

Urinary Tract Infection in Children with Myelomeningocele

D. G. W. COOPER

From the Department of Surgery, Queen Mary's Hospital, Carshalton, Surrey

This report deals with the incidence and progress of urinary tract disease in all children with myelomeningocele seen and treated in this Unit between the years 1958 and 1965.

During this period 415 (195 boys, 220 girls) cases were seen and 289 (70%) of these children are still alive. But, though 72% survived their first birthday, only 50% of those born more than 5 years ago have survived their fifth birthday, and this latter figure gives a better idea of the real mortality of these cases. Of those over the age of 2 years, 94% had obvious neurological involvement, of various degrees. Some of the problems associated with the management of the urinary tract in these children are similar to those encountered in other types of paraplegia in which urinary tract disease is the major cause of death (Hackler, Dalton, and Bunts, 1965). The over-all mortality figures from this cause range from 24 to 57% (Bunts, 1959; Dalton, Hackler, and Bunts, 1965). Will this be the case with myelomeningocele children?

Continnence

Only 13% of all cases were continent (Table I). Those children who developed hydrocephalus had a higher incidence of neurogenic bladder, and of urinary tract infections, and 93% had neurogenic bladders compared to the over-all incidence of 87%. Of the continent children, 57% were boys (Fig. 1) and as there were only 47% of boys in the whole series this represents a true higher incidence of continence in males. The sex distribution of infection and of upper urinary tract dilatation can also be seen from Table II.

Infection

The over-all incidence of infection in the children in this series was 37%. Fig. 2 shows that the incidence of urinary tract infection increases with age, and that only 40% of our cases reach their fifth

TABLE I
Neurogenic Bladder in 415 Cases of Spina Bifida

	Myelomeningocele	Myelomeningocele + Hydrocephalus
Total No.	95	320
No. with neurogenic bladder	64	298
Percentage with neurogenic bladder	67	93

Over-all incidence of neurogenic bladder 87%.

birthday with uninfected urinary tracts. In those children who die, it is once again seen that there is a gradual increase in the urinary infection rate with the passage of time. There appears to be no age during their first five years of life at which these children are especially liable to develop urinary tract infection.

The level of the spinal lesion had no relation to the incidence of urinary tract infection, but children with encephaloceles were less likely to develop urinary tract infections (Table II).

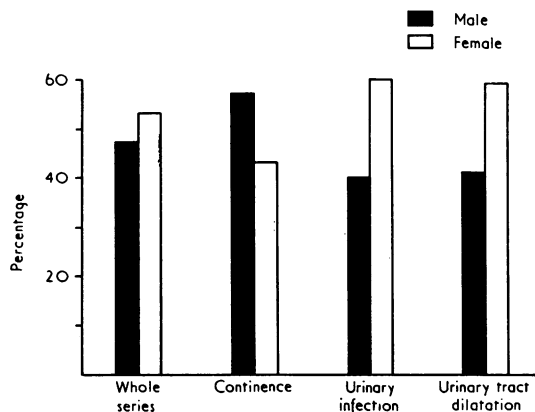


FIG. 1.—Sex distribution of continence, infection, and upper urinary tract dilatation.

TABLE II
Relation Between Level of Lesion and Number with Urinary Tract Infection

Level of Lesion	No. With Urinary Tract Infection	Percentage With Urinary Tract Infection
Occipital	1	4
Cervical	0	—
Thoracic	4	28
Thoracico-lumbar	23	35
Lumbar	46	41
Lumbo-sacral	22	36
Sacral	3	21

Over-all infection rate 37%.

The average age at death of those dying with urinary tract infection is higher than in those dying without this complication (15.5 months compared with 4.9 months in the uninfected group).

TABLE III
Percentage of Cases Infected By Different Organisms

Organism	Percentage of Whole Group (154)	Percentage of Iatrogenic Infections After Cystography (8)	Percentage of Out-patient Cases (22)
<i>Proteus spp.</i>	47	75	50
<i>Esch. coli</i>	30	25	19
<i>Ps. pyocyanea</i>	21	50	9
<i>Kleb. aerogenes</i>	12	12	4
<i>Esch. coli/Proteus</i>	15	—	4
<i>Proteus/Ps. pyocyanea</i>	2	—	4
<i>Staph./Proteus</i>	—	—	4
Others	17	—	—

Table III shows the organisms involved in the urinary tract infections investigated. The pattern of organisms in the whole group has been compared with that found in a routine out-patient check on every child seen with spina bifida. In both these groups proteus is the commonest infecting organism. It is possible that there is a significant reduction in infection by *Ps. pyocyanea* in non-hospitalized cases. The iatrogenic group consists of cases where infection of the urinary tract has followed the catheterization necessary for carrying out cystographic examinations. Once again, proteus is the commonest organism involved, but the numbers are small. Urinary tract infections in these children commonly begin with a single organism, but the chances of infection with multiple organisms increase with age. As one infection follows another, the organisms tend to change (Table IV).

