

REED NESBIT AND PEDIATRIC UROLOGY

DAVID A. BLOOM, M.D.

JACK LAPIDES, M.D.

HARRY SPENCE, M.D.

From the University of Michigan Medical Center,
Section of Urology, Ann Arbor, Michigan, and Dallas, Texas

ABSTRACT—Objectives. To ascertain the pediatric urology experience and contributions of Reed Nesbit, a urologist known primarily as an educator, transurethral resectionist, and prostate expert.

Methods. The writings of Nesbit and appropriate background references were analyzed.

Results. Nesbit's contributions to pediatric urology, particularly the Cabot-Nesbit orchidopexy, the buttonhole preputial transposition, the dorsal tunical tuck for chordee, and the elliptical anastomosis were significant.

Conclusions. Nesbit's contributions to pediatric urology were innovative and enduring.

Reed Nesbit was one of the foremost figures in the burgeoning specialty of genitourinary surgery during his years of practice between 1928 and 1968. His name became synonymous with transurethral resection, and practitioners from around the world flocked to Ann Arbor to study his methods. Nesbit achieved prominence in the medical profession far beyond his specialty, rising to the Presidency of the American College of Surgeons in 1967. Omitted in standard recollections of his contributions are his efforts in pediatric urology. As were most well-trained urologists of his era, Nesbit was versatile in all areas of urology, including those that have since developed into subspecialties. In fact, his contributions to pediatric urology were significant and their analysis offers a perspective of the emerging concepts, diagnostic modalities, and operative procedures central to contemporary pediatric urology.

EDUCATION AND CAREER OF REED NESBIT

Reed Miller Nesbit was born in 1898 in Concord, California, a small rural community east of San Francisco Bay. In 1917, he delivered his high school graduation oration on John Muir. He was educated at Leland Stanford Junior University, receiving a BA in 1921 and an MD in 1924. Stanford's medical school and Nesbit's experience there

were shaped by global events and some Michigan factors. Two years after the great earthquake and fire of 1906, Stanford took over the precarious Cooper Medical College in San Francisco. Flexner¹ criticized the resulting clinical programs in his report of 1910 and the institution, no doubt, responded to the complaints. A formal evaluation of Stanford's medical department in 1914 by Victor Vaughn, the influential Dean at Michigan, was favorable.² Albion Walter Hewlett, another important influence from Ann Arbor, was an eminent clinician and scientist who held the chair of internal medicine at Michigan from 1908 until 1916 when he assumed the chair at Stanford.³ The following year Stanford opened its own new hospital in San Francisco, next to Cooper's old clinical facility. World War I interrupted Hewlett's new job and took him to the front in France. When the war ended in 1918, Hewlett returned to Stanford where he became a dominant intellectual force in the medical school and on the patient wards during Nesbit's studies from 1921 to 1925. Nesbit then interned at Fresno County Hospital, where alumni from the University of Michigan Medical School dominated the surgical staff. The medical center at Ann Arbor was, therefore, not unfamiliar to Nesbit. Through an exchange of telegrams, Nesbit was recommended to Hugh Cabot, the director of surgery at Michigan, and an appointment was arranged as assistant surgical resident. Nesbit traveled east to the brand new thousand bed University Hospital in Ann Arbor, where he recalled his

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FIGURE 1. *Reed M. Nesbit's portrait in the composite picture of the University of Michigan Medical School Class of 1932. Nesbit was 34 years old at that time.*

first day of work on August 1, 1925, when an administrator, "... showed me the room I'd be sharing with another new resident, a fellow from Harvard named Charles Huggins."⁴ This was an uncommonly successful pair of roommates; in 1966 Huggins won the Nobel Prize for his work with hormonal manipulation of prostate cancer.

Cabot had come to Ann Arbor in 1920, 5 years before Nesbit, as Director of the Surgery Department and Dean of the Medical School. Cabot was primarily a genitourinary surgeon, having been trained in the tradition of Henry J. Bigelow of Boston and having founded the Genitourinary Clinic at the Massachusetts General Hospital in 1910. Cabot's focus, no doubt, was a motive for Nesbit's selection of Ann Arbor and dominated his training there. Davenport described Cabot's philosophy of instruction thus:

Cabot was particularly interested in training urologists. A urologist should not be narrow, he said, confining himself to one organ or sex. He should have sound medical training including at least a year of medical internship before training in general surgery. Finally, he should become the disciple of a well-trained urologist, and he should spend

more than a few months becoming a competent cystoscopist. The young urologist will encounter social problems: marriage, divorce, diseases and disabilities, and he must study social questions. "He will need to bring to these questions the best that his mind affords, for they are intricate, involve time honored if shop worn moral standards, and arouse passionate defence of long standing, if imaginary rights."⁵

