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Cryptorchidism : its incidence, complications, and treatment : with a review of 150 case histories

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CRYPTORCHIDISM: ITS INCIDENCE, COMPLICATIONS, AND TREATMENT; WITH A REVIEW OF 150 CASE HISTORIES.

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INTRODUCTION

Cryptorchidism, or cryptorchism as it is sometimes called, has been defined differently by various authors. Some distinguish between cryptorchidism and ectopy. The first term, they state, refers only to those testes which have not completed their transit along the normal course of descent from the abdomen into the scrotum, while the second term refers to those which have followed the course of descent through the inguinal canal but have become located in an abnormal position, such as in the perineal, pubic, or superficial inguinal regions. Other authors state that cryptorchidism includes all testicles that are undescended, incompletely descended, or imperfectly descended, including ectopy. All agree in excluding the migratory or retractile testes which may temporarily be drawn into the inguinal canal by hyperactive cremasteric muscles, a condition found mostly in the younger age groups. For the purposes of this article cryptorchidism and ectopy will be used as two separate terms.

Historically, the study of cryptorchidism had its formal beginning in 1786 when John Hunter published the first article of importance on the subject, in which he described the testis in the human fetus and its descent into the scrotum. With the exception of the addition of certain facts his work is still quite authoritative. Very little was contributed during the next century, but debate on the causes of descent and non-descent have formed the basis for many studies and articles during the last fifty to

seventy-five years. During the last thirty years interest has grown in the effects of hormones on the normal descent of the gland and in the treatment of cryptorchidism. E. T. Engle[2] did experimental work in this field using Macacus monkeys and chorionic gonadotropins in 1932, and J. B. Hamilton[3] (1938) used testosterone in his experiments upon the descent of the testis. Articles have been plentiful on this aspect of the problem in the last twenty years. The operative correction of cryptorchidism has been used for many years, one procedure widely used today having been first described by Franz Torek in 1909 and again in 1931.[4]

There is considerable difference of opinion today as to the correct statistics concerning the incidence of cryptorchidism, its accompanying complications, and the results under various forms of treatment. As Campbell pointed out in 1942, the facts have remained obscure because: 1.Differences in definition of terms do exist. 2.The medical profession has in the past largely neglected the science of statistics. 3.Medical authors have committed almost incredible errors of misquotation; and 4.Authors have published statistics from their hospital practices and have neglected the implication of the figures from their private practices. These points should be borne in mind as statistics are presented throughout this paper.

This discussion will concern itself with a review of the

literature, with emphasis on the last ten to fifteen years, in regard to the incidence of, complications occurring with, and treatment of the undescended testicle. A review of the case records from certain local hospitals for information to be found on this problem will also be presented.

A brief review of the embryological descent of the testes will serve to introduce this discussion. The gonads appear in the human embryo at about the fourth week of development as a proliferation of the mesothelial covering of the antero-mesial side of the mesonepheros. They remain undifferentiated until the beginning of the second month, when the testicle can be differentiated as such. During the third month the organs lie in the mid-abdomen. Between the seventh and the ninth month the process of descent normally occurs. A fold of mesenchyme at the caudal end of the testis attaches to the vaginal process of the peritoneum forming a structure called the gubernaculum. The gubernaculum has four insertions: 1.the lower portion of the scrotal fascia; 2.the perineal tissues; 3.an area near the pubic bone; and 4.the tissue over Scarpa's triangle. These may play a part in bringing about both normal and ectopic positions of the gland. In the sixth month the vaginal process evaginates through the abdominal wall via the inguinal canal into the scrotum. The testis later follows the same route through the inguinal canal in normal descent. Since the testis is retroperitoneal in position, it comes to lie behind the posterior wall of the vaginal process.

The canal connecting the vaginal process with the peritoneal cavity normally closes, and failure to do so causes a tendency for an indirect inguinal hernia to develop. (Hamm and Harlin)[5]

The factors usually said to prevent complete descent of the testicle are mechanical and hormonal. Mechanical factors would include adhesions, short spermatic vessels or vas deferens, and disproportion of the testis with an inguinal ring or the inguinal canal. The chorionic gonadotropic hormone (or anterior pituitary-like substance) which is implicated as playing a part in descent is found in comparatively large amounts in the human fetus, is practically absent up to the age of puberty, increases again during adolescence, and declines finally after the age of forty. (Hamm, F. C.; and Harlin, H. C.; 1953)[5] A lack of this hormone available to the fetus or a lack of response to it for some reason such as an inherent defect in the testis are other possible causes of non-descent. Since this paper does not deal primarily with the etiology of cryptorchidism, no further discussion of the causes will be attempted here.

REVIEW OF CASE HISTORIES

For this study of the cryptorchid problem, case histories from three local hospitals were investigated. The University of Nebraska Hospital had records of 95 cases between 1931 and the present year. The Immanuel Hospital had 32 cases on record between 1935 and 1955. The Methodist Hospital had 23 recorded cases

between 1947 and 1955. The age range of those at the Immanuel Hospital was from one month to 40 years, nineteen of them being less than sixteen years old. In eleven cases both testes were involved; the other twenty-one being unilateral--a ratio of approximately 1:2. Of the unilateral cases sixteen were on the right side and five on the left--a ratio of 3:1. In one bilateral case the glands were intra-abdominal in position, and in two unilateral cases they were so located--a total of four glands (9.5% of the total). All of the remaining thirty-eight testes in the other twenty-nine patients were thought to be located somewhere in the inguinal canal. A final diagnosis of ectopy rather than cryptorchidism was made in two patients, one being suprapubic and one superficial inguinal in location. The testes were stated to be definitely atrophic in only two patients--one nineteen years old and one twenty-four years old. However, because of incomplete descriptions in the records the true figures may be higher. Treatment was deferred in three cases: one, a 1-month-old infant with fibrocystic disease of the pancreas, who died in a short time; one being only one and one-half years old; and one being the nineteen-year-old patient mentioned above with the complication of atrophy of the gland. (Table I)

Orchiectomy or orchidectomy (excision of the gland) was performed twice--in the twenty-four-year-old patient with atrophy of the testis, and in a twenty-three-year-old patient with ectopy and a sound contralateral organ. A course of antuitrin-S hormone

therapy was tried in one case preoperatively, but without any signs of descent. In all, twenty-seven patients had orchidopexies (or orchiopexies) performed, with the testes being brought down into the scrotum and held there, either by suturing them to the inner thigh or by some form of temporary traction, such as a rubber band fixed to the thigh, for a period of several months. The Torek procedure for orchiopexy was used in twenty-four of the patients, involving dissecting the testes and cord structures free and bringing them down through the scrotum as far as possible without traction and suturing them at that point through an incision in the scrotum to the fascia of the inner thigh.[4] This necessitates a second procedure at a later date to free the scrotum and gland from the thigh. In one case the Bevan procedure was used, involving freeing of the cord structures and testis, bringing it down into the scrotum, and suturing it to the lower pole of the scrotum without any other means of fixation. In one bilateral case the gland on one side returned to a cryptorchid state postoperatively and was reoperated upon.

