Exstrophy of the Urinary Bladder

A 7-day-old infant, product of a full-term normal delivery (3,300 gm.), was admitted to Children's Hospital for a defect of the anterior abdominal wall. At birth the anterior wall of both the urinary bladder and the urethra was lacking, thereby exposing the mucosa to the outside. On the lower part of the bladder mucosa were two small elevated projections (ureteral orifices) from which there was a continuous intermittent squiring of urine. When the child strained or cried, the intrabdominal pressure and consequently the size of the bladder varied. Complete epispadias was present. Local contact with a dry diaper was painful, indicating an intact parasympathetic nervous system.

DIAGNOSIS

Exstrophy of the urinary bladder with complete epispadias (Grade II)

TREATMENT AND FURTHER COURSE

An excretory urogram was normal, and it was elected to readmit the infant at three-month intervals until the time of definitive repair. At home the extrofied tissue was bathed frequently with water and exposed to warm, dry air and sunlight. The exposed mucosa was covered with a fine-mesh gauze coated with petrolatum to minimize the painful irritation from contact with the diaper and to retard hypertrophic and metaplastic changes.

Accompanying exstrophy of the urinary bladder were diastasis of the pubic symphysis, flared ilia, and posterolaterally rotated hip sockets which caused the infant to walk with a waddling gait.
At 18 months of age a definitive two-stage repair was done. The initial reconstruction was orthopedic. The patient was placed in a prone position, and after dissection of the soft tissue, the ilia were divided 2 cm lateral and parallel to the sacroiliac joint to allow eventual coaptation of the pubic symphysis. After one week, the second stage of reconstruction entailing the bladder, urethra, pelvis, and abdominal wall was undertaken. The peritoneum was reflected from the bladder, allowing identification and mobilization of the right transverse band between the two halves of the pubic symphysis. This band, the external urethral sphincter, and its blood and nerve supply were carefully preserved. The bladder was catheterized and reconstructive repair of the urinary mucosa and sphincter was done around the indwelling catheter, after which the pubic symphysis was coapted. A plaster body cast with periodic changes was employed for six months. At 3 years of age the child had normal urinary control (continence with no reflux). The epispadias was repaired when the boy was 5 years of age prior to entrance into kindergarten.

Frequently, it is not feasible to reconstruct the bladder; the extrophic mucosa is removed and only penile and urethral reconstruction is done. The urinary stream is then diverted by implantation of the ureters into the rectum or sigmoid colon, or by an ileal conduit.

DISCUSSION

Extrophy of the urinary bladder occurs in 1 of 30,000 newborn infants. Mackay and Syme in 1849 advocated the application of external urinary receptacles in this malformation, and indicated little benefit from medical or surgical intervention. In the mid-1800’s urinary diversion was attempted; Syme performed the first successful uretero-sigmoid anastomosis in 1852, but the patient died of ascending pyelonephritis. Since 1921, Coffey’s’ method of uretero-intestinal anastomosis has been improved and widely used. Reconstruction of the irregular bony pelvis that accompanies extrophy of the bladder was first attempted in 1906 by Trendelenburg.

Embryology

Discuss the cause(s) of extrophy of the urinary bladder. The precise cause of extrophy is not known, but the human embryo during normal development does not undergo a stage comparable to extrophy or epispadias, therefore, the concept of developmental arrest cannot be applied. A widely accepted theory of the etiology of extrophy was
presented by Patten and Barry. To understand the concept of Patten and Barry, it is necessary to briefly review the normal development of the cloacal region.

In the third week of development (Fig 50A), there is a small region of contiguous ectoderm and entoderm in the midline of the embryo just caudal to the primitive streak; this is the cloacal membrane.

