THE UNDESCENDED TESTICLE[1]

BY R. E. SMITH, M.B. Camb., F.R.C.P.
MEDICAL OFFICER TO RUGBY SCHOOL AND LAWRENCE SHERIFF SCHOOL, AND PHYSICIAN TO THE HOSPITAL OF ST. CROSS, RUGBY

THE importance of the partially descended testicle reaches far beyond the bounds of surgery. A boy with this malformation may be debarred from the public services, particularly the fighting services; and he runs a risk of complications, real though often grossly exaggerated in textbooks. Animals so deformed are an economic loss to the stockbreeder. One of the pioneers who studied this subject was John Hunter, who asked his brother "to take every opportunity of learning exactly the state of the testis before and after birth." From William's observations, John stated that the testicle as a rule left the abdomen and descended into the scrotum in the eighth month of fœtal life.

My own interest in the undescended testicle is chiefly concerned with the natural history. Observations have been made since 1931 on boys attending two schools: one with approximately 600 boys from 13 to 18 years of age, and the other with 400 boys aged from 9 to 18. Though the population is changing continuously it has been possible to follow the progress of most of 50 cases for periods varying from 2 to 9 years.

AGE-INCIDENCE

Grey Turner in 1937 stated that he had never been satisfied that descent occurs later than the age of 3 years; but he added "perhaps detailed information from school medical officers, who have the opportunity of examining large numbers of young boys, may justify some other conclusion." Russell Howard says that "An imperfectly descended testis will occasionally descend into the scrotum at puberty." A census of the 1000 boys under my care was taken in 1937 and again in 1940; the findings are set out in table I.

TABLE I—FINDINGS IN SCHOOLBOYS EXAMINED IN 1937 AND IN 1940

Age (yrs.)	No. of boys	No. with u.t.	Known to have had u.t. at some time	U.t. with herniæ
First examination (1937)				
19–20	2	..	..	..
18	63	..	..	..
17	157	..	1 (0·6%)	..
16	196	..	1 (0·5%)	..
15	185	4 (2·2%)	7 (3·8%)	1 (0·5%)
14	187	3 (1·6%)	5 (2·7%)	2 (1·1%)
13	76	3 (4%)	3 (4%)	2 (2·3%)
12	63	1 (1·6%)	2 (3·2%)	..
11	31	..	..	..
10	12	..	..	..
9	10	..	..	..
8	2	..	..	..
Total ..	984	11 (1·1%)	19 (1·9%)	5
Second examination (1940)				
18–19	62	1* (1·6%)	4 (6·4%)	..
17	138	..	2 (1·5%)	..
16	165	..	3 (1·8%)	..
15	183	3 (1·6%)	5 (2·7%)	..
14	157	..	5 (4%)	..
13	125	2 (1·6%)	5 (4%)	..
12	49	2 (4%)	2 (4%)	..
11	45	3 (6·6%)	4 (8·8%)	..
10	28	1 (3·6%)	1 (3·6%)	..
9	20	1 (5%)	2 (10%)	..
Total ..	972	13 (1·3%)	33 (3·3%)	..
14 and over, 705		4 (0·6%)	19 (2·7%)	..
13 and under, 267		9 (3·3%)	14 (5·4%)	..

U.t. = undescended testicles.
* Operation for hernia at age of 3 years.

The first examination showed that all of 418 boys aged 16–20, and all of the smaller group of 55 under 12 years, had fully descended testicles. One boy aged 18, included in the table, had his testicle brought down by operation; 11 boys out of a group of 511 between the ages of 12 and 15 had undescended testicles, an incidence of 2·2% in the group. Comparison of the third and fourth columns shows that descent occurred on 8 occasions: spontaneously in 7 and by operation in the boy aged 17. Those in the last column are segregated because it is known that an associated hernia makes it probable that the testicle will not descend spontaneously.

