patient a real chance to father a child in spite of the danger of restenosis (Hendy and Pryor, 1992; Turek et al., 1996). On the other hand, vas aspiration during vasotomy (available in nine cases in our series) allows a further chance of sperm harvesting for ICSI procedures. Generally in cases with normal spermatogenesis, spermatozoa can be retrieved microsurgically via the opened vas in about 35% of the cases (Belker and Bergamini, 1997). Thus, we do not agree with others (Cytron et al., 1996), that a primary perineal aspiration of spermatozoa for ICSI from the seminal vesicles is the first choice in patients with ejaculatory duct obstruction, because reconstructive surgery may result in natural conception (Schlegel, 1997). We agree that pregnancy rates are limited to about 20% (overview in Schlegel, 1997), furthermore sperm function may be influenced by urine contamination of the ejaculate due to reflux (Vazquez-Levin et al., 1994). Nevertheless, in our opinion, the attempt at reconstruction remains reasonable. Aspirates containing motile spermatozoa should be cryopreserved for later ICSI. After a successful operation, any spermatozoa available should be stored.

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References


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