No further information as to the final results of the operations was found. Either before or at surgery associated indirect inguinal hernias or obvious hernial sacs were described in nineteen patients (60% of all patients). There were three cases of bilateral cryptorchidism with bilateral hernias. The repair of the hernias was always carried out at the same time that the orchiopexy was performed. There were no reported cases of associ-

ated torsion, hydrocele, or malignancy of the testicle. Also of interest is the fact that five of the patients operated on were younger than six years of age, the youngest being only twenty months old; but three of these did have the complication of quite prominent hernias.

Investigation of the ninety-five case histories at the University Hospital showed the age range to be from newborn infants to seventy-four years. Fifty-six of them were less than sixteen years old. Thirty cases of bilateral cryptorchidism were reported, leaving sixty-five unilateral cases--a ratio of slightly less than 1:2 or about 31.5% bilateral. Of the unilateral cases the rigth side was involved in thirty-eight instances and the left side in twenty-seven instances--a ratio of about 4:3. The testes were intra-abdominal thirty-three times in twenty-five patients (eight being bilateral) and were inguinally located ninety-two times in seventy-one patients (twenty-one being bilateral). One bilateral case involved an inguinal and an abdominal testis. This would mean that 36% of the cryptorchids were in an intra-abdominal position. A final diagnosis of ectopy in a perineal position was made in one case. Pain or discomfort of either an acute or chronic nature, often referable to strain, trauma, or the appearance of a hernia, was the presenting complaint in twenty-nine patients. Impotency was the complaint in one thirty-eight-year-old man with bilateral involvement. Hypospadias was associated

in three patients, epispadias in two, spina bifida in one, and Mongolism in one. Hydroceles were present twice and torsion twice. A teratoma with widespread metastases occurred in one twenty-nine-year-old patient who died without treatment, his retained gland being intra-abdominal. (Table II)

At operation the testicle was said to be definitely atrophic in six cases with complete agenesis in one other. Indirect inguinal hernias or hernial sacs were stated to be present forty-seven times in forty patients (42% of all patients). This figure would probably be higher if a larger percentage of the patients had gone to surgery. A trial of hormone therapy, usually antuitrin-S, was used or had been used at some earlier date in nine patients, with descent of the gland occurring in one testicle of a five-year-old boy with bilateral involvement. Five of these nine patients ultimately went to surgery. Fifty-one of the total of ninety-five patients were operated upon, thirty-nine having orchiopexies and twelve having orchiectomies. The patients in whom the testes were removed ranged from fourteen to seventy-four years of age, and atrophy was given as the reason for removal in the younger patients. Of the thirty-nine patients in whom the testes were brought down into the scrotum, thirty-seven had some form of temporary fixation or slight traction, and two had merely a Bevan type procedure and narrowing of the external inguinal ring. No record of any recurrences was found. No treatment was given in thirty-nine cases, seven of them being either newborn

infants or less than three years of age.

Study of the twenty-three case histories from the Methodist Hospital showed an age range from nineteen months to twenty-nine years, with ten of the patients being less than fifteen years old. There were seven cases of bilateral cryptorchidism (30.4% of the patients), eight cases (34.8%) of right unilateral, and eight cases of left unilateral involvement. One of the bilateral cases had both an intra-abdominal and an inguinal testis. Of all the glands nine were intra-abdominal and eighteen were inguinal in location.- a ratio of 1:2. Indirect inguinal hernias were associated nineteen times in sixteen patients (almost 70% of the patients), and one of them, in a nineteen month old infant, was strangulated. Atrophy was definitly stated to be present in three glands, one being in a fourteen year old boy. Pain of some degree was the presenting symptom with four patients. The final diagnosis was ectopy rather than cryptorchidism in three cases. Hypospadias was associated in two cases, hydrocele in two, and primary hypogonadism in one. Nineteen patients went to surgery, with orchidopexies being performed in fifteen cases and orchidectomies, when atrophy or difficulty in bringing the testis down were encountered, in four cases. A trial of hormone therapy using testosterone propianate was made preoperatively in one case, that of a fourteen year old boy, without descent. No treatment was used in four cases: a seven year old boy with bilateral involvement, a 10 year old in whom an associated hernia was repaired without attempting

Table I.

Review of Case Histories from Immanuel Hospital.

Age Range	Number of pts.	Bilat. Crypt.	Unilat. Rt.	Unilat. Lt.	Inguinal Testes	Abdomin. Testes	Hernia
1mo.-5yrs.	7	6	0	1	12	1	4
6yrs.-10	5	1	4	0	6	0	0
11 - 15	7	2	3	2	7	2	5
16-- 20	7	2	4	1	9	0	8
21 - 30	4	0	3	1	3	1	3
31 - 40	2	0	2	0	2	0	2
Totals	32	11	16	5	39	4	22

Table II.

Review of Case Histories from University Hospital.

Age Range	Number of pts.	Bilat. Crypt.	Unilat. Rt.	Unilat. Lt.	Inguinal Testes	Abdomin. Testes	Hernia
N.B.-5yrs.	19	12	6	1	16	15	5
6yrs.-10	18	8	7	3	21	5	7
11 - 15	19	6	7	6	21	4	13
16 - 20	17	2	8	7	16	3	10
21 - 30	8	0	2	6	7	1	5
31 - 45	4	1	1	2	5	0	3
46 - 74	10	1	7	2	6	5	4
Totals	95	30	38	27	92	33	47

Table III.

Review of Case Histories from Methodist Hospital.

Age Range	Number of pts.	Bilat. Crypt.	Unilat. Rt.	Unilat. Lt.	Inguinal Testes	Abdomin. Testes	Hernia
19mo.-5yrs.	1	0	1	0	1	0	1
6yrs.-10	3	2	0	1	4	1	2
11 - 15	6	1	3	2	7	0	4
16 - 20	9	3	2	4	7	5	10
21 - 29	4	1	2	1	3	2	2
Totals	23	7	8	8	22	8	19

to bring the testis down from the inguinal canal, a nineteen year old with bilateral intra-abdominal testes in whom a hypospadias was corrected instead, and a twenty-two year old with bilateral intra-abdominal testes and primary hypogonadism. (Table III)

Analysis of all of the 150 hospital cases studied shows that forty-eight of the patients (32%) had bilateral cryptorchidism, with sixty-two patients (41.3%) having had right unilateral involvement, and forty patients (26.7%) left unilateral involvement. Of the total of 198 retained testes 147 were inguinal (74.1%), forty-five were intra-abdominal (22.7%), and 6 were ectopic (3.2%). Indirect inguinal hernias were associated with 88 of the glands (44.3%), and seventy-five of the patients (50.%). There were four hydroceles (2%), two instances of torsion (1%), and ten of associated congenital anomalies (5%). Hormones were tried in eleven patients between the ages of five and fourteen years, with descent in only one testis. Only one case of malignancy in a cryptorchid was found--0.67% of the patients or 0.53% of the testes. Orchiopexies were used in eighty-one patients and orchiectomies in seventeen patients. No treatment was given in forty-six cases.