TABLE II *—DETAILS OF 27 CASES OF SPONTANEOUS DESCENT OF TESTICLE

Case No.	Age at descent (yrs.)	Bilateral (B) or unilateral (U)	Onset of puberty (yr.)	Size of testicles	Remarks
1	16	B	14	Normal	Pluriglandular dystrophy. Obese.
27	16	U (R)	12½	R = ½L at 16½	
37	16	U (L)	14	L = ½R	
7	R 14½, L 15	B	15	Normal	
10	14	U (R)	15	Equal	
16	Before 14	U (R)	14	Equal	
17	14½	U (L)	15	Equal	
25	14	B	14½	Normal	Obese
30	14	U (L)	12	L = ¾R at 14; L = ⅞R at 15½	
34	13½	U (L)	14	Equal	
35	R 14, L not desc. at 14	B now U (L)	14	Equal but small	
44	13½	U (R)	13	R = ¾ L	
36	13	U (R)	Not begun at 14	Equal	Opn. for L.I.H. at age 7
19	13¼	U (R)	13¾	R = ½L at 13½; R = ¾L at 15½	
18	13¾	U	13¼	Equal	
6	13	B	12½	Normal	
4	13	B	Later than 17¼	Normal	Obese
3	R 12½ (opn.), L 13¾ (spontaneous)	B	14¼	Normal	Obese
2	R 13, L 13¾	B	14		Obese. Opn. for L.I.H. at age 2
5	12	B	13½	Normal	
26	12	U (R)	12⅞	Equal	
28	12½	B	13½	Normal	
29	12	U (L)	11½	L = ¾R at 14. Nearly equal at 15	
32	12	U (L)	12½	L = ⅞R at 13. Nearly equal at 14	
33	R not desc. at 14, L 12	B now U (R)	13½	L normal	
41	11	U (R)	Not begun at 11½	Equal	Obese. Opn. for R.I.H. at age 8½
9	11¼	U (L)	12¼		Left district when 12½

* Cases 1–24 in tables II and III have been fully reported in *Arch. Dis. Childh.* 1939, **14**, 1.

The second examination showed that the principle is maintained: undescended testicles are less common as age progresses. If puberty is taken as occurring roughly at 13–14, and the boys are separated into two groups by making the 14th birthday a dividing line, the difference is seen at once. It must be remembered that the first examination of many boys is not until puberty, which would explain why the percentage for those over 13 is less than for the younger group.

McCutcheon's statistics, based on observations for 19 years, are even more favourable to the older group. In 1656 boys over 15 he found the testicle undescended in 13 (0·8%), and of 3386 under 15 years, 315 (9·4%) had undescended testicles.

The latest age at which a testicle can descend spontaneously is not known. Sir Robert Hutchison tells me that he knew a man in whom descent occurred while he was an undergraduate at Oxford (an event duly celebrated by a party). Table II shows that puberty is a common age for spontaneous descent, and the figures confirm those of Johnson, who in a study of 31,609 boys joining a club in New York found that spontaneous descent took place in 300 of 544 with undescended testicles, and of these, 216 descended between the ages of 11 and 14.

DESCENT IN RELATION TO PUBERTY

Table II contains details of 27 boys in whom one or both testicles have descended spontaneously; table III

1. A Hunterian lecture delivered before the Royal College of Surgeons of England on Jan. 23, 1941.

those of 23 boys in whom descent has not taken place. Cases 1, 2, 3, 4, 25, 41 in table II form a small group in which some endocrine disorder was probable.

The age of descent was uncertain in case 16. Of the 10 bilateral cases (excluding case 1 but including case 3), descent occurred bilaterally in 7 and unilaterally in 2 more, in whom descent of the other testicle is a reasonable expectation. Descent before puberty was common, the average interval being a year. Case 6 was the only one in which descent took place after puberty, which occurred at 12½.