Cabot's influence on Nesbit was enormous, during training and beyond; many of the Nesbit papers contained specific affectionate references to his old chief. In 1926, Nesbit became an Instructor in Surgery and was promoted to Assistant Professor 3 years later. The following year, 1930, Cabot was relieved of his responsibilities as Dean and Director by the University Regents "in the interests of greater harmony in the Medical School."⁶ Cabot departed abruptly for the Mayo Clinic. Frederick Collier replaced Cabot as Director of Surgery and reorganized the Department of Surgery to include a Section of Urology with Nesbit in charge. Given Cabot's preference for the terminology "genitourinary surgery," the designation of the unit as the Section of Urology seems to have been a deliberate effort to define a new era. Nesbit remained at that post for 38 years, which represented the formative era of modern genitourinary surgery (Fig. 1). His 83 urology residents, trained between 1930 and 1968, were provided sound exposure to genitourinary practice, including pediatric urologic concepts and procedures. A textbook was a logical product of this teaching program and in 1942 Nesbit published the first edition of *Fundamentals of Urology*. In 1950, two of his residents, Lapides and Baum, independently authored *The Pathophysiology of the Urinary Tract and the Male Reproductive System*, a unique physiologic perspective of urology, which Nesbit ultimately incorporated in his fourth edition of *Fundamentals of Urology* in 1953.^{7,8} Although first and foremost a clinical academician, Nesbit was quick to send a curious resident into a laboratory to pursue an idea. Nesbit's residents became leaders in academic medicine and pioneers in state-of-the-art clinical practices. His surgical reputation was largely focused on transurethral resection and prostate carcinoma; however, his work also included substantial contributions to pediatric genitourinary surgery, some of which remain viable in current practice. Nesbit retired from the University of Michigan in 1968 and he died in 1979.

EARLY YEARS OF CHILDREN'S GENITOURINARY SURGERY

Well into the 20th century, few urologists showed interest in children's genitourinary problems.⁹ This interest was a minor facet of most surgical practices,

although it must have been viewed as a particularly controversial and newsworthy aspect of urology. For example, in 1901, Charles Mayo's experience with hypospadias repair in 4 patients was worthy of a major communication in *The Journal of the American Medical Association*.¹⁰ The tools for pediatric urologic investigation lagged behind those for adults. Adult cystoscopic instruments were in use throughout the latter 1800s, whereas the first practical pediatric cystoscope, a 10.5 F instrument with an incandescent lamp at the tip, was not developed until 1907 by Edwin Beer, an innovative genitourinary surgeon in New York City.^{11,12} Pediatric tools permitted identification of specific pediatric urologic conditions. In 1919, Young, Frontz, and Baldwin¹³ at The Johns Hopkins Hospital in Baltimore, investigating pediatric obstructive uropathy, defined the clinical entity of posterior urethral valves, one of the index diseases that shaped the identification of pediatric urology. McCarthy increased the sophistication of pediatric instruments in 1929 with a miniature cystoscopy set that consisted of an 11 F observation piece, a 13 F single channel instrument, and a 15 F double catheterizing device. The importance of the channels was their use for retrograde urography, the primary means of upper urinary tract imaging. Although Swick and other investigators were experimenting with intravenous contrast agents, the retrograde method prevailed until well into the 1930s.¹⁴ Campbell in 1934¹⁵ reported on Diodrast, Iopax, and Skiodan as intravenous urography agents in 381 children. Thus, as Nesbit began his practice of genitourinary surgery, the critical tools and imaging modalities were newly in place for pediatric applications.

NESBIT'S PEDIATRIC UROLOGY

Of Nesbit's 162 scientific articles, 26 were specifically related to pediatric urology. Ten dealt with obstructive uropathy, urethral valves, nephropathy, and renal failure. Seven discussed penile reconstruction, hypospadias, chordee, and diphallus. Nine other articles included infant urography, megaureter, urinary retention during tetanus, appendicovesical fistula, Wilms' tumor, and a symposium on pediatric urology. In addition, many of Nesbit's other communications discussed pediatric patients and issues highly relevant to pediatric genitourinary practice. The important concepts that seem to have endured particularly well include the Cabot-Nesbit style orchidopexy, the buttonhole preputial transposition, the dorsal tunical tuck for chordee, and the elliptical anastomosis.

KIDNEY AND OTHER URINARY TRACT INFECTIONS

Nesbit's first clinical article, written in 1930, discussed coccal infections of the kidney in 6 youngsters, aged 10 to 19 years.¹⁶ The infections were believed to be blood borne, although several patients had obvious lower tract sources, including coital trauma and epididymitis. In 1932, Nesbit¹⁷ analyzed 48 cases of staphylococcal renal infection in his first sole-authorship clinical article. He quoted Scott's work at the Brady Urological Institute in Baltimore where the importance of positive blood cultures had been emphasized. Defloration and catheter chill were typical etiologic factors, but the route to the kidneys was unequivocally declared to be hematogenous. In 67% of patients, foci, such as boils or upper respiratory infection, were considered sources of the bacteria. In 1940, Nesbit¹⁸ detailed 80 cases of renal infection followed "from onset to conclusion." Ages were 2 to 67 years and urine was uninfected in only 52% of the patients.

An article on urinary tract infections in 1947, although not specifically related to children, outlined a broad approach to management of lower tract infections.¹⁹ Methods of collection were analyzed, and examination of stained centrifuged sediment was advocated. "The urine must be collected in a manner that will eliminate the possibility of contamination.... In urine collected in such a fashion, pyuria signifies urinary infection." At this time, Nesbit admitted the rare exception to the hematogenous route to the upper tract in this statement: "Only occasionally will the infection be primary in the lower urinary tract." Analyzing current treatment regimens, Nesbit downplayed methenamine on scientific grounds: "It is ineffective in an alkaline medium, since it is not an antiseptic in its own right." He did, however, recognize frequent empirical success with it. The disadvantages of mandelic acid were also outlined and three new antimicrobials (sulfonamides, penicillin, and streptomycin) were described in detail.¹⁹ An article on pharmacologic treatment of urinary tract infections in 1952 provided a state-of-the-art review.²⁰ "Stasis of urine is the commonest predisposing cause for infection, and likewise, the commonest obstacle to cure." Nesbit's last article on infections, a symposium on pediatric urology in 1955 with Baum, showed an important shift in belief; hematogenous coccal infections were now attributed as the source of infection in only 25% of cases, whereas lower tract bacillary infections were blamed for 75%.²¹ Still, the authors commented:

A study of the pathogenesis of acute urinary tract infections in children might not be necessary today, except for

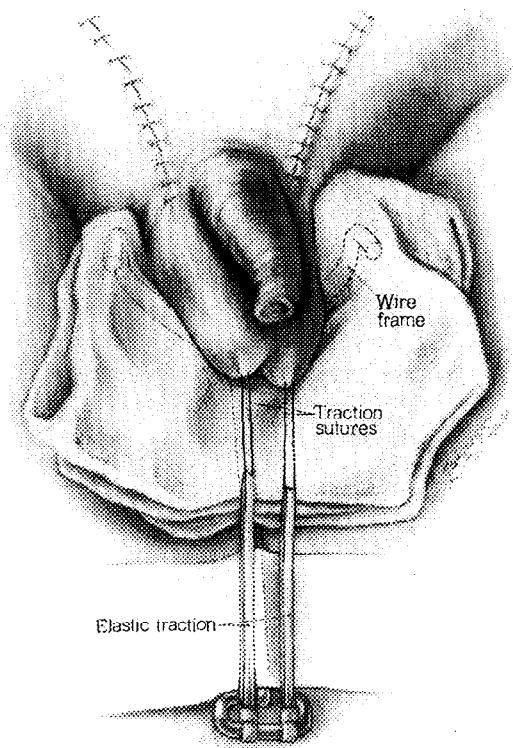


FIGURE 2. Orchidopexy traction device.²⁵ (Redrawn by Jaye Schlesinger from Jean Young's original drawings.)

purely academic purposes, had modern advances in the development of antibacterial agents truly satisfied the goal of Ehrlich.... Indeed one can but marvel that kidney infections occur so rarely among patients who are known to have bacteria in the bladder urine, and reflect upon the statement made in this connection by Hugh Cabot thirty-eight years ago in his dissertation upon the Doctrine of the Prepared Soil.... "It is not rare to find in the active, devoted young hospital surgeon a state of mind in which he almost believes that bacteria are the cause of infection. He appears to forget that infection is a result, and that bacteria in and of themselves can do nothing except in contact with living tissue and then, often, only under highly specialized conditions."

This was the era of the so-called battle of the catheter, when many argued that the act of catheterization recklessly introduced bacteria into a sterile system.²² To this point Nesbit wrote, "The hazards of neglected obstruction may be infinitely greater than the hazards of catheterization."¹⁸ The doctrine of the prepared soil was a great bit of clinical wisdom that Nesbit promoted far more in 40 years of teaching residents than did its putative originator.

CRYPTORCHIDISM

One hundred years ago surgical correction of cryptorchidism was controversial, with some au-

thorities recommending trusses and others debating various surgical repairs. Keyes²³ influential book on genitourinary surgery in 1890 stated that a truss was preferred if a testis was palpable in the inguinal canal and could be transiently manipulated into the scrotum. Regarding higher lying testes, he wrote, "the choice lies between letting it alone...or cutting down upon it and attempting to replace it in the scrotum...if the cord is long enough. Otherwise the operator must be prepared to castrate." In 1912, Ramon Guiteras,²⁴ the genitourinary surgeon in New York City who founded the American Urological Association, opined that the operative procedure of choice was the Bevan method. This consisted of mobilization of the testis, suturing it to the scrotal fundus, and placing a purse-string suture at the neck of the scrotum to prevent ascent. The two-stage Torek orchidopexy was the other principal surgical approach during Nesbit's training and consisted of testicular mobilization, bringing it down into the scrotum, passing the testis laterally out a scrotal window, and fixing the testis to fascia lata of the inner thigh. The scrotal and thigh incisions were sewn together and the patient was immobilized in the hospital for 10 to 12 days. Three months later the scrotum and thigh were separated and the testis was brought back into the scrotum where it was secured.

In 1931 Cabot and Nesbit described another method of single-stage orchidopexy. This was Nesbit's second clinical article and was published 1 year after Cabot's departure from Ann Arbor.²⁵ The authors noted that, since the first recorded orchidopexy, attributed to Rosenmerkel in 1820, 30 different surgical methods had been described. In clear language and with precise anatomic detail that reads like a modern surgical atlas, Cabot and Nesbit described a simple method of testicular mobilization. A scrotal space was created by finger dissection. A long catgut suture with a straight needle at both ends was passed through the remains of the gubernaculum, at the lower pole of the testis. The suture was tied and the two needles were passed into the base of the scrotum and out the skin 0.5 cm apart. Rubber bands and a wire frame maintained constant gentle traction for 12 days in the hospital (Fig. 2). Over a 2-year period, 25 patients, aged 3 to 19 years, were operated on. Six patients had bilateral undescended testes. Follow-up of 17 patients revealed normal scrotal location in 10 and upper scrotal position in 7. In 13 patients the testes were a normal size. Two patients had slightly larger testes, 1 had a slightly smaller testis, and only 1 was atrophic. Commenting on the Bevan orchidopexy, and