Table IV.

Combined Review of Case Histories from All 3 Hospitals.

Age Range	Number of pts.	Bilat. Crypt.	Unilat. Rt.	Unilat. Lt.	Inguinal Testes	Abdomin. Testes	Hernia
N.B.-5yrs.	27	18	7	2	29	16	10
6yrs.- 10	26	11	11	4	31	6	9
11 - 15	32	9	13	10	35	6	22
16 - 20	33	7	14	12	32	8	28
21 - 30	16	1	7	8	13	4	10
31 - 45	6	1	3	2	7	0	5
46 - 74	10	1	7	2	6	5	4
Totals	150	48 (32%)	62 (41.3%)	40 (26.7%)	153 (77.3%)	45 (22.7%)	88 (44.3%) Of glands

DISCUSSION

The overall incidence of undescended testicle in the male population has been estimated as being 0.3% to 0.5% by Moore and Tapper[6] (1940); two in every 1,000 (0.2%) by Campbell,[7] (1942) Hempel,[8] Coley,[9] Beven,[9] and Wangensteen[9]; and .12% by Monod[9] and Terrillon.[9] Wangensteen[10] (1927) quoted figures of 0.1% by Marshall, 0.23% by Gilbert and Hamilton, 0.6% by Howard, 0.75% by Baumrucker, and 0.17% by Renner. Figures of the War Department from the First World War enlistments as quoted by Wangensteen[10] showed an incidence of 0.31%. (Table V) Fruin[11] (1945) stated that 14% of male infants show incomplete descent with a decrease to 4.5% in early teens and 0.5% after the age of 16, which would mean that 85% to 90% of those cases present at birth will descend spontaneously. Carroll[12] (1949) also gave a figure of 14% incidence during infancy with a decrease to 4% by five years of age. Rea[13] in 1939, gave an incidence of 10% in newborns, and 2.% at the onset of puberty. Hofstatter[14] stated that in a series of 600 newborns, 96% of 450 term deliveries showed normal descent within eight to ten days after birth, but only 68% of 150 premature infants had normal scrotal testes. In schoolboys between the ages of seven and seventeen years, Johnson[15] found an incidence of undescended testes of 1.72% in 31,609 cases. Smith[15] ran two similar series in 1937 and 1940, finding an incidence of 1.1% with a history of incomplete descent in 1.9% in the first and 1.3% with a history of it in 3.3% in the second.

Table V.

Incidence of Cryptorchidism in the General Population.

Author	Estimated Incidence
Baumrucker (10)	0.75 %
Campbell (7)	0.2
Beven, Coley, Hempel, and Wangensteen (8)	0.2
Fruin (11)	0.5 (after age 16)
Gilbert and Hamilton (10)	0.23
Howard (10)	0.6
Monod and Terrillon (9)	0.12
Marshall (10)	0.1
Moore and Tapper (6)	0.3-0.5
Renner (10)	0.17
War Department (10)	0.31

Table VI.

Location of the Testes in Cryptorchidism.

Author	Intra-Abdominal	Inguinal	Pubo-superficial-Inguinal
Campbell (17)	14.3%	59.3%	26.4%
Charendoff, Ballon, and Simon (16)	20.0	80.0	
Fruin (17)	28.3	54.9	16.8
Findings from the present 150 cases.	22.7	74.1	3.2

Table VII.

Comparison of Bilateral and Unilateral Involvment of the Testes in Cryptorchidism.

Author	Bilateral	Unilateral Right	Unilateral Left
Burdick and Coley (17)	20%	50%	30%
Odiorne and Simmons (17)	11	59	30
Findings from the present 150 case reviews.	32	41.3	26.7

The frequency of abdominally retained testes compared to those retained in the inguinal canal was said to give a ratio of 1:4 by Charendoff, Ballon, and Simon[16] in 1951. Campbell[17] collected a series of 2119 cases from the literature, in which 14.3% had intra-abdominal testes, 59.3% inguinal, and 26.4% pubo-superficial-inguinal. Fruin[17] in 113 cases found 28.3% to be abdominal, 54.9% inguinal, and 16.8% pubo-superficial-inguinal in location. (Table VI) In a series of seventy-seven cases Odiorne and Simmons[17] found 20% to have bilateral involvement, 50% right-sided unilateral, and 30% left unilateral. Burdick and Coley[17] had 482 cases in which 11% were bilateral, 59% right, and 30% left unilateral. (Table VII)

The diagnosis of cryptorchidism depends upon either the palpation of the testicle in the inguinal canal or finding it there or in the abdominal cavity at operation. Ectopy can also be diagnosed by palpation. Abdominal retention can be assumed if the gland cannot be palpated in the scrotum, canal, or ectopic positions, although complete agenesis is still possible. A method of examination for distinguishing true cryptorchidism from a retractile testis, described by Koop[18] in 1952 requires that the examiner stand beside the supine patient, using his cephalad hand gently to attempt to milk the gland toward the scrotum while the other hand is ready to receive it if it can be pushed there. Steady traction will overcome the pull of the cremaster muscle. If it can be drawn into the scrotum it is a retractile or elevated testis and is not a subject for

medical or surgical treatment.

Hormonal assay has been advocated as an aid in diagnosis of the etiology of cryptorchidism in specific cases. Howard, Shiffen, Simmons, and Albright[19] (1950) found the urinary FSH (follicle stimulating hormone to be less than 6.5 m. u. per day in one patient (twenty-three years old). He was treated hormonally on the theory that the primary factor was endocrinologic and descent followed. Another patient seventeen years old showed 6.0 mg. of urinary 17-ketosteroids per day and 192 m. u. of urinary FSH per day by non-dialysis method. His problem was considered to be mainly mechanical and no descent followed hormone therapy. Sohval and Soffer[20] (1952) studied a case of eunuchoidism with cryptorchidism in which they later found the testes to be congenitally defective histologically. Assay for urinary gonadotropin gave negative results at thirty mouse uterine units per twenty-four hours, and urinary neutral 17-ketosteroids were reduced to 3.2 mg. per twenty-four hours. Normal values for FSH in the urine was said by Klineletter, Albright, and Griswold[21] (1943) to be 6.6 m. u. or more per twenty-four hours. The normal values for 17-ketosteroids in the urine were said by Fraser, Forbes, Albright, Sulkowitch, and Reifenstein[22] to be 8.1 to 22.6 mg. per twenty-four hours.

Usually there are no subjective symptoms with this condition. Occasionally there is a dull aching in the groin, a sharp pain on

motion, or a continual pain following some trauma to the region. Testicles which are retained in the inguinal canal or in an ectopic position are more liable to injury with its accompanying pain and discomfort than are normally positioned organs. (Hamm and Harlin[5]) Bilateral cryptorchid patients are also usually sterile because the higher body temperature suppresses sperm development (as will be seen later). Secondary sex characteristics are usually not impaired unless primary hypogonadism or hypopituitarism is an etiologic factor.

