Lumbar Arachnoid-Ureterostomy Combining the Matson Technique and the Pudenz-Heyer Valve

Report of a Case

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In 1949, Matson reported the apparently successful refinement of a shunting procedure introduced by Heile in 1925, for the treatment of communicating hydrocephalus.

That the refined procedure is capable of leading to excellent long-term results in the treatment of communicating hydrocephalus is confirmed in the most recently published American review of the surgical treatment of hydrocephalus. Those who deal with any significant number of children requiring surgical treatment for hydrocephalus are painfully aware of the average number of procedures required to maintain adequate shunting which must be contemplated when treatment of an infant is started, even were it possible to foresee that an individual case would not be complicated by infection or severe intravascular thrombosis at some time during the course of treatment.

In the current period of intensive effort to improve the ventriculo-vascular shunts and diminish their complication rates there may be a tendency for many surgeons to forget that there is a shunt which, when employed under rigidly restricted conditions, may fairly confidently be expected to function for many years and possibly for life.

The arachnoid-ureteral shunt has been considered and completely discarded by many because of the recognized hazard of severe fluid and electrolyte depletion when the patient encounters intercurrent illness associated with vomiting, diarrhea, or even a period of restricted fluid and salt intake, or when excessive sweating occurs. Although this problem can usually be dealt with satisfactorily when intelligent parents and their physicians are fully aware of its existence and when adequate medical facilities are reasonably near at hand, a significant hazard still remains.

An attempt to reduce this hazard was made in September, 1964, when a Pudenz-Heyer cardiac tube was inserted into the ureter of a 22-month-old child and led through the psosas muscle to a connection with a lumbar subarachnoid tube.

Case Report

R.D.A., a male child born on December 14, 1962, was operated upon in June, 1964, because of progressive non-communicating hydrocephalus secondary to a congenital cyst of the 4th ventricle.

Operation. Suboccipital craniectomy was performed with wide opening of the cyst. The child did well for 3 months, with good neurological development, and a persistently soft suboccipital decompression and anterior fontanelle. Three months after the surgical procedure the occipito-frontal circumference was 1 cm. greater than that before surgery.

Three and a half months after the surgical procedure evidence of increased intracranial pressure reappeared without any recognized precipitating event. The problem continued progressive for more than 2 weeks. Pneumoencephalography was then carried out and in comparison with the study prior to the suboccipital craniectomy revealed that the hydrocephalus had converted into a communicating type but that ventricular enlargement was essentially as extensive as originally noted. On September 29, 1964, a lumbar arachnoid-ureterostomy was carried out confirming largely to the technique described by Ingraham and Matson with the substitution of the Pudenz-Heyer atrial shunt tube for the ureteral portion of the shunt. Testing of this particular tube revealed a fall of the manometer water level to 100 mm. in 1 minute. In order to prevent reflux of fluid through the uretero-fascial suture line a loosely encircling 3-0 black silk ligature was placed about the ureter and indwelling tube. (This is contrary to Matson's recommendation and undoubtedly imposes some risk of ureteral necrosis.)

The postoperative course was entirely satisfactory for the first 2 days. On the 3rd day there was clear evidence of recurrence of increased intracranial pressure. It had been the opinion of the urologist participating in this child's management that voiding in the postoperative period had been adequate. Matson has recommended the placing of an indwelling bladder catheter in these children in the early postoperative period but we had elected to avoid catheterization hoping thereby to minimize the danger of infection. When the child was anesthetized in anticipation of re-exploration of the shunt, distention of the urinary bladder was apparent. An indwelling bladder catheter was placed and the bladder emptied over a 20- to 30-minute period; during this time the anterior fontanelle and suboccipital decompression softened, signaling the relief of the increased intracranial pressure. Continuous catheter drainage was carried out for 2½ days. When the catheter was then removed, normal voiding resumed, and intracranial pressure continued well controlled.

The subsequent clinical course of this patient throughout nearly 1 year since shunting has been most gratifying. The occipito-frontal circumference 49 weeks postoperatively was unchanged from the immediate
preoperative measurement. Psychomotor development has been normal. There have been at least 3 episodes of mild to moderate intercurrent infectious illness, and in June, 1965, there was a 2-week illness marked by intermittent diarrhea and almost daily vomiting, symptoms shared by other members of the family. None of these illnesses has been associated with symptoms suggestive of electrolyte and fluid depletion and none has required hospitalization or parenteral therapy.

Discussion

We have recently had the opportunity to collect 24 hour urine specimens from the patient described above and from a patient operated upon in December, 1961. In the latter case an ordinary non-valved polyethylene tube, size #6 French, was employed as the shunting device connecting the lumbar subarachnoid space with the left ureter. In this child also the previously progressive hydrocephalus has been brought under excellent control since the performance of the arachnoid-ureterostomy. There has been gratifying psychomotor development. However, the child has had at least 4 severe episodes of fluid and electrolyte depletion requiring hospitalization and parenteral therapy as lifesaving measures. Fortunately, the child’s reservoir of fluid and electrolyte is now large enough and his fluid and salt intake adequately enough maintained so that no episode of depletion severe enough to require hospitalization has occurred within the past 16 months.

Table 1 records the values for 24 hour urinary excretion of sodium and protein in these 2 patients and compares the results with normal values for children. The child with the valveless shunt, more than 3 years after his surgical procedure, was still losing quantities of protein, and probably more important, sodium in amounts several times normal. Although the patient with the valved shunt showed a greater loss of protein in the urine than normal, the sodium loss was in the normal range.

The quantitative sugar determinations on these 24 hour urine specimens and on several other 24 hour urine specimens collected early in the postoperative period in comparable children have been negative for urine sugar. This has simply made us aware that we cannot rely on urine sugar determinations to estimate the adequacy of shunt function.

The criteria which should be fulfilled before arachnoid-ureterostomy is undertaken include the following:

1. Cooperation of intelligent parents must be reasonably reliable.
2. Competent medical supervision with adequate facilities for parenteral therapy should be continuously available.
3. The lumbar subarachnoid space must be patent, in free communication with the ventricular system, and free from infection.

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<td>Twenty-four hour urinary excretion</td>
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<tr>
<td>Non-valved shunt</td>
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<tr>
<td>(actual value 202 mEq.)</td>
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<td>Valved shunt</td>
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<tr>
<td>(actual value 48 mEq.)</td>
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<td>Normal</td>
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4. Bladder innervation must not be so impaired that prolonged urinary retention might occur.
5. Separate and adequately functioning kidneys and ureters must be demonstrated preoperatively by intravenous pyelography.

We do not advise arachnoid-ureterostomy as the initial therapeutic procedure in the first year of infancy. We prefer to use a ventriculo-atrial shunt in infants with progressive hydrocephalus whether of the communicating or non-communicating type except for those with a potentially correctable cause such as a 4th ventricle cyst. However, we do consider arachnoid-ureterostomy when shunt revision is indicated in children older than 12 to 18 months, or when an initial shunting procedure is indicated in infants over 1 year old. In post-traumatic cases, in which the hydrocephalus may be self-limited, a temporizing procedure such as a peritoneal shunt is also considered.

Summary

1. When arachnoid-ureterostomy is employed under rigidly restricted conditions it may fairly confidently be expected to function for many years and perhaps for life.
2. We have reported a case in which we used a valve that provided a pressure limit below which spinal fluid did not flow into the ureter. This modification may significantly reduce the fluid and electrolyte depletion previously associated with this procedure.

References