TABLE III—DETAILS OF 23 CASES WHERE DESCENT DID NOT TAKE PLACE

Case No.	Present age (yr.)	Bilateral (B) or unilateral (U)	Onset of puberty (yr.)	Remarks
12	23	U (R)	14	Atrophic testis removed at 15; opn. refused at 13½.
14	21	U (R)	13	4 courses of Pregnyl unsuccessful. Testis transposed surgically in scrotum at age 16. R = ½L. Postop. course of pregnyl; later R = L.
11	19	U (R)	14	Testis at ext. ing. ring.
8	18	B	14	Testes at int. ing. ring.
15	18	U (R)	13	3 courses of pregnyl unsuccessful. Testis reascended ant. to ing. canal; lowered surgically. Postop. course of pregnyl. R = L.
23	18	U (R)	14	Opn. for R.I.H. at 14. Testis at ext. ing. ring.
24	18	U (R)	13	Opn. for R.F.H. at 8. Testis in sac transf. to neck of scrotum. 4 courses of pregnyl unsuccessful.
39	18	U (R)	14	Twin, 8 mths. prem.; 3 lb. at birth. Testis at ext. ing. ring.
20	17	U (R)	15	Testis at int. ing. ring.
21	17	U (R)	15	Testis at int. ing. ring. R = ½L. Opn. for R.I.H. at 3.
22	17	U (R)	14	R.I.H. Testis in hernial sac in canal.
31	16	U (L)	starting at 16	Testis outside ext. ing. ring.
42	16	U (R)	14	Small R. testis between int. and ext. rings at 15½. Impalpable at 16.
13	15	U (L)	11½	L. testis impalpable at 15.
33†	14½	U (R)	13½	L. descended at 12; R. at ext. ing. ring.
35†	14	U (L)	just starting	R. descended at 14; L. at neck of scrotum. Course of pregnyl at 13; no effect.
47	14	U (R)	13½	Testis at ext. ing. ring.
48	14	U (R)	13	R. testis removed at 7 because undescended.
43	13	U (R)	12½	Testis at neck of scrotum.
38	12	U (R)	12	R. below ext. ing. ring.
40	12	U (R)	not started	Testis can be moved in circle of 1 in. diam. over pubic tubercle.
45	10	B	do.	R. at int. ing. ring; L. impalpable.
46	10	B	do.	Neither palpable.

† Cases 33 and 35 are included in tables II and III.

Of the 15 unilateral cases (excluding cases 18, 33, and 35) the right testicle descended in 8 and the left in 7, the average age being 13. In 10 instances this was before puberty, usually 6–12 months. In 3 of the 6 others in whom descent took place after puberty, puberty occurred early, at 11½, 12, 12½; but in the 3 others puberty was at 13, 13¼ and 14 and descent at 13½, 13¾ and 16 respectively. Descent at 16 and so long after puberty is exceptional. In cases 4 and 17, the teeth generally and the canines particularly were late in erupting.

POSSIBLE INDICATIONS OF FUTURE DESCENT

Obesity.—The 6 already mentioned (cases 1, 2, 3, 4, 25 and 41) were the only boys who were unnaturally fat. Bilateral descent occurred in all except case 3, in whom the surgeon had already transferred the right testicle to the left half of the scrotum. Two of the rest (cases 2 and 41) had had an operation for an inguinal hernia on the same side as the undescended testicle. In case 1, some pluriglandular dystrophy was present and descent occurred at 16, two years after the onset of puberty. In cases 2, 3, 4, 25 and 41 obesity was marked and of the Fröhlich type. In cases 1, 2 and 4 both testicles descended spontaneously and puberty followed after an interval which on the average was over a year. This sequence of events would probably have occurred in case 3 if there had been no operation. In case 4, a highly intelligent boy in whom the fat was distributed as in the female, puberty was delayed and the pubic hairs were still extremely sparse even at the age of 17½. This boy had never had nocturnal emissions or any other sign of spermatogenesis. Only in 1 boy in this group (case 41) was the testicle unilaterally undescended. He had had a right inguinal hernia cured by operation when aged 8½, and the right testicle descended when he was 11.

Johnson found Fröhlich's syndrome associated with 17 bilateral and 11 unilateral cases in his series of 544. He does not mention whether the association is a favourable sign.

Hernia or previous operation for hernia.—According to Mimpriss, of 137 patients who were operated on from 1927 to 1934 in St. Thomas's Hospital, 85% had coexistent hernial sacs. These were discovered at operation and it is improbable that they would have been found by clinical examination. Of the 48 cases reported in tables II and III only 6 had clinically recognised herniæ on the same side as an undescended testicle (cases 2, 21, 22, 23, 24 and 41); and of these the only 2 (cases 2 and 41) in whom spontaneous descent occurred had generalised obesity. In the others the testicle has remained fixed or has atrophied. In case 24 the operation was performed when the patient was aged 8. The testicle, which was in the femoral canal, had a short cord and was transposed to the top of the scrotum, but it completely atrophied. Case 36, who had a right undescended testicle, was operated on for left inguinal hernia at the age of 7. It would be expected that a testicle embedded in a hernial sac, which is itself fixed by connective tissue to the vas and surrounding structures in and out of the inguinal canal, would be incapable of movement. The sooner operation is performed the better.

Herniæ may make their appearance during treatment. Spence and Scowen (1935) noted this 5 times in 33 patients receiving hormone therapy in addition to 4 who were known to have had herniæ before treatment started. In case 22 a hernia first appeared at 14½, although the testicle had been noted on several occasions as being in the right inguinal canal. The testicle remains as it was 6 years ago.