Many investigators have studied the histological differences between the descended and undescended testicle at various ages. Sohval[23, 24] (1954) studied testes from forty-two patients with cryptorchidism and compared them with sixty-four normally-placed glands from the age of prematurity to seventy-eight years. He found that growth and development were normally barely perceptible from birth to puberty, but at puberty increase occurred in the diameter of the tubules, spermatogenesis, maturation of Sertoli cells, and appearance of Leydig cells in the stroma--which becomes compressed. Up to puberty differences between the normal and retained organs were subtle, consiting of smaller tubule size and cell population with retarded epithelium maturation. During puberty the retained glands showed moderate retardation of spermatogenesis, tendency to fibrosis of the basement membrane and peritubular tissue, but normal Sertoli and Leydig cell differentiation. During adulthood degeneration of the seminal epithelium, tubular atrophy, and fibrosis of tubular and intertubular structures occurred. The

fibrosis increased sharply up to the fourth decade of life. Sohval found total absence of Leydig cells or partial absence of Sertoli cells in the adult only where the testicle was congenitally defective, as in eunuchoidism.

Rea[25] (1942) studied the testes from forty-six cryptorchids, ages fifteen to seventy, having assumed that there are no differences between the undescended and descended organs until puberty. He concluded that degeneration in cryptorchidism is proportional to the age (after puberty) and that there are no differences between the testes that are located in the inguinal region and those found in the abdomen. Cooper[26] (1929) in studying twelve retained and thirty-six normal scrotal testes decided that the further the pre-adolescent testis had progressed in its normal route of descent, the more closely it corresponded histologically to the normal pattern for the age. Changes in the retained glands were the appearance of fibrous tissue and the apparent disappearance of tubules with an increase of stroma. He found spermatogonia persisting in the quiescent state and Sertoli cells persisting--although possibly decreased in number. Leydig cells were thought to be unaffected by the location of the gland. Pace and Cabot[27] (1951) studied twenty-four cases of cryptorchidism and found mostly normal appearance of the glands in the second decade of life, some degree of atrophy in the third decade, extensive atrophy during the fifth decade, and complete fibrosis and destruction during the sixth decade. Sniffen[28] in 1952 stated

that before puberty there is no clearcut morphological difference between the normal and the cryptorchid gland, but in early puberty retardation appears in the Sertoli cell development and in the formation of sperm cells.

Nelson[29] (1951) did experimental surgery on rats-- transplanting their testes into intra-abdominal positions for various periods of time from twenty-eight days to two-hundred and eighty days and then replacing them in their original positions. He studied the glands for gross, histological, and functional changes, and their ability to return to normal. He found that the germinal cells undergo progressive deterioration at intra-abdominal temperatures, depending upon the length of time that they were confined there. All authors were consistent in stating that the abnormal position of the testis is detrimental to its normal function, the fertility potential in such cases being low. Bilateral cryptorchid cases are reported as usually being sterile.

The commonest condition accompanying or complicating cryptorchidism is that of indirect inguinal hernia. Moore and Tapper[6] (1940) reported it as occurring in twenty-six out of twenty-eight cases (about 93% of the cases). Fruin[11] (1945) reported an incidence of 87% with cryptorchidism. Lewis[30] (1948) stated that Uffreduzzi found hernias occurring in 90% of cases and that Mimpress found them in 85%. Beach[31] (1948) had a series of forty-six cases of undescended testes with a hernia or potential hernia

Table VIII.

Occurance of Indirect Inguinal Hernias in Patients with Cryptorchidism.

Author	Patients with Cryptorchids.	Patients with Hernias.	Percentage with Hernias.
Beach (31)	46	?	100 %
Fruin (11)	?	?	87
Mimpress (30)	?	?	85
Moore and Tapper(6)	28	26	93
Odiorne and Simonds (10)	?	?	57
Rawlings (10)	?	?	75
Rousing (10)	?	?	100
Schonholzer (10)	?	?	93
Uffreduzzi (30)	?	?	90
Present review of 150 case histories.	150	75	50

in almost every case. Wangensteen[10] (1927) quoted statistics in which the incidence varied from 57% (Odiorne and Simonds) to 100% (Rousing), with 75% (Rawlings) and 93% (Schonholzer) in between. He also stated that Coley had found 1,357 cases of cryptorchidism in 80,734 reported cases of indirect inguinal hernias (1.68%). Rea[13] stated that Eccles had found cryptorchidism in 2% of 48,000 reported cases of hernias. Both of these last two percentages are considerably above the estimated incidence of cryptorchidism in the population (male) as a whole. (Table VIII).

Hydrocele and torsion of the testicle are stated by many authors to be increased in frequency with undescended or incompletely descended testes, but few give any statistics as the basis of such a claim. Hamm and Harlin[5] (1953) found five cases of hydrocele in forty-two patients with retained testes (twenty-six also had indirect inguinal hernias). Wangensteen[10] quoted Soudder as having found cryptorchidism in 47% of thirty-two cases of testicular torsion.

Much has been written about the incidence of malignant tumors in the undescended testicle. Wangensteen[10] quoted Cunningham as having reported 452 cases of testicular malignancies with 412 being in the normal scrotal gland, leaving forty in retained glands. Since only about one in every 500 testes is supposed to be retained, the likelihood of malignant change would be fifty times greater than in a normally placed organ, using his

figures. The same author also stated that Bulkley found one out of every four malignancies of the testis to be in cryptorchids. Sohval[23] (1954) found four instances of primary testicular carcinoma in forty-two patients (including twenty-seven adults) with non-descent. Schwartz, and Mallis[32] (1954) had 100 patients with non-descent and found four tumors--two being in previously operated cases. Pace and Cabot[27] (1951) found three cases of carcinoma in twenty-four cryptorchids. Rea[13] (1939) quoted Hinman as having collected 649 cases of malignancy in the gland with 12.2% being cryptorchids. He stated that Coley, Cunningham, Odiorne, Simmons, Schischko, Lipschutz, and Dean had found 9.9% cryptorchids in 1371 cases of carcinoma. Rea also quoted Kocker as having found one malignancy in 100 cases of non-descent and Rubaschow as having decided that 11% of testicular carcinoma occurred in cryptorchids, which would again be fifty times more often than its incidence would justify. Gordon-Taylor and Till[33] in 1938 reported fifty cases of malignancy in testes, with fifteen being in cryptorchid glands--eight being intra-abdominal and seven being inguinal.

Campbell[7] (1942) collected 1422 cases of malignancy in the gland from the literature and found 165 of them to be in undescended testes (about 11.6%). He stated that Gilbert and Hamilton had collected 7000 such cases and found 840 to be in cryptorchids (about 11.0%), with 345 being intra-abdominal in location and 490 being in the inguinal canal (41.3% to 58.7%). Campbell also coll-

ected statistics of twenty-two carcinomas in 1413 patients with non-descent (1.5%) and sixty-eight cryptorchids in 672 testicular malignancies (10.1% , with thirty-three being intra-abdominal and thirty-five inguinal in location (48.5% to 51.5%). He found 362 cases of malignancy of the scrotal testis in 500,000 hospital admissions of male patients plus fourteen malignancies in abdominal and seventeen in inguinal glands-- giving figures of 7.8% cryptorchids in the total of 394 testicular carcinomas. He concluded that one abdominal testis out of twenty and one inguinal testis out of eighty undergoes malignant change; i.e., if the occurrence of malignancies in the abdominal and inguinal testis is approximately the same and the ratio of abdominal to inguinal testes is about 1:4, then the abdominally located gland is four times more likely to undergo malignant change. (Tables IX, X, XI).

