Renal Function and Growth after Antireflux Surgery in Children

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Summary: The outcome of antireflux surgery for vesico-ureteral reflux (VUR) was studied in 39 children (65 renal units). The T max of the renogram improved significantly after operations in 51 (78.5%) of the 65 renal units due to a reduction of the back pressure. Improvements in scarring were observed in only 3 (7.3%) of 41 scarred kidneys. The growth of 38 kidneys was examined using the renal ratio, more than 2 years (mean, 3 years and 1 month) after the operation. The normal renal ratio was restored in 1 of 12 small kidneys with a preoperative size of less than the mean -2SD. The other 11 kidneys remained small, but 6 of these grew with a normal growth curve. The growth of the remaining 5 kidneys was unremarkable. Of the 26 kidneys with a normal renal ratio, 4 became small after the operation, but all the others had growth within the normal range.

Key words: Vesico-ureteral reflux — antireflux surgery — reflux nephropathy — small kidney — renal growth

Introduction

Antireflux surgery is known to prevent reflux nephropathy (RN) due to vesico-ureteral reflux (VUR) and to maintain satisfactory renal function. VUR, on the other hand, is reported to resolve spontaneously by conservative treatment in 60–85% of undilated VUR ureters and 25-40% of dilated VUR ureters (Edwards et al. 1977; Bellinger, 1985). For this reason, the indications for antireflux surgery are controversial among investigators, despite the very high success rate (more than 95%) of the surgery. In this study, the results of antireflux surgery in children with VUR were analyzed.

Subjects and Methods

This study involved children with VUR who could be followed for at least 6 months after antireflux surgery, performed between January, 1978 and June, 1989. The children included 20 males and 19 females (65 renal units). VUR was graded according to the International Classification (International Reflux Study Committee, 1986), and the pyelonephritis grade (PG) was determined on the basis of Ikoma’s system (Ikoma et al. 1986). RN was diagnosed by IVP, CT, or 99mTc-DTPA renoscintigraphy. Renograms were recorded for 25 minutes after intravenous injection of the radioisotope, and the patterns (Machida, 1961) and peak time (T max) were examined. The renal growth was evaluated, using the renal ratio (RR); which is the longitudinal renal length divided by the length of L2 plus its disc (Orikasa, 1977). Antireflux surgery was performed using the Politano-Leadbetter method or the Paquin method, and ure-
teral tapering was performed, if there was marked ureteral dilatation.

Results

The preoperative VUR grade in the 65 renal units was II in 2%, III in 26%, IV in 35%, and V in 37%. The disease was primary VUR in 24 patients and secondary VUR in 15. The major conditions underlying secondary VUR were neurogenic bladder in 6, operation for anal atresia in 3, complete double ureter in 2, ureteroceles in 2, and posterior urethral valves in 2. In patients with secondary VUR, antireflux surgery was performed only when no improvements in VUR were observed after the primary disease was treated by surgery, drug therapy or clean intermittent catheterization (CIC) for at least 1 year. The age of the patients at the time of the operation was less than 3 years in 6 and 3 years or above in 33 patients.

Of the 65 renal units, the renographic pattern improved, postoperatively, from M₁ or M₂ to N in 24 of 51 renal units and from L to M₂ in 3 of 14 renal units.

A T max was not observed in renograms during the 25 minutes after the injection of the radioisotope in 46 renal units (Fig. 1○). It was observed in the remaining 19 units after a mean of 8.03 minutes (Fig. 1★). After the operation, the T max was still unobserved within 25 minutes in 14 renal units of the former group (Fig. 1◆), but it appeared after a mean of 8.45 minutes in 32 renal units (Fig. 1◇). In the latter group, the postoperative interval between the injection and the occurrence of T max was shortened significantly (p<0.01) to a mean of 3.09 minutes (Fig. 1○).