Unilateral and bilateral non-descent.—Descent took place spontaneously in 27 boys (table II), 15 of whom had unilateral and 12 bilateral affections. Of the boys with undescended testicles (table III), only 5 were under 14, 3 with unilaterally and 2 with bilaterally arrested organs. It is best to exclude these from our present comparison, because descent later is highly probable. Of those who were 14 and over, non-descent originally was unilateral in 15 and bilateral in only 3. In case 8, hope for spontaneous descent now that the patient is 18 has been given up; one testicle has descended in both of the others (cases 33 and 35), and there is reasonable hope that the second testicle will descend in case 35 and possibly also in case 33. This establishes the fact, often quoted, that bilaterally affected testicles have much greater chances of descent than unilateral ones. We could go further and say that if arrest is bilateral non-descent at puberty is exceedingly rare.

This does not mean, however, that unilaterally undescended testicles rarely descend, for descent occurred spontaneously in 16 such cases (all ages included), compared with 15 unilateral cases aged 14 and over which failed to descend; 3 cases in the undescended group were under 14, and in these descent may still take place. The unilateral undescended testicle, uncomplicated by a clinically recognisable hernia, has an almost equal chance of descending spontaneously at about puberty or of remaining undescended.

Anatomical considerations.—In my own series, the surgeons operating on cases 14 and 15 both reported that the testicle was anterior to the inguinal canal—in other words, was ectopic. Case 19 has an interesting history: it was known that when he was 13 his right testicle was lying opposite the lower ring of the inguinal canal; at that age, while in a camp, he stretched out vigorously and got acute pain in the inguinal region, and he noticed after this that his testicle had descended. It was then only half the size of its fellow, but it has grown and is now almost of normal size.

Spence and Scowen (1938) have tried to differentiate between testicles in the inguinal canal and in the superficial inguinal position by the following criteria:

(*a*) A superficial inguinal ectopic testis lies more superficially than one situated in the inguinal canal.

(*b*) When the testis is moved upwards and outwards in the direction of the canal, the superficial inguinal ectopic testis

remains in the superficial position and becomes more obvious, whereas one situated in the canal will occupy a position deeper in the canal and thus will become less easily palpable.

(*c*) A testis situated in the canal cannot be moved towards the femoral region, whereas this may be possible in the superficial inguinal type.

(*d*) When a testis situated in the canal is moved downwards it will travel in a direct path towards the neck of the scrotum, whereas one situated in the superficial inguinal region will tend to move slightly lateral to the neck of the scrotum.

For the last two years I have studied my cases with these anatomical points in mind, and I have concluded that the first and the two last criteria are valid but not the second. Often a testicle obeying (*a*), (*c*) and (*d*), if moved upwards and outwards in the line of the canal becomes more prominent as though it cannot get further than the internal ring upwards or the external ring downwards.

It may be concluded that obesity is a favourable accompaniment, and descent usually takes place before puberty. Bilaterally non-descended testicles nearly always descend before puberty: approximately half of the unilateral cases descend at about puberty.[2] A clinically recognisable hernia or a previous operation for one is an almost certain sign that the testicle will not descend, unless it is in a fat boy. Further evidence is required to confirm Spence and Scowen's claim to differentiate between testes in the inguinal canal and the superficial inguinal ectopic testis, the latter of which in their opinion rarely descends spontaneously. I have tried to collect some evidence to prove or disprove whether prematurity is a cause of non-descent, but the war put an end to this research.

RISKS OF LEAVING THE TESTICLE UNDESCENDED

The aberrant testicle is supposed to be particularly liable to inflammation, trauma, torsion and malignant disease. Little mention is made of atrophy. In my ten years as a school medical officer, among the 600 boys who are resident there have been 7 cases of torsion of the spermatic cord and 2 of the hydatid of Morgagni; 1 of sarcoma of the testicle; 2 of large hydroceles, 1 being after mumps; and 2 of hæmorrhage from the pampiniform plexus, probably traumatic. All these have occurred in normally descended testicles. On the other hand, there have been no complications except atrophy among those with undescended testicles.