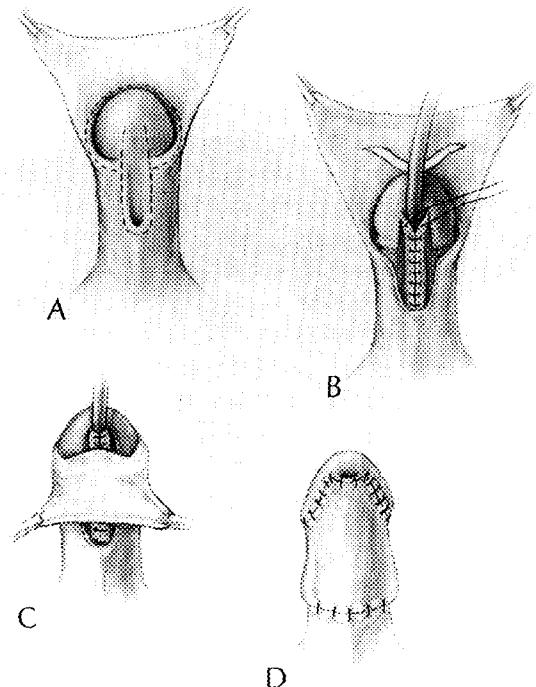


FIGURE 3. Buttonhole transposition of the prepuce, in Nesbit's last clinical article.³⁸ (Redrawn by Jaye Schlesinger from original drawings.)

anticipating the Fowler-Stephens technique, Cabot and Nesbit wrote that it:

has the objectionable feature of the purse-string above the testis which may interfere with the circulation.... The...operation...has the further objectionable feature of dividing the spermatic vessels in those instances in which complete descent is otherwise impossible. Bevan excused this procedure by stating that the deferential artery that accompanies the vas is sufficient to supply the testis. Experience has hardly borne out this assertion.

The authors further commented that the Torek methods are "formidable procedures and are applicable only in cases in which complete descent can be obtained." This was Nesbit's only article entirely on cryptorchidism. In 1935 Cabot,²⁶ then at the Mayo Clinic, reported this same method as sole author without reference to his prior article with Nesbit. The Cabot-Nesbit approach did not immediately join the clinical mainstream. In 1937 Campbell's authoritative textbook on pediatric urology stated that two operations for undescended testis were in vogue, the Bevan and the Torek, and, of these, the Torek was preferred.²⁷ Roth,²⁸ in Patton's account of urologic surgery during World War II, wrote:

The Torek operation, Bevan's operation, and other individual modifications of these corrective procedures were

done rather commonly, but they were much more frequent in hospitals in the zone of interior than in overseas installations, and there is a strong and logical implication that trained urological surgeons attempted salvage more often than general surgeons did.

By 1953, Robert Gross²⁹ in Boston preferred a Cabot-Nesbit style orchidopexy, which he outlined in his classic book on pediatric surgery. A silk suture on the testis and rubber band secured to an adhesive dressing on the contralateral thigh maintained traction in the hospital for 6 days. No reference was made to the Cabot-Nesbit article. The Cabot-Nesbit orchidopexy was the key step between the Bevan, Torek, and the other early methods and the nearly ubiquitous contemporary method that utilizes a Cabot-Nesbit dissection with fixation into a subcutaneous scrotal pouch.³⁰ Elastic traction and lengthy hospitalizations are a matter of history, but the operative dissection has never been better described than by Cabot and Nesbit in 1931.

In 1948, Nesbit and Lapidés³¹ published an article on hormones in urology. The discussion of cryptorchidism distinguished undescended testis from pseudocryptorchidism (ie, the retractile testis), outlined reasons that "No testis should be allowed to remain undescended after the onset of puberty," and advocated surgical correction for unilateral undescended testis. In bilateral instances, however, the authors recommended leaving the gonads alone until the onset of puberty and then using a trial of chorionic gonadotropin (100 to 500 IU up to six times a week for 8 weeks) followed by an operative procedure if descent does not occur. Eunuchoidism and eunuchism were also discussed.

GENITAL RECONSTRUCTION

Nesbit's first article with a resident described a case of diphallus in 1933.³² This report offered a historical review and analysis of the 44 preceding diphallus communications in the literature. The authors performed cystourethroscopy but did not describe a surgical repair. Nesbit's first hypospadias paper was presented in Williamsburg, Virginia, to the American Association of Genito-Urinary Surgeons in 1940. This was a two-stage repair, in which the first consisted of chordee correction and resurfacing the penile ventrum using prepuce brought anteriorly by a buttonhole maneuver. "Experience with a number of patients having this first stage procedure has demonstrated its value." The buttonhole was an important contribution and it is still in general use (Fig. 3). The next step consisted of a Duplay urethroplasty, closed with subcutaneous stainless steel sutures.³³

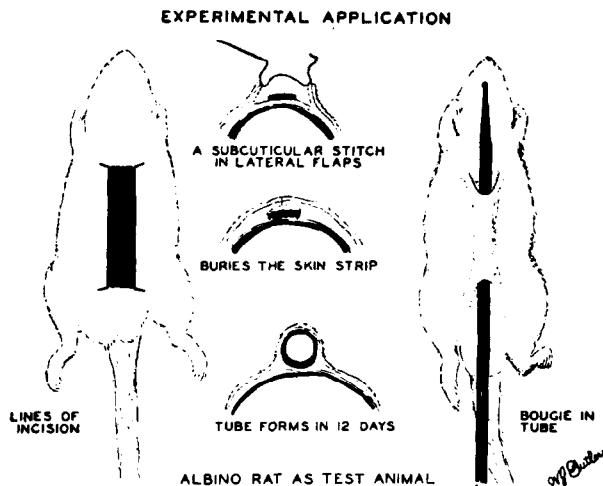


FIGURE 4. *Rat model for Denis Browne urethroplasty.*³⁴

In 1950, Nesbit wrote this in the *Journal of Urology*:

A new and extraordinary technique for constructing the urethra in treating hypospadias has been reported recently by observers returning from Mr. Denis Browne's clinic in London.... There are no reports in the literature describing Mr. Denis Browne's technique, and it is not our purpose to preempt his right to prior publication. However, this novel procedure has provoked an inquiry into the basic principles....