Changes in PG after antireflux surgery were then studied. Scarring of calices and renal papilla improved from PG-I in 18 of 24 renal units. In scarred kidneys showing PG-II or more advanced scarring, improvements from PG-II to PG-I were observed in only 2 kidneys and from PG-III to PG-II in only 1 kidney.

Fig. 2 shows a kidney from a female with bilateral primary VUR, who was 3 years old at the time of the operation. (a) shows ⁹⁹ᵐTc-DTPA renoscintigrams obtained 3 and 6 minutes after injection of the radioisotope. Both kidneys showed scarring of PG-II (arrows), and the left kidney was small. (b) shows renoscintigrams 6 years after the operation. Renal scarring had disappeared, and the left kidney had grown to a normal size and attained a length equal to the right kidney.

Renal growth after antireflux surgery was studied in 38 renal units more than 2 years (mean 3 years and 1 month) after the operation (Fig. 3). There were 12 kidneys with a renal ratio of less than the mean -2SD, and these were regarded as small kidneys. The RR of 11 of these kidneys remained less than the mean -2SD even after the operation, but 1 kid-
ney attained a normal RR. However, of the 11 kidneys that remained small after the operation, 6 had grown, showing growth curves similar to those of normal kidneys. Of 36 kidneys with normal preoperative RRs, 4 kidneys were less than the mean -2SD. In 3 of these kidneys, the apparent length of the kidney had increased preoperatively due to hydronephrosis associated with VUR. The other 32 kidneys showed growth within the normal range.

Fig. 2. 99mTc-DTPA renoscintigram before and after a bilateral antireflux operation in a 3 y/o girl.
Antireflux surgery reduces the water hammer and ensures a reduction of the risk of pyelonephritis. This prevents progression of the functional impairment of the refluxing kidney and induces subsequent renal growth (Orikasa et al. 1977; Mundy et al. 1981; Scott et al. 1986).

Analysis of the renographic pattern also indicated a marked alleviation or disappearance of the water hammer in this study. A normal pattern was restored from M₁ or M₂ in 24 of 51 renal units, and the non-functional L pattern improved to M₂ in 3 of 14 renal units (Noda et al. 1990). Moreover, the T max of the renogram, which was not observable in 46 renal units before the operation, had a mean of 8.45 minutes after injection of the radioisotope in 32 of these renal units after the operation. The interval to the appearance of T max was also shortened significantly (p<0.01) from a mean of 8.03 minutes before the operation to a mean of 3.09 minutes after the operation in the remaining 19 renal units. However, the effects of antireflux surgery on PG were unremarkable. PG-I scarring of calices improved markedly, but improvements from PG-II to PG-I were observed in only 2 kidneys and from PG-IV to PG-III in only one kidney. Scarring of the kidney is generally considered to be irreversible, but improvements are occasionally observed with imaging techniques. This may be explained by improvements or compensation in the residual nephron function at the site of the injury due to improvements in the renal blood flow from the removal of the back pressure by the antireflux surgery (Konda et al. 1989). This speculation is supported by the postoperative improvements in GFR, despite the presence of scarring before the operation (Scott et al. 1986).
Concerning renal growth, kidneys with a normal RR before the operation maintained a size above the mean -2SD, with 4 exceptions. On the other hand, of the 12 small kidneys with a preoperative RR less than the mean -2SD, only 1 recovered to a normal size. The other 11 kidneys remained small even after the operation, but 6 of these had growth curves that paralleled the normal growth curve.

Pompino and Kocabasoglu (1982) reported cases in which small kidneys grew to a normal size after the operation. The current results were consistent with this report and further indicate that small kidneys can grow at the same rate as a normal kidney. These changes are considered to be due to improvements in the renal circulation associated with the alleviation of the water hammer by the operation.

From these observations, antireflux surgery is considered to prevent reflux of urine, reduce the risk of pyelonephritis, and induce subsequent growth of the kidney. These findings encourage the establishment of a method for early diagnosis of VUR and aggressive therapeutic intervention.

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References