Torsion.—A long mesorchium is supposed to facilitate the torsion of undescended testicles. When torsion of an undescended testicle takes place operation is performed because of the resemblance to a strangulated hernia, a possibility not considered in the differential diagnosis if the testicle is fully descended. Torsion of the fully descended organ is fairly common, but accounts in textbooks are misleading. Nausea and vomiting are rare; the pain comes on very suddenly if the patient is awake, but is not excruciating; pyrexia is minimal. Even if untwisting, whether manually or by operation, has not been performed, the temperature is rarely above 100°F. I cannot agree with Romanis and Mitchiner (1937) that acute orchitis closely simulates torsion.

Bowen (1933) has reported 5 cases of what he calls acute idiopathic epididymo-orchitis, all of which I would have diagnosed as acute torsion, a diagnosis which he discards because the pain was not severe, there was no vomiting, and the testicle was not inverted as it must be, in Bowen's view, if the testicle can rotate on its axis. Sudden acute pain followed by a rapid increase in the size of the testicle (or of the hydatid of Morgagni or other vestigial organs) are, in my opinion, the two infallible criteria for a correct diagnosis.

In 1938, Lambert and I reported 9 cases of torsion, 4 occurring at Wellington, a school of 650 boys, in 1934–35, and 5 at Rugby, a school of 600 boys, in 1933–37. In 3 the torsion was of the hydatid of Morgagni. Since then I have seen 2 more examples of torsion of the testicle and 1 of the hydatid of Morgagni. All 3 were in patients with fully descended testicles, and I have never seen torsion in an undescended testicle.

2. My conclusions about spontaneous descent are echoed by the observations of Armstrong (1918), late M.O. to Wellington College; Marshall (1937), M.O. to Taunton School; and Bjerre (1937), M.O. to a school in Denmark.

Atrophy.—Undescended testicles certainly atrophy after puberty.

Vines studied the histology of 28 undescended testicles removed from patients past puberty, and found the greater the interval between removal and puberty the more advanced was the atrophy and fibrosis. In 12 specimens from patients aged 15–21, spermatogenesis was seen in one only. He states that "by the age of 16 well-marked atrophic changes are often present." These changes were only seen in the post-pubertal phase and not in testicles removed before or at puberty. These findings are strictly in agreement with those of Wangensteen (1935), who carried out histological examinations of biopsied material obtained from testicles when they were fixed to the thigh and when they were freed several months later. The germinal epithelium often distinctly improved, but the normal adult state was never attained. However, in one instance, where the patient died accidentally 16 months after the thigh detachment, the histological picture was not unlike the normal. Isolated areas of mature spermatogenesis were present throughout. If this fact could be substantiated by observations on others it would prove that further development is possible after the testicle is released from the thigh and placed in its normal habitat, the scrotum. A follow-up over a period of years would show how many of those operated on were fertile. Grey Turner in his paper reported a man aged 31, the father of three children, who had had a double orchidopexy when aged 15.

Vines, Wangensteen and Mimpriss agree that atrophy does not take place until after puberty, and Mimpriss (1938), in his Hunterian lecture, concluded that recovery of normal spermatogenesis was possible as late as 16–17 years. These facts are substantiated by a clinical study of testicles which have spontaneously descended (table III). All in whom bilateral descent occurred had normal testicles and in case 3 the testicle which descended spontaneously was equal to the one surgically transplanted in the scrotum. In many of the unilateral group the testicles immediately after descent were small, although most grew after descent and almost attained parity, and will no doubt function efficiently later. Several on descent compared favourably with their fellows. We are therefore on safe ground if we do not interfere until puberty, after which treatment must be carried out as soon as possible.

Malignant disease.—Neoplastic degeneration has always been a bogy to the surgeon as much as to the patient or his parents.

Pace and Cabot (1936) found 3 instances of adenocarcinoma among 24 undescended testicles, but none of these patients showed any clinical evidence of malignant disease, the diagnosis being based on the histology of the testicles examined, which in nearly all the 24 cases were removed "to facilitate the cure of a hernia"; 2 of the patients were aged 21 and 27, and the diagnosis was controversial in the third, who was 67. Vines (1935) did not observe any malignant change in 38 unilateral undescended testes, 28 of which were from patients aged 14–66, nor in 6 bilaterally undescended testicles. Coley (1919) stated that of 64 patients with undescended testicle, 12 had sarcoma. MacKenzie (1934) stated that up to 1931 he had seen no instances of malignancy in 105 cases of undescended testicle, but later that he had seen 3 examples in retained testes, in men aged 30, 48 and age not stated. Eccles (1902), on the other hand, observed 854 cases of undescended testicle without finding one with a malignant tumour, although many had attacks of inflammation, in some instances oft repeated.