Nesbit's inquiry, his only pediatric laboratory investigation, utilized a male rat model. A strip of abdominal skin was created by two parallel incisions, after clipping the hair. The strip was buried under lateral flaps, leaving the skin at either end continuous with the surface skin. Complete circumferential epithelialization of the buried strip occurred in 12 to 14 days, by which time the neoepithelium comprised one fifth to one third of the total circumference of the new tube. Some contraction of neoepithelium took place over the next 40 days, but after that the tubes appeared stable³⁴ (Fig. 4).

During Nesbit's era of practice, the typical repair of hypospadias involved two main stages. One of the attendant problems was meatal stenosis after the first stage. In 1954, Nesbit, Charles MacKinney (a resident), and Reed Dingman (professor of plastic surgery) reported a method of Z-plasty to correct stricture of the interval meatus.³⁵

Also in 1954, Nesbit³⁶ produced an article on chordee without hypospadias, a disorder that only recently has achieved due recognition. "Congenital chordee without hypospadias is one of the rarest of all genital tract anomalies." Chordee, in this case report, was due to a bowstring effect of

the anomalous urethra, which Nesbit corrected by dividing it in the mid-penile region. After 6 months, he restored continuity using a Denis Browne urethroplasty (the name was misspelled as Dennis Browne). In most instances of chordee in subsequent reports, Nesbit did not have to disturb the urethra to fix the bend. In 1964 he presented this topic to the Genito-Urinary Surgeons and detailed 3 cases.³⁷

A student at the University of Michigan had noticed all his life that during erection the penis deviated to one side in the shape of a banana... There appeared to be two major alternative methods of correction: 1.) to perform some sort of plastic procedure which would lengthen the short side, or 2.) to shorten the longer convex corpus. The latter was elected for practical reasons and this was accomplished by simple plication of the fascia on the lateral aspect of the longer corpus. Six vertical rows of plicating sutures of heavy silk were used.... No fascia was excised.

The 2 other cases had downward bending, true chordee without hypospadias. "The deformity appeared to be due solely to a disparity in length between the upper convex fascia and the lower concave fascia of the corpora." In the second patient, Nesbit modified his operation by mobilizing the dorsal neurovascular bundle and excising four symmetrical elliptical segments "on the upper surfaces of the 2 corpora with only occasional incision into the erectile structures" (Fig. 5). The last patient was operated on by Lapides using Nesbit's technique. "A recent report on Dr. Lapides' patient indicates near perfect straightening and, as in the previous cases, no interference with erections." Correction of chordee remained a consistent interest of Nesbit in his later years; in 1966 he presented this topic again to the Genito-Urinary Surgeons and it was the subject of his last article,³⁸ which was published in the *Journal of Urology* in 1967.³⁹ He referred to this method as a "check-rein effect."

IMAGING

In Nesbit's early years of practice, intravenous urography held great appeal for urinary tract diagnosis, but the problems of intravenous access with safe and effective contrast agents restricted wide utilization. At a meeting of the American Urological Association in White Sulfur Springs, West Virginia, Nesbit proposed a subcutaneous injection method for infants and children. He used an adult dose of Diodrast (20 cc of 35% Diodrast in 80 cc normal saline). The skin over the scapula was anesthetized and 50 cc of the isotonic material was injected per side. Radiographs were obtained at 10, 20, and 30 minutes. Experience with 31 cases, aged 1 day to 9 years, was recounted and uograms of 2 children

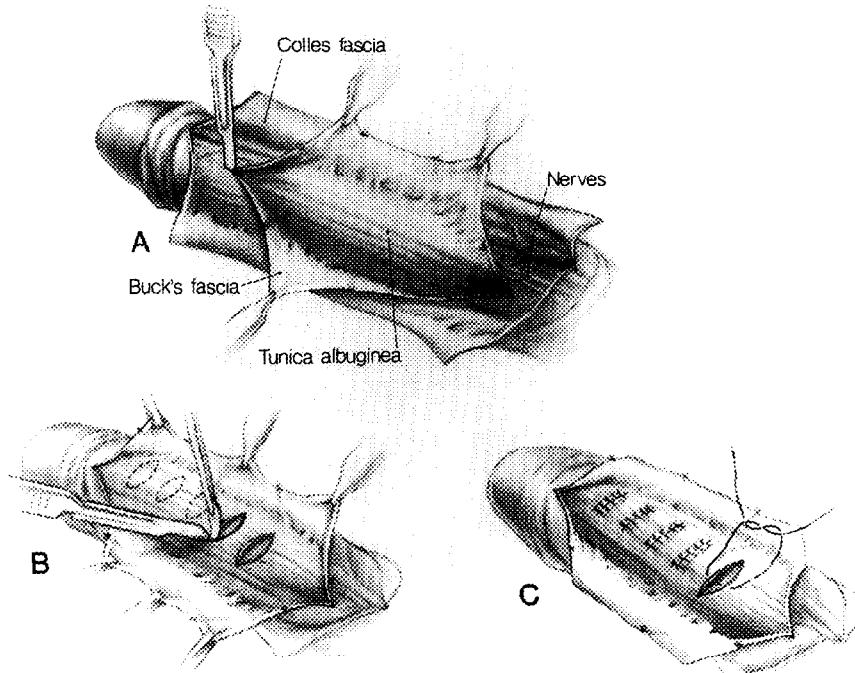


FIGURE 5. Correction of congenital curvature of the penis without hypospadias.³⁷ (Redrawn by Jaye Schlesinger from original drawings.)

