Technical considerations in the implantation of Tenckhoff catheters for continuous ambulatory peritoneal dialysis in children

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SUMMARY

The technique used for peritoneal catheter placement in the Oregon CAPD program is described.

It includes:

1. Catheter placed by open technique in the operating room.

2. Use of «adult» size Tenkhoff catheter of the single-cuff «unattached» type. The intraperitoneal end is trimmed at surgery to custom fit the child.

3. Partial omentectomy when appropiate.

4. Catheter placement deep in the pelvis with demostration-of position and function intraoperatively.

5. Identification and repair of inguinale or umbilical defects at the same operative procedure.

The average catheter life span has been 9.7 ± 8.2 months. The reasons for catheter replacement have been: Tunnel infection (7), Cuff slippage (1), Candida peritonitis (1), Omental obstruction (1), Resistant bacterial peritonitis (1), Dialysate leakage (1).

Key words: Pediatric CAPD, Tenckhoff catheter.

RESUMEN

Partiendo de una experiencia en DPCA pediátrica de 3 años y 12 pacientes, se describe la técnica utilizada para la implantación del catéter de Tenckhoff en niños.

Los detalles fundamentales de la misma incluyen:

1. Realización por cirujano a «cielo abierto».

2. Utilización de catéter de tamaño adulto de un solo manguito (se modelan preoperatoriamente ajustándolos al tamaño del niño).

3. Realización de omentectomía parcial cuando sea necesario.

4. Colocación del catéter en pelvis con demostración de posición y función intraoperatoria.

5. Identificación y reparación de hernias inguinales y/o umbilicales en el mismo acto quirúrgico.

Una vez colocado el catéter se inicia DP con solución al 1,5 % heparina 500 U/litro y cefarina 125 mg/l. Los volúmenes de intercambio inicial son de 15 c.c./kg. y 1 hora de duración. Posteriormente se incrementa gradualmente el volumen y tiempo de intercambio, hasta alcanzar los 35 c.c./kg. y la pauta de 4 cambios/día.

Usando esta técnica, hubo que sustituir 12 catéteres por las siguientes razones: infección del túnel, 7; deslizamiento manguito, 1; peritonitis, 1; peritonitis bacteriana resistente, 1; escape de líquido, 1.

Palabras clave: DPCA pediátrica, catéter de Tenckhoff.

The pediatric CAPD program in Oregon was established over three years ago. CAPD has proven to be a successful home maintenance dialysis technique for our young patients with end-stage renal disease. A large measure of the success of this technique has been the result of a close working relationship between pediatric nephrologists and interested pediatric surgeons who together have developed a surgical catheter placement technique that emphasizes: 1) creation of a watertight seal at the point of exit of the catheter from the peritoneum, 2) partial omentectomy when appropriate, 3) catheter placement deep in the pelvis with

demonstration of position and function intraoperatively, 4) identification and repair of inguinal or umbilical defects at the same operative procedure.

Details of the approach used in our program during its first two years have recently been reported [1]. We report here an updated catheter placement technique and the catheter results from three years' experience in 12 pediatric CAPD patients. A detailed review of other aspects of this experience is presented in an accompanying report.

Patient Population

Twelve children maintained on CAPD in Oregon since February, 1979 are the subjects of this report. Patient ages at onset of CAPD ranged from two weeks to 15 years (mean: 6.6 years) and patient weights ranged from 2.5 kg. to 28.0 kg. (mean: 15.0 kg.). There are four girls and eight boys. Duration of CAPD ranges from seven months to 36 months (mean 19.3 months).

Technique

Pre-operative

Although the following technique for placement of the CAPD catheter is intended to be simple and straightforward, only with strict attention to detail will surgeon and nephrologist be rewarded with a catheter which may function indefinitely. All catheters are placed by open technique in the operating room. We use only «adult» size Tenckhoff catheters in all patients, including the 2.5 kg. newborn infant. A single Dacron-felt cuff on a silastic base may be ordered «unattached» and then glued in the appropriate location by the surgeon and/or nephrologist 24 hours prior to catheter implantation. We have recently special ordered single cuffs glued by the manufacturer at a site only 3 cm. above the first side holes for use in smaller patients.

Currently we prefer the Quinton Shadow-Strip ® or Shadow-Cath ® radiopaque catheter [2] for their compliance, ease of remodeling of a trimmed intraperitoneal portion and the proven durability of silastic catheter and cuff. There are advantages to other brands; the ideal pediatric permanent peritoneal catheter has not yet appeared. We do not use the Oreopoulos-Zellerman (Toronto Western) catheter. We find no use for «pediatric» size catheters of any design. These catheters are only slightly smaller in external diameter and so much shorter that they leave an inadequate extra-abdominal section.