Gilbert and Hamilton[34] (1942) found the peak incidence of tumors of the testis to be between thirty and forty-four years of age with the overall incidence being 0.0013%, and they suggest that the occurrence of the condition in the reproductive years may mean that endocrine factors stimulate it. These authors further classified 126 tumors in cryptorchids, with eighty-eight being unicellular in type, thirty being teratomas, four adenomas, two interstitial cell tumors, one adrenal carcinoma, and one spindle cell sarcoma. They stated that the likelihood of involvement of the second gland is 0.7% overall, but 15% if the second testis is in the inguinal canal and 30% if it is intra-abdominal. They found

Table IX.

Incidence of Testicular Malignancy in Patients with Cryptorchidism.

Author	Pts. with Cryptorchids	Testicular Malignancies	Percentage
Campbell (7)	1413	22	1.5 %
Kocker (13)	100	1	1.0
Pace and Cabot (27)	24	3	13.5
Schwartz and Mallis (32)	100	4	4.0
Sohval (23)	42	4	9.5
Present review of 150 case histories.	150	1	0.67

Table X.

Incidence of Cryptorchidism in Malignancies of the Testes.

Author	Testicular Malignancies	Pts. with Cryptorchids	Percentage
Bulkley (10)		¼ of cases	25.0 %
Campbell (7)	394	31	7.8
"	672	68	10.1
"	1422	165	11.6
Coley, Cunningham, Odiorne, Simmons, Dean, Schischko, & Lipschutz (13)	1371	136 ?	9.9
Cunningham (10)	452	40	8.9
Hinman (13)	649	79 ?	12.2
Gilbert & Hamilton(7)	7000	840	11.0
Gordon-Taylor & Till(33)	50	15	30.0
Rubaschow (13)	?	?	11.0

Table XI.

Location of Cryptorchids having Associated Malgnancies.

Author	Intra-abdominal		Inguinal Canal	
Campbell (7)	48.5%	(33 cases)	51.5%	(35 cases)
"	45.1	(14)	54.9	(17)
Gilbert & Hamilton(7)	41.3	(345)	58.7	(490)
Gordon-Taylor & Till(33)	53.3	(8)	46.7	(7)

more than one in every ten cases of testicular malignancy to be in improperly descended testes.

Lewis[30] (1948) stated that tumors are twenty-two times more common in cryptorchids than their incidence would justify, but the overall incidence of tumors is so low (one in 50,000 males per year) that orchidopexy or orchidectomy in the hope of preventing it is not indicated. He also did not believe that orchidopexy prevents the formation of tumors. Grows[35] (1953), on the other hand, stated that abdominal testicular tumor has little chance to be discovered, and that the gland should be placed where it can be palpated. Finally, Grove[36] (1954) believed that the incidence of malignancy in true cryptorchid cases is so minute that its potential occurrence cannot be used as an indication for orchidopexy.

Treatment in cases of cryptorchidism can be carried out for the purposes of: 1.promoting better function of the organ and preventing sterility; 2. prophylaxis against malignancy or at least placing the gland where such a condition could be more easily recognized; 3. relieving pain or discomfort and placing the gland where it is less apt to be affected by trauma; and 4. psychic or cosmetic benefits. In regard to the latter some authors refer to a few reported cases of suicide in young men afflicted with this condition. The time for treatment to be instituted and the type to be used varies from author to author. All recognize that surgery has a definite place, but there are differences of opinion as to

the value of hormone therapy.

Hamm and Harlin[5] (1953) advised placement of the gland in the scrotum before the sixth year of life, with a trial of hormones in selected cases. They stated that bilateral cryptorchids were more apt to have a hormonal cause and should give better results under this treatment. Large hernias and hydroceles were contra-indications for this treatment and ectopy always required surgery, they stated. Chorionic gonadotropin was used--androgen being reserved for cases in which the testicle did not develop after placement. They advocated using 250 to 500 international units, i. m., biweekly for eight weeks and reported only occassional good results. Larger doses were not used because of the attempt to avoid any sexual maturation, although some edema of the foreskin and scrotum, without any increases in phallic size or amount of pubic hair, was noted.

Lewis[30] (1948) quoted Wells as saying that hormone therapy has little effect on the sexual development of a child if given under eight years of age. He stated that Hotchkiss found five patients whose testes descended after puberty to be sterile and fifteen out of nineteen patients with descent before puberty to be fertile. Lewis reported that Thompson and Heckel treated 860 testes from 579 patients by hormones with 20% beneficial results. There were no results where the gland was intra-abdominal in location. Their results differed from those reported in the earlier literature in which 61% benefited, they said, because they did not

treat patients with migratory testes. Lewis further stated that Einhorn and Rowntree treated forty patients with no descent occurring in three past the age of puberty, descent occurring in three at puberty, and descent in one out of ten in prepuberty. Results were thought to be slightly better in underdeveloped, fat individuals than in normal or tall, thin ones. Lewis also reported that Lowsley had concluded that hormone therapy rarely causes descent after the age of ten. Mertz was said to advocate its use between six and seven years of age. Drake was said to believe that if there was no evidence of glandular disturbance, one should simply observe the patient until the fifteenth year. Reiser was reported to say that hormone therapy before the age of puberty is questionable and at puberty is unnecessary, unless there is evidence of hypogonadism. Moore and Tapper were quoted as believing that hormones enlarge the gland and its structures but do not cause descent in true cryptorchidism, and Deming was said to advocate the use of hormones pre- and post-operatively because of this enlargement. Lewis himself stated that he used a course of antuitrin-S in 500 rat unit dosages three times weekly for a total of 30,000 units, beginning one to two years before the expected onset of puberty and before trying surgery.

Deming[37] (1952) stated that the opportune time for hormone therapy is from the ages of five to seven with its contraindications being ectopy, hydrocele, or hernia. He found it to be rarely successful in unilateral cases, since both glands had previously

been equally stimulated in utero by chorionic gonadotropin and both would have descended if some other factor had not prevented it. His course of treatment involved giving follutin-S, 250 i.n. u., three times weekly for a total of four weeks, giving beneficial results in 5% of 189 cases. He also used the hormone as an adjunct to surgery. Rea[13] (1939) stated that treatment should be deferred until ages nine to eleven and at that time a trial of gonadotropic hormone was useful. His review of the literature found reports of 70% beneficial results with this treatment, whereas his own results showed only 16% having descent.