with Wilms' tumor and 2 with bladder exstrophy were reproduced.⁴⁰ An article with Valk in 1947⁴¹ described the use of oblique projection in urography. This modest refinement of technique was intended for visualization of upper tract calculi, but would become an important mainstay of upper and lower tract imaging for children in years to come. A splendid history of genitourinary applications of roentgenology was published in 1956.⁴² Nesbit recounted how:

upper tract visualization was discovered fortuitously by Volcker and von Lichtenberg while making roentgenograms of the bladder using colloidal silver (Collargel). One of their plates demonstrated that the solution had entered the ureter and renal pelvis and outlined these.... Later deliberate attempts were made to fill the renal pelvis by means of ureteral catheters which resulted in successful pyelograms. They reported their results in 1906, and called attention to "pyelography" (which they named) as an aid to diagnosis.

Thus was born retrograde pyelography. Further in the article, he wrote:

Stewart of Los Angeles, California has recently observed that delayed cystograms and cystograms made during micturition will often reveal ureteral reflux not demonstrated by immediate cystograms in children who suffer from recurrent urinary infection.

Nesbit commented that these studies could reveal upper tract dilation by virtue of vesicoureteral reflux in children with normal excretory urograms. This was one of the few preludes in the literature to the voiding cystourethrogram, now an integral imaging study in pediatric urology. Nes-

bit⁴³ commented on reflux, again, in a later article on renovascular hypertension, wherein he discussed an 11-year-old girl with hypertension and infrequent voiding. Contrast medium injected in the bladder refluxed up both ureters to scarred kidneys.

LOWER URINARY TRACT FUNCTION

Nesbit's primary career focus was on the surgical management of prostatic obstruction. Investigation of bladder dysfunction was therefore a natural step. His studies of lower tract function comprised a major report to the Society of Genito-Urinary Surgeons in 1939. He outlined thoughts on normal bladder function and toilet training, categorized the major bladder dysfunctions, and analyzed an 11-year-old with urgency and nocturnal enuresis.⁴⁴ In 1940, Nesbit and Gordon⁴⁵ discussed normal bladder function in broad terms:

The function of the bladder is under the control of 2 related mechanisms—first, the sphincter, which is under direct cerebral control through the somatic nerves, and, second, the detrusor which is governed by a conditioned reflex by way of the autonomic nervous system.

Three articles on neurogenic bladder, relating to trauma and congenital lesions of the lower spinal cord, were significant for pediatric urology.^{46,47} Nesbit recommended transurethral sphincterotomy to relieve outlet obstruction in some situations. He reported bladder tonus in spinal shock with Lapiés in 1948.⁴⁸ They concluded that bladder tone and filling curves were not impaired in

spinal shock and discovered that many instances of atonic bladder after spinal injury were the result of overdistention injury. Urinary retention during tetanus was described in a 16-year-old boy after a gunshot wound to the upper extremity. This occurred 2 months after the injury and required 2 weeks of continuous bladder decompression. Water manometer cystometrograms revealed bladder paralysis.⁴⁹

An article on cystometry with Baum in 1954⁵⁰ explored neurologic diagnosis in a 43-year-old janitor at the University Hospital with a 2-year history of obstructive uropathy. No obstructive uropathy was evident, but a cystometrogram revealed a large adynamic bladder and a lumbar bony defect was found on a plain abdominal radiograph. Despite surgical repair, there was no recovery of parasympathetic function. The article offered a scholarly explanation of the cystometric and neurologic approach to lower tract dysfunction.

Nesbit was one of the first to recognize the pivotal role of infrequent voiding in voiding dysfunctions. His analysis of an 11-year-old girl with recurrent febrile urinary infections, bilateral vescoureteral reflux, renal scarring, and hypertension noted concomitant voiding dysfunction. "One of my associates inquired into her micturitional behavior and found that she was one of the peculiar individuals—and we have seen them occasionally—who only urinate once every 24 hours." She was placed on a program of frequent urinations, asking her to void four times every 24 hours.⁴²

RENAL DISEASE

In 1940 Nesbit and Ratliff⁵¹ proposed that three groups of patients accounted for most instances of chronic nephropathy. In today's terms we would describe the first group as those with reflux nephropathy. Illustrative cases included a 14-year-old girl with hypertension, fever, pyuria, and white blood cell casts. She died after 3 months of hospitalization. A second girl, 15 years old, had previously undergone a right nephrectomy for a dysplastic kidney, but now was having urinary frequency, edema, hypertension, and renal insufficiency. Both patients most likely had vescoureteral reflux, although neither this diagnosis nor the voiding cystourethrogram were in the practitioner's vocabulary and armamentarium in 1940. In group 2, chronic nephropathy was the result of obstructive uropathy. In group 3, the causal factor was trauma. The same year Nesbit spoke on hypertension in unilateral renal disease to the American Medical Association in New York City. The second case in this presentation was a