All children with spina bifida cared for at home and attending as out-patients had their urine tested

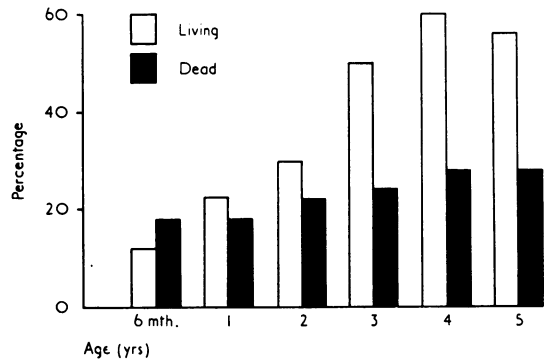


FIG. 2.—Urinary infection rate in different age-groups.

over a nine-month period. Infection was present in only 26%, as compared to the over-all figure of 37%.

Dilatation of Upper Urinary Tract

Dilatation of the upper urinary tract was observed in 33% of the children with urinary tract infection (51/154), whereas only 15% of those in the uninfected group showed these changes (39/261). The over-all number showing dilatation of the upper urinary tract is 22%.

In those children who developed dilatation of the upper urinary tract, the changes were unilateral in 37% (34/91).

Fig. 3 shows that the over-all incidence of upper urinary tract dilatation will level off at 30% in spite of more intensive investigation of these children. The incidence of upper urinary tract dilatation increases with age in a similar manner to that of urinary infection.

In this series, dilatation of the upper urinary tract was more common in girls (see Fig. 1). Table V shows that children with a thoraco-lumbar lesion are more likely to develop dilatation of the upper urinary tract than children with other lesions. In the light of recent work on the innervation of the

TABLE IV
Incidence of Multiple Infection

Age (yr.)	Percentage With Multiple Organisms
1	47
2	50
3	59
4	62
5	64
6	77
7	87
8	91

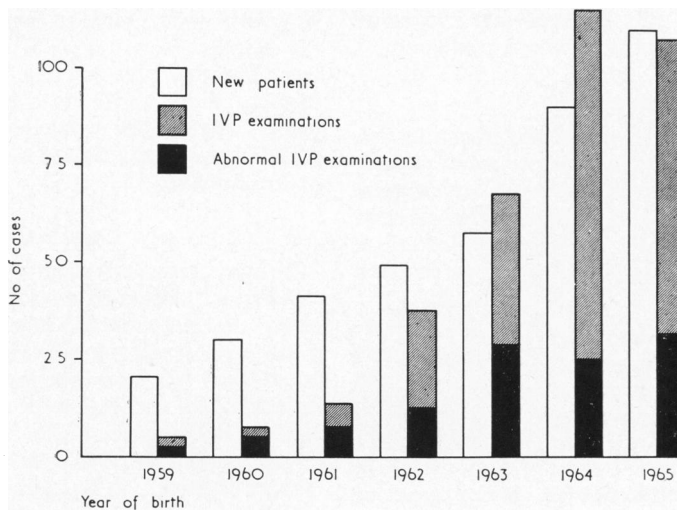


FIG. 3.—Number of patients per year, normal and abnormal findings at intravenous pyelography.

bladder (Tanagho, Hutch, Meyers, and Rambo, 1965; Tanagho, Miller, Meyers, and Corbett, 1966; Tanagho and Smith, 1966), it seems that this difference may be due to the involvement of the sympathetic outflow in children with the higher lesion. Bladder pressures in all phases of micturition tend to be lower in girls (Nunn, 1965), and it is hard to accept the higher prevalence in girls of dilatation in the upper urinary tract as being due to mechanical obstruction. Many of these cases of upper urinary tract dilatation may be secondary to infection. This conclusion is based on the finding of a high incidence of infection, incontinence, and urinary tract dilatation in girls (see Fig. 1).

It has been shown that, in dogs, infection may cause reflux without any change in the haemodynamics of the bladder (Schoenberg, Beisswanger, Howard, Klingensmaier, Walter, and Murphy, 1964).

It has also been shown experimentally that kidneys with chronic pyelonephritis develop hydronephrosis more rapidly in the presence of urinary tract obstruction (Nicolai, 1964). While the main factor involved in these cases of upper urinary tract dilatation is undoubtedly paralytic involvement of the bladder, the higher incidence of infection in girls may add an important inflammatory element to the cause of reflux.

Urinary tract dilatation did not, in this series, significantly affect the mortality rate during the first five years of life. Over the five-year period of this study the mortality rate in children with dilatation of the upper urinary tract was 25%, and this is little different from the over-all mortality rate in children without these changes (29%). A study of the cause of death in over 1000 treated cases of myelomeningocele confirms the fact that deaths from urinary tract disease are spread equally over the first five years of life.