Robinson and Engle[38] (1954) used large doses of chorionic gonadotropin over a short period of time (4000 to 5000 units daily for three days. If no change was noted in one week surgery was recommended. Maitland[39] (1953) advocated expectant treatment in unilateral cryptorchidism uncomplicated by hernia and hormone trial in all bilateral cases in the seventh year. Weekly injections of 500 i.n.u. of chorionic gonadotropin up to twelve doses were used. Forty-one patients out of 104 cases were treated in this way with "good" results in twenty-five. Corbitt[40] (1952) used gonadotropic hormone, 500 to 1000 units, two to three times weekly for six to twelve weeks and followed it, if unsuccessful, with testosterone propianate, 10 to 25 mgms, two times weekly--the latter drug being less effective and more uncontrollable. The ages at which he used this treatment were between ten and twelve years.

Beach[31] (1948) stated that hormones are not satisfactory

treatment but are diagnostically significant, since those testes which would normally come down at puberty anyway do so, thus saving an operation. He used Pranturon on patients between the ages of eight and eleven in 500 unit doses three times weekly for six weeks, then 1000 units two times weekly for two weeks if there was some sign of descent. He stopped after that because of possible irreversible precocity being produced but stated that "A large phallus plus an adolescent moustache at the age of ten is preferable to a small organ and no beard at twenty.

In his studies Iason[41] (1944) found that the urine of the normal child contains little or no anterior pituitary-like hormone, whereas that of children with cryptorchidism frequently contains this substance. In such cases he advocated a trial of gonadotropic hormone before surgery. Kiefer[42] (1952) is another author who believes that endocrine therapy is really more of a diagnostic procedure than a "cure", since endocrine abnormalities rarely are the cause of non-descent, and where they are there is usually bilateral involvment.

Thompson and Heckel[43] (1941) treated 89 testes in 67 patients with 100 to 500 i.n.u. of gonadotropin three to six times per week. They had 24% success with the glands and 27% success with the patients. There was 32% success in 34 patients ages ten and under, and 17% in 15 patients ages sixteen to thiry-seven. There was 36% success when the glands were in the canal and only 6% when they were intra-abdominal. Abnormal positions of the

testis gave 35% response, which contradicts the statement by other authors that ectopy must be treated surgically.

Chastain and Newlin[44] (1954) studied 1301 Navajo Indian boys between the ages of eleven and eighteen and found and treated twenty-seven cases of cryptorchidism-- five being bilateral. They used chorionic gonadotropin, 500 units, i.m., three times weekly for six weeks. Nine patients (33.3%) obtained excellent results. One testicle in each of two bilateral cases also descended. Nine patients who had datectable hernis showed no descent. The younger patients showed the best response. The eighteen cases without good response were given testosterone, 20mgms., i.m., three times weekly for four weeks, without benefit to any. One of the nine who had benefited showed regression of the gland to a low inguinal canal position, and the younger boys who had shown secondary sex characteristic changes began to lose them three to four months after therapy was discontinued. These authors concluded that such treatment will reduce the number of surgical patients but has poor results with patients past puberty or with intra-abdominal testes.

Einhorn and Rowntree[45] (1941) treated twenty-six unilateral and fourteen bilateral cryptorchid cases, two of the latter and five of the former being intra-abdominal in location. The ages of the patients were five to seventeen years. Gonadotropic hormone was used subcutaneously three times weekly in 200 rat unit dosages for two to eight weeks. Six unilateral and six bilateral cases descended with no success occurring in those past the age of thirt-

Table XII.

Results of Hormonal Therapy.

Author	Cases Treated with Hormones	Beneficial Results
Chastain & Newlin(44)	27	40.7% (11 pts.)
Deming (37)	189	5.0
Einhorn & Rowntree(30)	40	10.0 (4 pts.)
" " (45)	40	30.0 (12 pts.)
Maitland (39)	41	61.0 (25 pts.)
Rea (13)	?	16.0
Thompson & Heckel(30)	579	20.0
" " (43)	67	27.0
" "	"	32.0 (ages 10 & under)
" "	"	17.0 (ages 16 to 37)
" "	"	36.0 (if in canal)
" "	"	6.0 (if in abdomen)
Zelson & Steinitz(47)	17	53.0
Results of present review of 150 Case Histories.	11	9.1 (1 pt.)

een.

Campbell[46] (1951) stated that when no detectable hernia is present, one should try APL (anterior pituitary-like substance) in 100 to 200 rat unit doses, two times per week up to 2,500 units before attempting surgery. Zelson and Steinitz[47] (1940) believed that gonadotropic hormone could cause descent in 31% of all cases and that male sex hormone could cause descent in 15% with partial benefit in another 45%. In seventeen of their own patients, ages $7\frac{1}{2}$ to $12\frac{1}{2}$ years, there were fifteen unilateral and two bilateral cryptorchids which were palpable in the canal in all but three cases. Nine patients had received previous therapy. They used 500 units of gonadotropic hormone plus 5 mgms. of testosterone propianate three times weekly for three to twelve weeks in four patients and 500 units of the gonadotropin plus 10 mgms. of the testosterone in the same schedule in thirteen patients. There was complete descent in nine cases (55%), four of which had been previously treated. There was no effect in the other eight. The penis and scrotum enlarged in all but three patients, and the pubic hair increased in eight. In three cases an inguinal hernia became evident. One bilateral case showed descent. The age at which these authors preferred to use this treatment was between eight and ten years. (Table XII).

Most authors agree that if hormone therapy has failed to give good results , or in those cases where hormones are contra-

testis gave 35% response, which contradicts the statement by other authors that ectopy must be treated surgically.

Chastain and Newlin[44] (1954) studied 1301 Navajo Indian boys between the ages of eleven and eighteen and found and treated twenty-seven cases of cryptorchidism-- five being bilateral. They used chorionic gonadotropin, 500 units, i.m., three times weekly for six weeks. Nine patients (33.3%) obtained excellent results. One testicle in each of two bilateral cases also descended. Nine patients who had detectable hernis showed no descent. The younger patients showed the best response. The eighteen cases without good response were given testosterone, 20mgms, i.m., three times weekly for four weeks, without benefit to any. One of the nine who had benefited showed regression of the gland to a low inguinal canal position, and the younger boys who had shown secondary sex characteristic changes began to lose them three to four months after therapy was discontinued. These authors concluded that such treatment will reduce the number of surgical patients but has poor results with patients past puberty or with intra-abdominal testes.

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indicated, surgical placement of the testis in the scrotum should be tried. As Robinson and Engle[38] (1954) pointed out, the exact type of operation is not too important if: 1. the spermatic cord is of sufficient length; 2. an adequate blood supply remains; 3. as little tension as possible is used (the cremasteric fibers sometimes needing to be stripped back and the vessels mobilized up to the aorta); and 4. the testis is fixed to the scrotum and the scrotum to the thigh for a time in order to prevent the gland from returning to a higher position. Grove[36] (1954) said that every abdominal testis should be placed where it can be felt or else an orchidectomy should be performed, and no inguinal testis should ever be placed in the abdomen, as might be done if the cord structures were too short to allow placement in the scrotum-- because of the possibility of a malignancy developing silently in that position. Lewis[30] (1948) stated that for the sake of spermatogenesis the internal spermatic vessels must be preserved, while the collateral circulation alone is enough to prevent atrophy and to retain androgen production. Therefore,the vessels should be freed under direct vision. The course of the vessels should also be straightened, since traction will not stretch them much. When correction of a cryptorchid could not be satisfactorily carried out, Beach[31] (1948) performed orchidectomies--if the contralateral organ was sound. On the other hand, Corbitt[40] (1952) stated that surgery should only be performed in the presence of complications, such as inguinal hernia or torsion of the testis.