The day before scheduled catheter placement, surgeon and nephrologist see the patient and family and agree upon optimum catheter location on the patient's abdomen. Adolescent and pre-adolescents prefer a more lateral point of entry than the customary midline insertion site. For these patients we try to make the catheter as inobtrusive as possible. Peritoneal entry site is planned at a point midway on the line between the symphysis pubis and the anterior superior iliac crest, above level at which the youngster wears his/her jeans. Tunnels in these patients run laterally and exit sites are at the level of the anterior axillary line, above the belt. This allows the catheter, connecting tubing, and empty CAPD bag to disappear quickly into a pants pocket after looping briefly over the patient's belt.

The usual midline entry site is preferred for younger children. The length of the intraperitoneal portion may be estimated pre-operatively adding 1 cm. to the measured symphysis to umbilicus distance. The intraperitoneal end may then be trimmed at surgery to custom fit the child. If the peritoneal cuff has come from the manufacturer unattached it is glued 24 hours before placement at a distance 3-5 cm. above the first side holes using silicone medical adhesive [3] as described by Tenckhoff [4]. We no longer use 2-cuff catheters.

Intraoperative

Intraoperative procedures begin with a 2 cm. incision 1 cm. below the umbilicus. The linea alba and peritoneum are incised, the peritoneum fixed by two temporary sutures (fig. 1). Digital examination assures that no adhesions of the bowel to the peritoneum are present.

Patients who have had omental encasement of a previous catheter resulting in catheter dysfunction due to one-way obstruction or children who are found to have an extensive omentum may require partial omentectomy. This is accomplished by resection of as much omental tissue as can be easily delivered through the 2 cm. incision. In our experience the omentum so removed does not exceed an area = 8-10 cm^2.

The Tenckhoff catheter is threaded over a lubricated catheter guide with a gentle distal curve. The guide and catheter are passed just behind the anterior abdominal wall for several cm. The guide is then turned 90° to allow a gentle curve into the deep pelvis on either side and removed as the catheter is advanced easily into position. The catheter tip should rest deep in the pelvis but should not be in contact with the lateral or posterior abdominal wall and should not be imbedded in adhesions, omentum, or loops of bowel. Further trimming of the intraperitoneal portion may be required to allow the catheter to assume this optimum position. The catheter which is too long can result in painful infusion as well as poor function and is to be avoided.

If an umbilical defect is present, even one as small as 0.5 cm. in diameter, it is closed at this time from the inside through the incision.

The peritoneum is now closed. A purse-string suture

TABLE I

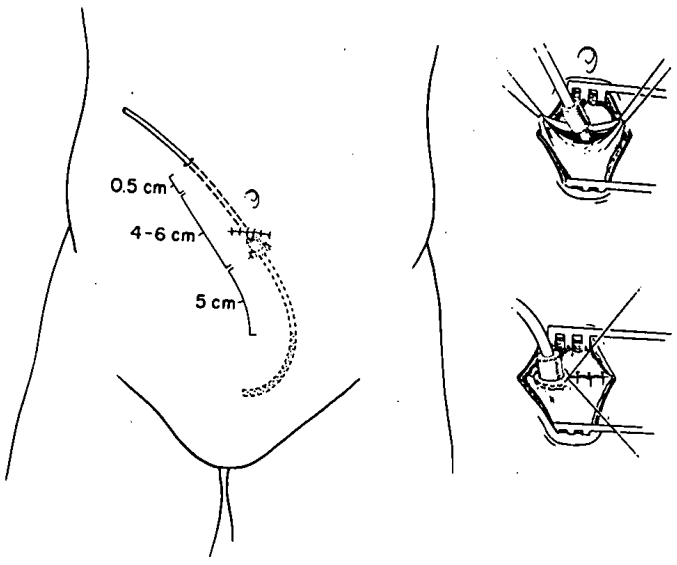
PEDIATRIC CAPD CATHETER LIFE-SPAN
(Compiled 2-1-82)