TABLE V

Relation Between Level of Lesion and Back Pressure Changes

Level of Lesion	Number With Urinary Tract Dilatation	Percentage With Urinary Tract Dilatation
Occipital	0	—
Cervical	1	25
Thoracic	3	19
Thoracico-lumbar	31	43
Lumbar	32	25
Lumbo-sacral	8	12
Sacral	3	19

Reflux

This is classically demonstrated by means of cystographic radiological techniques. However, the hazards of introducing infection into a previously sterile, but almost certainly abnormal urinary tract, during catheterization have been frequently emphasized, and some believe that on these grounds this investigation is not justified in children with spina bifida. We have carried out this investigation on only 55 children: of those coming uninfected to cystography, 42% developed a urinary tract infection as a direct result of this examination; in only

20% of these cases was an abnormal cystogram associated with a normal intravenous pyelogram.

Management

All children with confirmed urinary tract infection have received intermittent symptomatic chemotherapy. It has not been our policy in any of these patients to use long-term prophylactic chemotherapy. However, a few patients, with infections which relapsed on cessation of therapy, have received continuous chemotherapy for long periods.

Dilatation of the upper urinary tract, if progressive, has been treated surgically. 24 children have had urinary diversion procedures, and 21 operations have been carried out on the bladder neck.

Discussion

A group of 415 children with varying types of spina bifida have been closely followed and treated throughout their lives by this Unit. Our figures give a more accurate idea of the incidence of disease in these children as a whole than do figures from urological centres.

Although we would expect to see similarities between the urological problems encountered in these children and those encountered in the management of paraplegia of other origin, this does not appear to be the case. No cases of amyloidosis have been found in any of our necropsies (80% of all those who have died have had a post-mortem examination), whereas amyloidosis has been found in 43-85% of adult paraplegics who die, and has even been incriminated as the cause of renal failure. Stone formation has also been notably absent in our cases. It is possible that the greater flow of urine in children protects them from stone formation, and they have greater resistance than adults to amyloid changes in the presence of chronic sepsis.

Urinary tract disease does not seem to contribute greatly to the mortality during the first five years of life and 40% will survive this period without serious urinary tract infection. We found dilatation of the upper urinary tract in only 22% of our cases, and a much lower rate of infection than that reported by other workers. These low figures are not due to inadequate investigation. It is possible that many of the other recorded series are either of cases relatively untreated by our present standards, or of selected children who already have urological problems. It thus seems that if a large enough group of children with spina bifida are studied, the

prognosis with regards to their urinary tract during the first five years of life is much better than has been thought. By the time they reach their fifth birthday a third will show dilatation of the upper urinary tract, a third will have chronic infection but no dilatation, and a third will show neither but will be incontinent.

Conclusions

Urinary tract infection occurs in 60% of all children with spina bifida during the first five years of life, and is commoner in girls. It is not related to the level of the spinal lesion. It is less common in children who are out-patients. Urinary tract infection does not seem to be a major cause of death in the first five years of life.

Upper urinary tract dilatation occurs in about 30% of all cases. It is commoner in girls; and with spinal lesions affecting the thoracic region. Infection of the urinary tract probably contributes to the causation of dilatation of the upper urinary tract.

Although evidence of urinary tract infection was noted on many occasions at necropsy, in no case was there evidence of amyloid disease, contrasting with the great frequency with which amyloid disease is observed in other types of paraplegia.

Following cystography, infection developed in 42% of cases which were previously uninfected. Abnormality not previously shown by intravenous pyelography was only demonstrated by cystography in 20% of cases.

I would like to thank Mr. H. B. Eckstein and Mr. D. M. Forrest for permission to study their cases.

REFERENCES

- Bunts, R. C. (1959). Preservation of renal function in the paraplegic. *J. Urol. (Baltimore)*, **81**, 720.
- Dalton, J. J., Jr., Hackler, R. H., and Bunts, R. C. (1965). Amyloidosis in the paraplegic. *ibid.*, **93**, 553.
- Hackler, R. H., Dalton, J. J., Jr., and Bunts, R. C. (1965). Changing concepts in the preservation of renal function in the paraplegic. *ibid.*, **94**, 107.
- Nicolai, C. H. (1964). Role of chronic pyelonephritis in the production of experimental hydronephrosis. *ibid.*, **92**, 347.
- Nunn, I. N. (1965). Bladder neck obstruction in children. *ibid.*, **93**, 693.
- Schoenberg, H. W., Beisswanger, P., Howard, W. J., Klingenmaier, H., Walter, C. F., and Murphy, J. J. (1964). Effect of lower urinary tract infection upon ureteral function. *ibid.*, **92**, 107.
- Tanagho, E. A., Hutch, J. A., Meyers, F. H., and Rambo, O. N., Jr. (1965). Primary vesicoureteral reflux. *ibid.*, **93**, 165.
- , Miller, E. R., Meyers, F. H., and Corbett, R. K. (1966). Observations on the dynamics of the bladder neck. *Brit. J. Urol.*, **38**, 72.
- , and Smith, D. R. (1966). The anatomy and function of the bladder neck. *ibid.*, **38**, 54.