13-year-old girl with chronic pyelonephritis resulting in destruction of the kidney, hypertension, and death. Chronic pyelonephritis was a common diagnosis in that era and in most instances this was the result of reflux nephropathy.⁵² Nesbit reviewed 172 patients with chronic pyelonephritis for a talk in Buffalo in 1941. He found that 42% had some etiologic factor, although vescoureteral reflux was not among his list of possibilities.⁵³

Beginning in the autumn of 1957, a hemodialysis unit was operated and administered at the University of Michigan by the Section of Urology. Although supervised by the urology staff, the unit was operated by urology residents during a 6-month research block. The residents had no other clinical responsibilities, and many of them had taken a prior elective in the cardiorenal unit with John Merrill at the Peter Bent Brigham Hospital in Boston. Nesbit's first article from this endeavor was delivered in 1960 and specifically addressed management of acute renal failure in children, providing 2 patients as examples. Peritoneal dialysis was attempted in a 4-month-old but was unsuccessful due to failure of fluid return. Hemodialysis was technically successful using a bed scale that continuously monitored weight during dialysis. This was the youngest human ever dialyzed at that time. The child eventually died and acute cortical necrosis was found at autopsy. An 11-year-old thought to have acute tubular necrosis was hemodialyzed during 21 days of complete anuria and recovered.⁵⁴ An article with Joseph Cerny⁵⁵ in the *Surgical Clinics of North America* in 1961 described indications, methods, and outcomes of 100 dialyses over a period of 2 years in the unit. Patients ranged in age from 4 months to 66 years. Among 3 youngsters, 8 and 9 years old, with acute glomerulonephritis, 2 survived. In 1966, with Cerny and Karl Herwig,⁵⁶ Nesbit presented 9 years of hemodialysis experience in 170 patients. Acute and chronic renal failure, as well as drug intoxication, were managed with 663 dialyses. Although urologic residents still staffed the unit, a permanent staff, including hemodialysis technicians, was in place. By this time a renal transplantation program had been initiated in Ann Arbor and 19 patients had undergone successful preoperative dialyses.⁵⁶

OBSTRUCTIVE UROPATHY

Nesbit's publications on this topic commenced in the mid-portion of his active academic career. In 1944, Nesbit advocated perineal urethrotomy, a procedure with which he had become adept in his transurethral prostate experience, to introduce

instruments for incision of posterior urethral valves.⁵⁷ A short article on hydronephrosis focused primarily on ureteropelvic junction obstruction, a diagnosis that Nesbit said was ordinarily made without difficulty on the basis of intermittent pain, sometimes with positive urine findings.⁵⁸ He showed an example of a 40-year-old physician, whose symptoms had been ascribed to gastrointestinal disease for many years. That situation, with an "incomplete though continuous blockage of the ureter" was distinguished from another clinical scenario with "intermittent, complete obstruction of the ureter, accompanied by intense pain in the kidney — the Dietl's crisis of a former day." Nesbit argued that these latter patients had normal urograms when asymptomatic and that urography must be performed "during an attack of pain." When the cause of obstruction was an aberrant vessel crossing the ureter, he divided the ureter and performed a "plastic operation at the ureteropelvic junction."⁵⁸

In 1951, Nesbit returned to the topic of posterior urethral valves in an article with Thirlby and Raper. A series of 22 patients under 17 years of age was presented. Excretory urograms and cystoscopy, utilizing perineal urethrostomy in small children, were advocated:

and patients that are on catheter drainage should have x-rays made after filling the bladder with contrast medium introduced by way of the catheter. The cystogram made in this way will sometimes reveal evidence of an obstructive lesion at the bladder outlet...[and] ureteral reflux.⁵⁹

Visiting the Medical Evangelists School in Los Angeles in 1952, Nesbit expanded further on congenital hydronephrosis. Five cases were detailed and he distinguished, once again, between intermittent and continuous obstruction.⁶⁰ Diagnosis and surgical therapy of pediatric obstructive uropathy were explored in an article with Baum in 1954⁶¹ discussing meatal stricture, urethral valves, bladder neck contracture, and bladder neck hypertrophy. The first illustration, depicting a 2-month-old infant with an enlarged phallus believed due to phimosis, was most likely an instance of megrourethra. Bladder neck disorders in boys and girls were a common clinical diagnosis and were ascribed to a fundamental structural disorder. Present conventional wisdom argues that these structural changes result from voiding dysfunctions that only infrequently need surgical redress.

Nesbit and Withycombe⁶² investigated primary megaloureter in 1954. Two criteria were offered to make this diagnosis: dilation of the ureter and absence of obstruction. Four cases were reported. The first 3 were operated on and all had subsequent infections; 1 of these patients eventually re-

quired ureteral substitution with ileum. In contrast, a fourth patient, diagnosed at 9 years of age, was managed without surgical correction and re-evaluated at 33 years of age, when she was asymptomatic:

It appears that she has fared better than the others.... Perhaps in this particular type of case it might be better to focus our therapeutic efforts along conservative antibacterial avenues and be less concerned with correction of ureteral dilatation.

Bladder neck contracture was addressed again in 1954 with a report on a Heineke-Mikulicz operation in 14 patients, including 8 children.⁶³ An article on obstructive uropathy in children stated:⁶⁴

...obstructive uropathy in children is less understood by the medical profession (than that of senescent men), with the result that physicians and parents often overlook certain abnormalities of micturitional behavior in infancy. For the male normally urinates with a forceful high trajectory stream, which is at once the object of curious pride to his mother as well as the envy of his male parent, and he empties his bladder with a continuous stream.