In 201 surgically treated cases of cryptorchidism Deming[37] (1952) found agenesis present in nine and used orchidectomy in twelve cases where the organ was deformed or could not be brought down. Gordon-Taylor and Wyndham[48] (1947) reported replacing two inguinal testes in the abdomen (orchidocleisis) without ill effects. This was presumably done to prevent the organ from being so liable to injury. Thompson and Heckel[43] (1941) treated twenty-five patients after hormone therapy had failed by surgery, finding fibrous bands in all, absence of the external inguinal ring in one, agenesis in two, and abnormal direction of the peritoneal process (upward over the external oblique or rectus sheath or downward toward the perineum) in eleven.

Nelson[29] (1951) reported that Hansen had treated twenty-five bilateral cryptorchid cases and thirty-six unilateral cases by surgery. Of the bilateral cases only two finally had "normal" fertility, five were "moderately" fertile, four were seriously impaired, and fourteen were completely sterile. Of the thirty-six unilateral cases none showed any essential change in sperm production. Einhorn and Bowatree[45] (1941) reported surgical fixation in twenty patients, sixteen having unilateral and four having bilateral cryptorchids. There were good functional results in none of the bilateral cases and in eight of the unilateral ones. Results were fair in three of the unilateral cases and poor in the other five.

Hamm and Harlin[5] (1953) stated that forty-two patients were

operated upon for this condition at the Brooklyn Hospital between 1942 and 1952. There was bilateral involvment in nine and unilateral in thirty-three, with the left side being involved one more time than the right. In five cases no testis was found. Two testes were in the abdomen and nineteen in the inguinal canal, eight being in the upper scrotum. The age at operation varied from seven to thirty years. Orchidectomy was performed in five cases. Thirty-four patients had their testes brought down into the scrotum, entirely satisfactory results occurring in twenty-eight cases.

Gross[35] (1953) reported 933 cryptorchid cases having been seen in Chidren's Hospital at Boston, Mass., during the thirty years prior to 1951, 211 being still too young for operation at the time that his paper was written--the optimum age for best surgical results being nine to twelve years in his opinion. 722 patients were operated upon for 827 undescended testes. There was agenesis of thirty-six testes in thirty patients (4%). Sixteen perineal testes were found in twelve patients. 90% of the total number operated upon showed good surgical results. In following the patients after surgery over a period of many years no testicular malignancies were found, although fifty-eight such cases had been reported in the literature at that time, occurring about ten years post-operatively.

Mimpress[49] (1945) drew the conclusion from his study that there is no need to regard imperfect descent as a condition for which treatment should be carried out at once, and that orchidopexy

at about the age of puberty will give suitable results. Furthermore, according to him, the type of treatment needed, if any, becomes progressively more obvious up to that time.

SUMMARY.

The problem of cryptorchidism has been presented with emphasis on the incidence, complications, and treatment. 150 case histories from local hospitals are also reviewed. The literature reveals an overall incidence in the male population of from 0.1% to 0.75%. Newborn infants show an incidence of around 14% with a gradual decrease up to the age of puberty. The ratio of abdominally retained to inguinally retained testes is said to be about 1:4. Bilateral involvement has been estimated between 11% and 20%, with 50 to 59% being right and 30% left unilateral. In the 150 cases studied 22.7% were intra-abdominal and 77.3% were in the inguinal region, with 32% of them being bilateral, 41.3% right, and 26.7% left unilateral.

Histological studies of cryptorchids at various ages show that atrophy and fibrosis tend to progress proportionally to the age of the patient and that elements concerned in spermatogenesis are affected quite early. Androgen production is not usually much impaired, unless congenital hypofunction is present. This would mean that unless the retained gland is brought down eary in life, at least sometime before puberty, fertility potential, especially

in bilateral cases, will be significantly reduced.

Indirect inguinal hernias have been stated to accompany from 57% to 100% of cryptorchid cases, probably depending upon how the author selects his cases and whether he takes into account the potential threat of a patent processus vaginalis or small hernial sac found at operation. In the 150 cases reviewed here definite hernias or hernial sacs were recorded in 50%, a figure which would undoubtedly be higher except that forty-six patients were not treated and there was no opportunity for potential hernias to be discovered.

Malignancy has been found in the retained testicle in from 1% to 13.5% of cases by various authors. Only one such case was found in the 150 cases studied here—an incidence of 0.67%. If, however, as most figures show cryptorchidism is found in from about 8% to 12% of testicular malignancies, then malignancy occurrs ten to one-hundred times more frequent in cryptorchidism than its overall incidence would justify (depending upon what figure one uses for the incidence of cryptorchidism).

Trials of hormone therapy using chorionic gonadotropin or a similar substance in doses less than those which would produce permanent sexual changes have been used by many authors with variable results. The preferred age for this is before the onset of puberty and probably after the first five years of life. Results should be better with inguinal than with abdominal testes and better with bilateral than unilateral cases—the bilateral ones

being more likely to have a hormonal etiology. 5% to 60% of the cases reviewed in the literature responded to this treatment, while one out of eleven cases treated hormonally (or 9%) in the 150 case histories studied responded.

Hormonal assay for urinary gonadotropins and 17-ketosteroids may aid in the diagnosis of the etiology of cryptorchidism in any particular case. If the hormone levels are below normal the cause is probably hormonal and hormone therapy could be expected to give good results. If the levels are fairly normal, however, the cause is probably mechanical and surgery would seem to be indicated. At the present time little work has been reported on this and its use would be limited by the difficulty in having these tests performed.

Orchidopexy is the most accepted and satisfactory treatment for most cryptorchid cases today. Orchidectomy should be used only where the gland cannot be satisfactorily brought down into the scrotum or where extensive atrophy or a suspected malignancy is present.

CONCLUSIONS

1. The high incidence of malignancy with cryptorchidism which is reported in the literature could not be substantiated in this study of 150 hospital case histories.
2. Treatment of cryptorchidism should be carried out before pub-

erty in order that the function of the gland, particularly spermatogenesis, can be preserved as completely as possible. Trials of hormone therapy before attempting surgery can bring about descent in a fair number of patients if some selection is used, thus reducing the number of cases that would eventually require surgery.

4. Hormonal assay as an aid to etiologic diagnosis is not yet established but is promising.

BIBLIOGRAPHY

1. Hunter, John: "A Description of the Situation of the Testis in the Foetus, with its Descent into the Scrotum." Med. Classics. 4: 421-441,(1786).

2. Engle, E. T.: "Experimentally Induced Descent of the Testis in the Macacus Monkey by Hormones from the Anterior Pituitary and Pregnancy Urine." Endocr. 16: 513-520, 1932.