By the fourth week (Fig 50B) the tail of the embryo has elongated and the cloacal membrane is just caudal to where the belly stalk joins the body. In this position the cloacal membrane now forms the ventral
wall of the urogenital sinus. Mesoderm from the side of the cloacal membrane migrates toward the fifth week (Fig. 50C) this mesoderm unites cranially to form the genital tubercle. The mesoderm infraumbilical portion of the ventral body wall midline of the embryo, and as a result the distal end and the cloacal membrane increases seventh week (Fig. 50D), the urorectal septum inserts into a urogenital and an anal membrane.

The concept of Patten and Barry used to describe bladder suggests that the mesodermal genital tubercle arise lateral instead of crurion septum fuses with the cloacal membrane; the primordia of the genital tubercle fuse in the opening is cranial while the anal opening is caudal. The mesoderm of the genital tubercle, in the lateral to the urorectal septum—would not contain the infraumbilical portion of the abdominal ectoderm and entoderm make contact without rupture imminent. When the urogenital sinus infraumbilical region of the body wall also sp mesodermal reinforcement, and thus establish padias. Rupture of the infraumbilical region of diastasis of the pubic symphysis, flared ilia, and hip sockets.

Classification

What types of genitourinary extrophy are they classified? Classification is based on the external bladder, urethra, and pelvic bones.

**Genitourinary Exstrophy**

Grade I (minimal)—Diastasis of the pubic abdominus muscles is minimal. The bladder sphincter are extrophic.

Grade II (mild)—Diastasis of the pubic symphysis muscles is minimal. Extrinsic bladder and the trigone expose considerable amount of bladder straining. The urethra is complete.
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At approximately the des the cloacal mem-

lain extrophy of the onents that form the where the urorectal are, when the paired dline, the urogenital the genital tubercle abnormal position—ate to the formation l, and in areas where avening mesoderm, a brane ruptures, the , due to the lack of extrophy and epis- e body wall producesosterolaterally rotated

possible and how are cal appearance of the

ymphysis and rectus urethra and external

ymphysis and rectus abby of the neck of the e ureteral orifices. A scosa prolapses upon epispadic.

Grade III (moderately severe)—Grades I and II, and in addition there is bony involvement, i.e., diastasis of pubic symphysis, flared ala of the ilia, hips rotated posterolaterally, and feet pronated.

Grade IV (severe)—Grades I, II and III. In addition, there are extensive defects of the infraumbilical fascia, accompanied by one or more of the following: omphalocele, inguinal hernia, undescended testis, ventrally located anal orifice, relaxed anal sphincter, and intermittent rectal prolapse.

Associated Malformations

What malformations accompany extrophy of the urinary bladder? This defect characteristically shows epispadias; inguinal, femoral, or umbilical hernias; and cryptorchidism. Additional abnormalities include vesico-rectal fistula, rectal malformations, ureteral duplication, spina bifida, and hemivertebrae.
Gonadal Dysgenesis

The patient was the product of a full-term uneventful pregnancy and delivery in a 24-year-old primigravida mother. Physical findings suggestive of Turner's syndrome that were noted at birth included pterygium colli, edema of the hands and feet, hypoplasia of the nailbeds, and hypertelorism of the nipples. Walking, talking, and teething occurred at the normal ages.

At 16 years of age the patient saw a gynecologist because of primary amenorrhea, nonappearance of the secondary sex characteristics, and statural underdevelopment. Physical examination revealed retarded general somatic development. There was a lack of breast development, with no glandular tissue palpable and rudimentary nipples. The neck was short and webbed. There was a moderate cubitus valgus. Axillary hair was absent, pubic hair was scant, and the external genitalia were of infantile character; moreover, vaginal examination disclosed markedly underdeveloped labia. The vagina was too small for digital examination and the uterus and adnexa could not be palpated rectally.

The estrogen level was low. The urinary level of 17-ketosteroids was depressed, while the gonadotrophins were elevated. Vaginal smears showed atrophy of the epithelium. A buccal smear was negative for sex chromatin. The peripheral blood karyotype was 45X.