This article discussed meatal stricture, posterior urethral valves, and obstructive lesions of the bladder neck. Nesbit recognized the brittle electrolyte and fluid status of infant valve patients. A brief article on urinary obstructions in children in *Surgery, Gynecology, and Obstetrics* made this comment:⁶⁵

Any male infant who does not emulate the boy made famous in the statue in Brussels and who urinates with an interrupted stream must be regarded with grave suspicion.

In 1957 a discussion of urinary diversion in cord bladder described the ileal conduit in children with myelomeningocele and stressed the importance of the mental preparation of the patient for this procedure.⁶⁶ A paper on obstructing valves in the female urethra with Harold McDonald, Jr. and Stewart Busby targeted girls with recurrent urinary tract infections:⁶⁷

The urologist should, at the onset of examination, find out whether the child is suffering from the infrequent voiding syndrome which alone can provide a favorable soil for acquiring and perpetuating infections.

Nesbit discussed the cystometric investigations of Lapides, the tinkle audiometer of Lyon and Smith, and the voiding urethrocystogram:

...there are differences of opinion in interpretation of the voiding cystourethrogram which displays an open yet prominent ring at the bladder outlet with a ballooned proximal urethra tapering down to a small distal urethral segment.

This was the Lyon ring. In addition, Nesbit presented a case of true valvular obstruction in the female urethra.⁶⁷

The Mexican Urological Society heard a presentation in 1965 on posterior urethral valves by Nesbit and Mario Lambardini⁶⁸ on 51 patients treated in Ann Arbor. Pitfalls of endoscopic recognition of valves were discussed, and the authors advocated voiding cystourethrography, which they credited largely to Kjellberg, Innes Williams, Burns, Waterhouse, and Hamm. The voiding study detected valves in 7 patients who only had nocturnal enuresis, which was cured after they were removed endoscopically. A Coudé-tipped Bugbee electrode was used to incise the valves, although the authors also mentioned Hamm's technique of engaging the valve with an infant resecting loop. A perineal urethrostomy was still advocated for small urethras and open resection was proposed as an alternate method. The spectrum of valvular disease was evident in this series. Of the 29 patients managed since the prior valve report by Nesbit, Thirlby, and Raper,⁵⁹ 18 were well, 4 had died, and 4 were still on catheter drainage. Three patients were still having symptoms or infections but were considered improved after treatment of the valves. Another article with Lambardini⁶⁹ also discussed posterior urethral valves under the provocative title "Infantile Prostatism." As in Nesbit's other articles on this topic, the specific details of the radiologic studies were outlined.

PEDIATRIC MALIGNANCY

A report of 16 Wilms' tumors treated in the 9 years until 1943 in Ann Arbor, Michigan, began as follows: "All of the published reports of Wilms' tumors in childhood give a rather poor or hopeless prognosis." Published survival rates were quoted between 12% and 23%. Nesbit and Adams⁷⁰ treated 16 patients with combinations of nephrectomy (12 patients) and radiation therapy (7 preoperative, 4 postoperative, and 1 patient with chest metastases had irradiation alone). Four were inoperable and died, without treatment. Survival was reported in 8 patients. This was an extraordinary success rate for the time. Nesbit credited the radiation and recommended its postoperative application for all patients with Wilms' tumor. An article on adrenal tumors in 1947 included 12 children aged 1 to 13 years. The value of urinary 17-ketosteroid excretion in the diagnosis of masculinizing syndromes was touted, and Nesbit's surgical skill was evident in his successful adrenalectomies, generally through flank incisions.⁷¹

URETEROSIGMOIDOSTOMY

Nesbit described a method of elliptical anastomosis in a report on uretersigmoidostomy in

1948. He suggested that this anastomosis, with a transverse diameter 3.1416 times the diameter of the ureter, would not be vulnerable to constriction. He later discussed the elliptical anastomosis not only for uretersigmoidostomy, but also for pyeloplasty and ureteroneocystostomy.^{72,73} In 1960 Nesbit delivered the Ramon Guiteras Lecture at the American Urological Association. His title was "Another Hopeful Look at the Uretersigmoid Anastomosis." The preface was historical and philosophical, leading up to his own experimental and clinical work. Uretersigmoidostomy was a controversial topic and many investigators, Nesbit noted, were convinced that "man cannot live a cloacal existence." For example, he reiterated Stamey's concern that the electrolyte disturbances of uretersigmoid diversion remained its most severe indictment. Advocating this operation, while acknowledging its limitations, Nesbit⁷⁴ wrote:

When supravesical urinary diversion becomes necessary in any patient the problem that confronts the surgeon is a most serious one. Any operation that he performs creates an arrangement that at best is a poor substitute for the human functioning bladder.... It behooves us therefore to continue in our efforts at the improvement of techniques in the hope that some day we might achieve this goal that has been a frustrating challenge to imaginative surgeons for over a century.

That last sentence would have made a fine epitaph for Reed M. Nesbit, a man whose career did, in fact, improve the techniques and scientific basis of genitourinary surgery. His pediatric efforts were no less innovative than those of his famed adult practice, and ironically have proved at least as enduring.

David A. Bloom, M.D.
Section of Urology
University of Michigan Medical Center
1500 East Medical Center Drive
Ann Arbor, MI 48109

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