I suggest that the discrepancy between these figures depends on the age at which the testicle was removed. The older the patient the greater is the risk of the testicle becoming malignant. Transplantation into the scrotum does not necessarily remove this liability. Chevassu and Carillon (1938) recorded 5 cases of neoplasm in artificially descended testicles, and Chauvin (1938) has reported others, which are summarised in table IV.

Nearly all the neoplasms were seminomata. No surgeon has, to my knowledge, followed up his cases to see what proportion of those in whom operation was apparently successful have developed abnormalities in later life. Nevertheless, the 12 examples published by the French surgeons show that even early operation is no absolute guarantee against subsequent neoplastic

degeneration. Though the interval between descent and neoplasmic change was longest in those operated on before puberty, the average age of onset of the neoplasm was 26, compared with 31 in those who were operated on later. Undue emphasis need not be laid on this comparison; but the advisability of any operation after puberty, except orchidectomy, is questionable.

TABLE IV—INCIDENCE OF NEOPLASMS IN PATIENTS OPERATED ON BEFORE AND AFTER PUBERTY

BEFORE PUBERTY		AFTER PUBERTY	
Age at operation	Age when neoplasm appeared	Age at operation	Age when neoplasm appeared
8	30	15	15
8	36	20	25
11	20	20	35
13	20	26	26
13	23	26	42
		27	43
		32	33

The risks of torsion, trauma and inflammation, then, are not great, and probably no greater than in the fully descended testicle. The risk of malignant degeneration seems a real one, but it may not be less if the testicle has been surgically lowered into the scrotum. Atrophy is a real danger and no undescended testicle should be left untreated for more than a year after puberty.

The patients do not suffer constitutionally from their deformity. Except for those with general adiposity and with herniæ, they differ, on the average, in no way from their fellows. Wessel (1938–39) considered 8–11 years was the ideal age for operation and deprecated postponing it until puberty because he noticed an access of athletic ability after operation. This may have been wishful thinking, and I certainly have not noticed it. Nor does the undescended testicle have any effect on the intelligence. Several of my cases were scholars, some were superannuated, but in most the mental age was the same as the chronological.

RÔLE OF SURGERY AND ENDOCRINOLOGY

Bigler and others (1938) summarised eighteen reports of the treatment of undescended testicles by hormones, and found that of 267 testicles treated 176, or 65%, descended completely. The authors of some of these reports were probably prompted to publish them because of their high proportion of successes; others may refrain because of their low proportion. Often details of treatment are missing, and it will be more helpful if only those results are considered where precise information is given. Such a series is that of Spence and Scowen (1938), in all of whose cases adequate treatment was given (at least 500 units twice a week, usually for 6 months and in some instances for over a year). Table v is modified from Spence's.

Spence and Scowen excluded from their series those they considered in the superficial inguinal position; I have excluded the retractile tests, for Spence and Scowen themselves admit that they would descend normally. Most of their patients were young and success was minimal with patients over 17. Spence and Scowen have added greatly to our knowledge, but since their publication of 1935 they have become more sober in their claims for hormone therapy (1938). The conclusion is growing that those testicles which descend with hormone therapy are usually those that descend spontaneously. Only half of the bilateral and a third of the unilateral undescended testicles were brought down by hormone therapy. These results compare unfavourably with those where no therapy was given until puberty.

Although operation should be postponed until puberty, delay after that is fatal to the testicle. The difficulty is to persuade the patient's parent of this. Only 3 of the parents of the boys who have passed puberty have consented to operation.

In case 12, an atrophic testicle was removed over a year after the onset of puberty, when operation was first advised. He received no endocrine therapy. In the 2 others (cases 14 and 15), the testicles were both ectopic, having reascended anteriorly to the inguinal canal. Both had received copious endocrine therapy, which had increased the size of the testicle, and at operation one was transposed through the scrotal septum and the other was brought down into the scrotum with satisfactory results. In both, the testicles have attained parity with their fellows.

Table III shows that the testicle is usually arrested at the external inguinal ring (7), at the internal inguinal ring (4), or at the neck of the scrotum (4); in only 1 case was the testicle between the rings. These clinical observations bear out the surgeon's findings at operation.