The patient received a cyclic dose of oral estrogen for two years, during which time the breasts developed and the external and internal genitalia matured. No menarche occurred. Treatment has continued.

DIAGNOSIS

Turner's syndrome
A

1
2
3

B

4-5

C

XX XX XX XX XX XX X

6-12

D

13-15

E

XX XX X X

16 17-18

F

XX XX

19-20

G

XX XX

21-22

XO karyotype, arrow, of Turner's s
DISCUSSION

What is gonadal dysgenesis and how is it classified? Gonadal dysgenesis is the absence of germ cells from the gonads (streak gonads) and the absence or underdevelopment of the female genital ducts and external genitalia. Gonadal dysgenesis can be categorized into three clinical types: (1) pure gonadal dysgenesis with no somatic anomalies, (2) gonadal dysgenesis with short stature as the only somatic anomaly and (3) Turner's syndrome, a gonadal dysgenesis of the female accompanied by short stature, sexual infantilism, and at least two somatic anomalies.

The incidence of Turner's syndrome in patients with primary amenorrhea varies between 15 and 50 per cent. In 1938, Turner described a syndrome of sexual infantilism, congenital webbed neck and cubitus valgus. Since Turner's description, many somatic anomalies have been associated with this syndrome. In 1956, Polani, Lessof, and Bishop postulated that patients with Turner's syndrome have only one X chromosome; this was verified in 1959 by Ford and coworkers, who published the first karyotype of Turner's syndrome.

Embryology

Discuss the development of the ovary. In the presomite embryo (3 weeks) (Fig. 53A), primordial germ (sex) cells are recognized within the yolk sac endoderm. The formation of the tail fold carries these germ cells into the wall of the hindgut where, via the dorsal mesentery, they migrate to the medial aspect of the mesonephric ridge to lie beneath the epithelium (Fig. 53B). The latter soon proliferates and bulges into the coelom as the genital ridge. Celluloid (sex) cords enclosing the primordial germ cells develop in the genital ridge as they penetrate the underlying mesenchyme. At this stage, the gonads are indifferent and, although the sex was determined at fertilization, histological differentiation is not yet possible. The female gonad differentiates (8-weeks' gestation) later than the male (6-weeks' gestation). The primordial germ cells (Fig. 53C, D) become surrounded by a capsule of flattened epithelial pregranulosal cells, thereby forming the primordial follicles which constitute the ovarian cortex. Mesenchyme then invaginates the gonad, separating the closely packed primordial follicles whose germ cells are now called oogonia. This mesenchyme is the ovarian stroma or medullary material. Many early follicles regress; moreover, second ingrowth of coelomic epithelium forms additional follicles. The period of proliferation of sex cords continues through the eighth month of gestation.

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Fig. 53 Developing gonad in the female

It is suggested that the migration of germ cells from the hindgut via the dorsal mesentery to the primitive genital ridge requires two active X chromosomes, and if one chromosome is lost as in Turner’s syndrome or if part of it is deleted, migration does not occur and a streak gonad results.
Cytogenetic Findings

Explain the 45th X karyotype characteristic of Turner's syndrome. Numerical aberrations from the normal diploid number of chromosomes occur as two types: euploidy and aneuploidy. Euploidy deals with balanced chromosome set in which the somatic complements are exact multiples of the basic number, while in aneuploidy the chromosome number is not the exact multiple of the basic set and individual chromosome are missing or present in a multiple state. Thus, if one of two members of a pair of homologous chromosomes is missing (i.e., nondisjunction the individual is monosomic for that particular chromosome as Turner's syndrome.

Associated Malformations

Several malformations are associated with Turner's syndrome. Most commonly occurring are webbing of the neck, short neck, cubitus valgus, shield-like chest, multiple pigmented nevi, and hypoplastic nails. Other malformations include senile facies, epicanthic folds, high-arched palate, low-set ears, low hair line on the neck, coarctation of the aorta, and idiopathic hypertension.