3. Hamilton, J. B.: "The Effects of Male Hormone upon the Descent of the Testis." Anat. Rec. 70: 533-541, 1938.

4. Torek, Franz: "Orchiopexy for Undescended Testicle." Ann. Surg. 94: 97, 1931.

5. Hamm, F. C. and Harlin, H. C.: "Management of Undescended Testicle." N. Y. J. Med. 53: 295-298, 1953.

6. Moore, N. S. and Tapper, S. M.: "Cryptorchidism: A Theory to Explain Etiology. Modifications in Surgical Technique- A Preliminary Report." J. Urol. 43: 204, 1940.

7. Campbell, H. E.: "Incidence of Malignant Growth of the Undescended Testicle." Arch. Surg. 44: 353-369, 1942.

8. Hempel: Quoted by Carroll, W. A.[12]

9. Coley, Beven, Wangensteen, Monod and Terrillon: Quoted by Rea, C.E.[13]

10. Wangensteen, O. H.: "The Undescended Testis." Arch. Surg. 14: 663-731, 1927.

11. Fruin, R. L.: "Cryptorchidism: A Discussion and Report of 113 Cases." Mil. Surg. 97: 365, 1945.

12. Carroll, W. A.: "Malignancy in Cryptorchidism." J. Urol. 61: 396-403, 1949.

13. Rea, C. E.: "Functional Capacity of the Undescended Testes." Arch. Surg. 38: 1054, 1939.

14. Hofstatter; Quoted by Rea, C. E.[13]

15. Johnson and Smith: Quoted by Lewis, L. G.[27]

16. Charendoff, M. D.; Ballon, H. C.; and Simon, M. A.: "Torsion and Rupture of an Intar-abdominal Seminoma." J. Urol. 66: 274-279, 1951.

17. Odiorne and Simmons, Bardwick, Odley, Campbell, and Fruin: Quoted by Lewis, L. G.[27]

18. Koop, C. E.: "Undescended Testicle- Differential Diagnosis and Management." Med. Clin. N. Am. 36: 1779-1785, 1952.

19. Howard, R. P.; Sniffen, R. C.; Simmons, F. A.; and Albright, F.: "Testicular Deficiency: A Clinical and Pathologic Study." J. Clin. Endocr. 10; 121-186, 1950.

20. Sohval, A. R. and Soffer, L. J.: "Congenital Testicular Deficiency." J. Clin. Endocr. and Met. 12: 1229-1238, 1952.

21. Klinefelter, H. J. Jr.; Albright F.; and Griswold, G. C.: "Experience with a Quantitative Test for Normal or Decreased Amounts of Follicle Stimulating Hormone in the Urine in Endocrinological Diagnosis." J. Clin. Endocr. 3: 529-544, 1943.

22. Fraser, R. W.; Forbes, A. P.; Albright, F.; Sulkowitch, H.; and Reifenstein, E. C.: "Colorimetric Assay of 17-Keto-steroids in Urine." J. Clin. Endocr. 1: 234-256, 1941.

23. Sohval, A. R.: "Histopathology of Cryptorchidism." Am. J. Med. 16: 346-362, 1954.

24. Sohval, A. R.: "Testicular Dysgenesis as an Etiologic Factor in Cryptorchidism." J. Urol. 72: 693-702, 1954.

25. Rea, C. E.: "Histologic Character of the Undescended Testis after Puberty." Arch. Surg. 44: 27-34, 1942.

26. Cooper, E. R. A.: "The Histology of the Retained Testis in the Human Subject at Different Ages, and its Comparison with the Scrotal Testis." J. Anat. 64: 5-27, 1929.

27. Paoe, J. M. and Cabot, H.: "Histological Study in 24 Cases of Retained Testes in the Adult." Surg., Gyneo, and Obst. 63: 16-22, 1951.

28. Sniffen, R. C.: "Histology of Normal and Abnormal Testis at Puberty." Ann. N. Y. Acad. Sci. 55: 609-618, 1952.

29. Nelson, W. O.: "Mammalian Spermatogenesis: Effect of Experimental Cryptorchidism in the Rat and Non-descent of the Testis in Man." Rec. Prog. in Hormone Res. 6: 29-56, 1951.

30. Lewis, L. G.: "Cryptorchidism." J. Urol. 60: 345-356, 1948.

31. Beach, E. N.: "Undescended Testis; Cause and Treatment." J. Urol. 60: 623, 1948.

32. Schwartz, J. W. and Mallis, Nicholas: "Teratoma Testis: Report of 100 Consecutive Cases." J. Urol. 72: 404-410, 1954.

33. Gordon-taylor, G. and Till, A. S.: "On Malignant Disease of the Testicle, with Special Reference to Neoplasms of the Undescended Organ." Brit. J. Urol. 10: 1-45, 1938.

34. Gilbert, J. B. and Hamilton, J. R.: "Studies in Malignant Tumors of the Testis." Cancer Research. 2: 125-129, 1942.

35. Gross, R. E.: Surgery of Infancy and Childhood. Philadelphia, Saunders and Co., 1953. Pgs. 467-481.

36. Grove, J. S.: "The Cryptorchid Problem." J. Urol. 71: 735-741, 1954.

37. Deming, C. L.: "The Evaluation of Hormonal Therapy in Cryptorchidism." J. Urol. 68: 354-357, 1952.

38. Robinson, J. N. and Engle, E. T.: "Some Observations on the Cryptorchid Testis." J. Urol. 71: 726-734, 1954.

39. Maitland, A. I. S.: "Maldescent of the Testicle." Glasgow Med. J. 34: 170-179, 1954.

40. Corbitt, R. S.: "The Undescended Testicle." Med. Press, Lond. 228: 475-478, 1952.

41. Iason, A. H.: " Cryptorchidism." Am. J. Surg. 65: 353, 1941.

42. Kiefer, J. H.: "Undescended Testis: Types and Management." Ohio St. Med. J. 48; 1105-1107, 1952..

43. Thompson, W. O. and Heckel, H. J.: "Endocrine Treatment of Cryptorchidism." J. A. M. A. 117: 1953, 1941.

44. Chastain, J. B. and Newlin, L. K.: "Treatment of Undescended Testes." Ariz. Med. 11: 323-326, 1954.

45. Kinhorn, N. H. and Rowntree, L. G.: "Results in Treatment in 40 Selected Cases of Cryptorchidism." J. Clin. Endocr. 1: 649, 1941.

46. Campbell, M.: " Undescended Testicle and Hypospadias." Am. J. Surg. 82: 8-17, 1951.

47. Zelson, C. and Steinitz, E.: "Treatment of Cryptorchidism with Chorionic Gonadotropic Hormone and Male Sex Hormone." J. Pediatrics. 17: 315, 1940.

48. Gordon-Taylor, G. and Wyndham, N. R.: "On Malignant Tumours of the Testicle." Brit. J. Surg. 35: 6-17, 1947.

49. Mimpriss, T. W.: "Treatment of Retained Testis." Proc. Roy. Soc. Med. 38: 507, 1945.