Spence (1938) reported some obstruction in 6 patients who were operated on after unsuccessful hormone therapy. In all of these the testis had been palpable through the skin before operation. In one the intercolumnar fascia stretched as a firm sheet completely across the external inguinal ring forming a barrier; in another the testis lay just inside the external ring and was firmly held by adhesions in the inguinal canal; in a third, the testis lay near the internal ring, where it was held by fibrous tissue. Thompson and Heckel (1939) have also shown that anatomical peculiarities are common. Of their 38 patients, 12 had bilateral and 26 unilateral undescended testicles. Often the testicles descended spontaneously, but 11 patients whose testicles did not descend were treated surgically. In all of these, fibrous bands prevented descent; in addition, the structures attached to the cord were often short, in 4 the peritoneal process was abnormally directed, and in one the external ring was absent.

These recent observations confirm John Hunter's experience: "The place where the ligament is most confined is the ring in the tendon of the external oblique muscle: and accordingly I think one sees more men who have one testis or both lodged immediately within the tendon of that muscle than those who have one or both still included in the cavity of the abdomen."

TABLE V

Position of testicle	No. of testes	Descent	%
Bilateral (66 testicles)			
Retractile	28	28	100
Inguinal canal movable but not in scrotum	23	13	56
In inguinal canal and not freely movable	3	0	0
In pubic region, movable but not in scrotum	1	1	100
Not palpable	11	4	36
Total, excluding retractile	38	18	47
Unilateral (32 testes)			
Retractile	5	5	100
In inguinal canal, movable but not into scrotum	18	7	39
In inguinal canal and not freely movable	3	1	33
In pubic region, movable but not into scrotum	2	1	50
In pubic region and movable into upper scrotum	1	0	0
In upper scrotum	1	0	0
Not palpable	2	0	0
Total, excluding retractile	27	9	33

The conclusion is inevitable that the testicle which does not descend at puberty is prevented from doing so by anatomical obstruction. The surgeon's task, at first apparently a difficult one, is made easier by hormone therapy. Under this treatment the testicle undoubtedly hypertrophies, as can be judged clinically, and coincident with this is an increase of the circulation, fragile spermatic blood-vessels becoming able to withstand the strain of being stretched when the testicle is inserted into the scrotum. Usually one post-operative course of hormone therapy will cause the testicle to enlarge further and maintain its new position. Puberty is the ideal age for operation, for at this time there is an access of gonadotropic substances in circulation.

SUMMARY

Undescended testicles associated with clinical herniæ should be treated surgically; others should be given the chance to descend spontaneously at puberty. If they fail to do so, operation should be performed without

delay. A preliminary course of hormone therapy will not often cause descent but will make operation easier. Most of the testicles which do not descend spontaneously will be found to be ectopic or to have anatomical obstructions.

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REDUCTION OF DUST-BORNE BACTERIA IN A WARD BY TREATING FLOOR AND BEDCLOTHES

BY

M. VAN DEN ENDE, M.B. CAPE TOWN

E. T. C. SPOONER, M.A. CAMB., M.R.C.S.

(*From National Institute for Medical Research, Hampstead*)

IN a previous paper (van den Ende, Edward and Lush 1941) laboratory investigations on the dust-laying effect of liquid paraffin on textiles were described. The experiment reported here was performed to determine whether the treatment of bedclothes by the method described would significantly reduce the number of dust-borne organisms in the air of hospital wards.

The surgical ward in which the experiment was carried out (fig. 1) consists of four subdivisions, a first and second female ward containing 12 and 11 beds respectively, and two male wards containing 16 beds each. The distance between beds is approximately a yard. Before the experiment was begun the floor, which is of pine planks, had been treated by occasional scrubbing and regular waxing with a standard floor polish; it is swept with a soft brush thrice daily. The four divisions of the ward intercommunicate by ordinary doors.

The windows of the ward are protected outside by brick anti-blast screens which reach to about two-thirds of their height. Each window is provided with a series of horizontally hinged inside blackout screens which are raised and lowered at morning and night and whenever an air-raid alert is sounded. A few windows were opened at irregular times during the experiment. About a third of the patients in the ward were ambulant. Each bed is provided with a mattress, three blankets, two sheets, a thick cotton counterpane, and pillows. Before the beginning of the experiment, bedding was laundered in the hospital laundry in the usual way. It received no special treatment.