Patient	Duration of CAPD (months)	Total CAPD Catheters	Reasons for Replacement	Life-Span (months)
1	36	4	1 - Leakage	3
			2 - Tunnel Infection	12
			3 - Tunnel Infection	19
			4 -	2+
2	32	1	—	32+
3	24	2	1 - Resistant Bacterial Peritonitis	7
			2 - CAPD Discontinued	17
4	30	2	1 - Tunnel Infection	28
			2 - —	2+
5	16	2	1 - Tunnel Infection	12
			2 - CAPD Discontinued	4
6	21	2	1 - Tunnel Infection	16
			2 - —	5+
7	22	2	1 - Omental Obstruction	14
			2 - —	8+
8	18	3	1 - Candida Peritonitis	12
			2 - Tunnel Infection	4
			3 - —	2+
9	11	3	1 - Cuff Slippage	1
			2 - Tunnel Infection	9
			3 - 66	1+
10	9	1	1 - —	9+
11	7	1	1 - —	7+
12	7	1	1 - —	7+
TOTALS: 12	233	24	Average Life Span 9.71 ± 8.2	

is secured at one point to the catheter cuff through the bottom 0.1 cm. of the cuff substance (fig. 1). When secured, this suture pulls a «collar» of peritoneum around the base of the cuff creating a water-tight seal and securely anchoring the catheter in position. Correct positioning of the catheter is confirmed by intraoperative AP and cross-table lateral pelvic radiographs which must be obtained prior to construction of the subcutaneous tunnel or institution of dialysis.

When catheter position is satisfactory by direct visualization and on x-ray a solution consisting of 7-8 c.c./kg. of Renal M-60™ mixed with an equal volume of dialysate is infused into the peritoneal cavity. The patient is placed in a 45° reverse Trendelenburg position for a radiograph of the abdomen which includes the inguinal areas («Peritoneography»). If this procedure demonstrates an inguinal hernia sac or patent processus vaginalis, an inguinal exploration is then carried out with high ligation of the sac and tightening of the internal ring.

A short, straight, 4.5 cm. to 6.5 cm. subcutaneous



tunnel is now constructed, usually passing at a slight angle from the midline (fig. 1). In the past a second or subcutaneous cuff was placed near the exit wound

TABLE II

SUMMARY OF REASONS FOR CATHETER REPLACEMENT

Tunnel Infection	7
Cuff Slippage	1
Candida Peritonitis	1
Omental Obstruction	1
Resistant Bacterial Peritonitis	1
Dilaysate Leakage into Subcutaneous Tissue	1
	12

in the skin of the abdominal wall. This proved to be an unfortunate practice. These superficial cuffs stood out in the thin subcutaneous tissue of these children and increased susceptibility to tunnel trauma at that point. Trauma to the skin overlying the cuff led to bruising and subsequent erosion and/or tunnel infection. This sequence of events led to the replacement of six catheters for chronic tunnel infections, all of which were working well at time of replacement. We have since used only single cuff in an attempt to avoid this problem.

Before the skin incision is closed, continuous low-volume dialysis passes (15 c.c./kg.) are instituted to insure that the catheter is functional and the peritoneal closure is water-tight. The initial dialysis solution usually consists of 1.5 % Dianeal (Travenol) to which has been added 500 units Na heparin/liter and 125 mg. cepharin/liter. Exchange volumes are kept at 15 c.c./kg. Six one-hour passes are accomplished in the post-operative period after which heparin and antibiotics are no longer routinely used in the dialysate.

Dialysis now continues without interruption and with gradual extension of dwell times and increase in exchange volumes over the ensuing five to seven days. A regular CAPD schedule of five exchanges/day at 35 c.c./kg/exchange is reached by the time of hospital discharge on the 6th or 7th post-operative day.

RESULTS

Early experience demonstrated that post-operative leakage of dialysate at the catheter insertion site could not be avoided in infants and children with limited subcutaneous tissue, despite use of low volumes and bed rest. Leakage of this type forced replacement of one catheter and led to development of the purse-string peritoneal suturing technique described above. Since institution of this technique 33 months ago we have had no further problems of dialysate leakage.

Peritoneography has demonstrated inguinal hernias in three boys and patent processus vaginalis in two. One child had an apparently normal peritoneogram only to develop bilateral inguinal hernias six months into CAPD. Review of the initial study revealed an inadequate volume of dye had been used and the anterior inguinal extensions of the peritoneum inadvertently failed to fill.

Table I presents the details of pediatric CAPD catheter experience in our program. A summary of the reasons for catheter replacement is presented in Table II. Note that average catheter life span is 9.7 $\pm$ 8.2 months (range one month to 32 months). Only one catheter has been lost to obstruction, while cuff trauma leading to tunnel infection has forced replacement of six catheters. With elimination of the offending superficial cuff we hope this problem has been resolved.

CONCLUSIONS

A surgical technique for the design and placement of the pediatric CAPD catheter has been described. A close working relationship between nephrologists and interested surgeons has been instrumental in the continued improvement of these procedures, to the benefit of our patients. Our experience has demonstrated the value of active participation by interested surgeons in the establishment and continued successful development of a pediatric CAPD program.

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