Two plate-exposing machines were used which exposed one plate for 15 min. in each hour, the plates being placed on a revolving table so that each exposure happens in the same place. The machines were placed nearly in the centre of the two female wards, as indicated in fig. 1. Each machine was surrounded by an openwork screen made of thick paper-board slats nailed on wooden uprights, measuring a yard square and a yard high. The object of this was to prevent passers-by from rubbing against the plates. Each day's run was begun at 7 A.M. and ended after 10 P.M. The plates used were 5% horse-blood Hedley Wright agar which had been dried in the incubator before use. Colonies were counted after aerobic incubation at 37° C. for 48 hours. Possible hæmolytic streptococcus colonies were picked to blood agar, tested for soluble hæmolysin production, and sent to Dr. Frederick Griffith, who kindly typed them.

PRELIMINARY TESTS

Two 24-hour runs in the male wards showed that these were not suitable for the experiment, for the curves obtained were very irregular and apparently unrelated

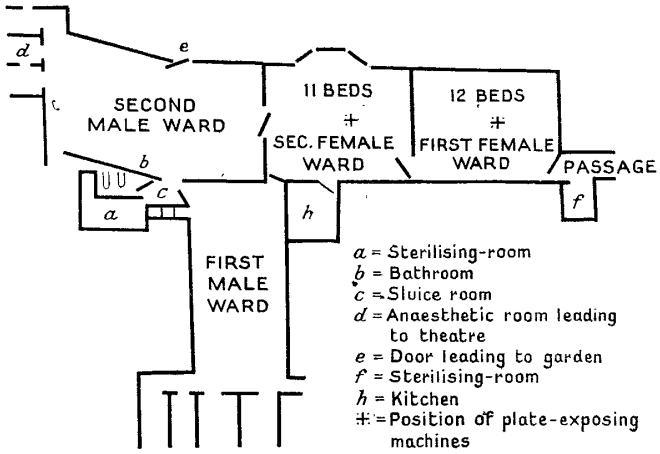

FIG. 1—Sketch map of surgical ward.

to the daily ward routine. This was probably because the machines were placed in draughty places, and possibly because a large number of the male patients were nearly convalescent soldiers of considerable activity and some mechanical curiosity.

It was therefore decided to carry out the experiment in the second female ward (11 beds), using the first female ward as a control. Accordingly, on Jan. 16 and 17, before either the floors or the bedding had been treated, the machines were run. The plate-counts for these two days in the second female ward are recorded in fig. 2; the curves for the first female ward were similar. Nothing untoward happened to the ward routine, and it is probably fair to accept these two days as reliable samples. One point of interest emerges from a study of the 8 colonies of hæmolytic streptococci obtained. Their types were: 1 colony each of types 13, 11 and 8; 1 colony of a group-G streptococcus; 2 colonies of unidentified group-A streptococcus; and 2 colonies of type 4/24. This last type (4/24) had been introduced into the male wards on Jan. 12, five days before, on 5 patients with burns of the face and hands, all of whom were heavily infected, and who by the 15th had developed heavy infections of their throats. Since this type of streptococcus had not previously been encountered in the ward, and was not then or since found in the wounds or throats of any of the female patients, its presence in the dust of the female ward probably indicates that there is a fairly free interchange of dust between the different divisions of the ward. Both of the colonies obtained on the 16th and 17th were on plates exposed in the second female ward, which communicates with both of the male wards by simple doors. A colony of the same streptococcus was obtained from the air of the first female ward on Feb. 6. The plate-counts for these first two days show definite maxima at the hours of bedmaking and floor-sweeping.

TREATMENT OF FLOOR AND BEDDING

Floor—On Feb. 4 the floor in the second female ward was scrubbed, and on the 5th it was oiled with spindle oil. On the 6th the sampling machines were run in both female wards. The counts for this run were little if at all below those of the preliminary run; and there was no significant difference between the first ward, which had not been oiled, and the second which had.

Bedding.—On the 6th, blankets, sheets, counterpanes and pillow-cases sufficient for the 11 beds in the second female ward were treated with 30% liquid paraffin in "white spirit" in the hospital laundry. Fifteen gallons of the spirit-paraffin mixture was placed in a slate tank. Each of the articles of bedding (all of which were clean) was soaked, wrung out by hand, and spun in a hydro-extractor. The excess fluid which was spun out was recovered and returned to the tank. The bedding was dried in a steam-heated drying machine.