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Inconstant ascending testis as a potential risk factor for spermatogenesis in infertile men with no history of cryptorchism

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The usual testicular location, either low or high in the scrotum, as well as testis ascent into suprascrotal position at least once a week from a usually scrotal position reported by the patient to occur spontaneously and regularly, were recorded in 85 fertile and 1014 infertile men, including 95 with a history of cryptorchism. The frequency of at least one testis being in a high scrotal location was similar in fertile (16.5%) and non-cryptorchid infertile (17%) men but higher in previously cryptorchid infertile men (27.2%), a difference probably due to cryptorchism. Testicular ascent was more frequent when scrotal location was high rather than low. An ascending testis was encountered more frequently in previously cryptorchid (30.4%) than in non-cryptorchid infertile men without any history of cryptorchism (18.3%) or in fertile men (11.8%). Moreover, in infertile men, spermatogenesis was more depressed in cases of testicular ascent than when both testes were never ascending, independently of a varicocele. Testis ascent could be a risk factor for spermatogenesis in infertile men without any history of maldescended testicle.

Key words: cryptorchism/infertility/spermatogenesis/testis ascent/varicocele

Introduction

Cryptorchism or undescended testis is one of the several situations in medical–surgical management which repeatedly produces divergent opinions. Most disputes concern embryology (Backhouse, 1982; Hutson, 1994), definition (John Radcliffe Hospital Cryptorchism Study Group, 1988), epidemiology (Chilvers and Pike, 1989), aetiology (Swerdlow *et al.*, 1983; Davies *et al.*, 1986; Hutson *et al.*, 1994), therapeutic management (Hazebroek *et al.*, 1987), and results (Chilvers *et al.*, 1986). The epidemiology of cryptorchism is still unclear, and many risk factors seem to be involved such as birthweight, gestational age or maternal exposure to hormones (Chilvers and Pike, 1989). Over the past 25–30 years, incidence of cryptorchism was reported to have increased from 1.7 to 3.2% when calculated from cumulative orchidopexy rates (Chilvers *et al.*, 1984) and from 0.96 to 1.85% when evaluated from examination of infants 3 months old (John Radcliffe Hospital Cryptorchism Study Group, 1992).

Whatever the treatment, hormonal or surgical, cryptorchism is the only risk factor for testicular cancer that can be considered unequivocally established, with a mean relative risk of six (Chilvers *et al.*, 1986; Strader *et al.*, 1988; Giwercman *et al.*, 1989). Infertility or subfertility is a less well defined risk, with discrepant data ranging from normal spermatogenesis (Puri and O'Donnell, 1988) or fertility (Cendron *et al.*, 1989; Lee *et al.*, 1993) to a depression in sperm concentration (Chilvers *et al.*, 1986; Yavetz *et al.*, 1992) or in subsequent fertility (Lipshultz, 1976). Finally, treatments of an undescended testis have an unusual feature in that although the initial anatomical result of orchidopexy or hormonal therapy is rapidly apparent, the functional result of treatment may not be known until $\geqslant$15 years later.

In the search for factors that can be further involved in the impairment of spermatogenesis and/or fertility, we have recently reported that a 'retractile testis' was more frequent in infertile men with a history of cryptorchism than in fertile men, and that testicular 'retractility' was associated with a decreased sperm output (Mieusset *et al.*, 1995). As 'retractility' appeared to be a risk factor for fertility in formerly cryptorchid men, the aim of the present study was to determine whether 'retractility' was a phenomenom exclusively limited to history of cryptorchism or a common factor in infertile men. In this way, infertile men with or without a history of cryptorchism were compared to fertile men as to testicular location and 'retractility' (referred to as 'ascending testis' in the present study).

Materials and methods

Populations

From January 1989 to November 1993, 1014 new male patients presented for couple infertility, without evidence of main infertility factors in their partner (i.e. anovulation or tubal obstruction). During the same period, 85 successive fertile men, with fertility defined as the birth of at least one child, asked for a vasectomy (n = 20) or were candidate sperm donors (n = 65).

Clinical investigations

A clinical examination was carried out for both fertile and infertile men. The location of the testes and the existence of a testicular ascent were recorded as follows: with the patient standing up and completely naked, the precise location of each testis was noted after a 5 min acclimatization (Mieusset *et al.*, 1987) to room temperature (20–25°C). When a testis was lying in the low scrotum it was recorded as in a 'normal location'. When it was located in the upper part of the scrotum, i.e. close to the root of the penis with part of the empty

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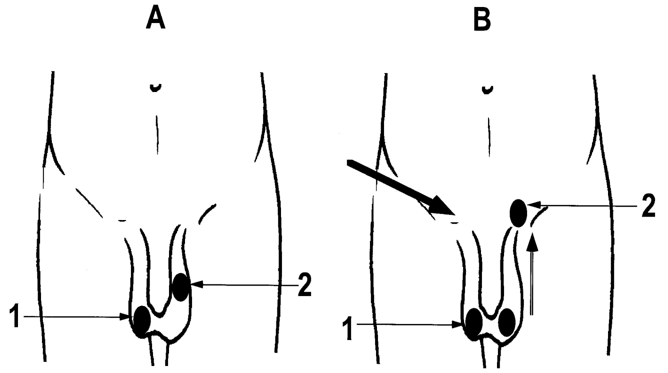

Figure 1. Diagnosis of testis position in the scrotum (**A**) and of testicular ascent (**B**). (**A**) Scrotal position (1 = low scrotum; 2 = high scrotum) recorded by observation after 5 min acclimatization to room temperature (20–25°C) before any physical examination. (**B**) 1 = main position of the testis, i.e. scrotal; 2 = inconstant position of the same testis referred to as 'ascending testis' when occurring (small double-line arrow) at least once a week. This information was recorded by asking the patient if either of his testes was sometimes located in position 2, with the physician indicating position 2 with his finger (large solid arrow).

scrotum underneath, the testis was considered to be in a 'high location' (Figure 1A). Then, the patient was asked whether each testis was spontaneously ascending up in a supra-scrotal location, with the physician indicating the supra-scrotal area with his finger (Figure 1B). Ascent was not recorded when it happened only in a cold environment or during a cremasteric reflex. Each testis was then pushed up close to its corresponding inguinal canal (Mieusset and Bujan, 1994) by the physician to confirm the ascending possibility. A testis was considered as 'retractile' when ascending up spontaneously and regularly, i.e. at least once a week, in such a position. We have used such a definition of 'retractile testis' in a previous study of infertile men with a history of cryptorchism (Mieusset *et al.*, 1995). However, we unfortunately misused the term 'retractile testis'. Indeed, in children a retractile testis is a *non-scrotal* testicle, i.e. an undescended testis, that becomes a scrotal one only when manipulated (Lipshultz, 1976; Schoorl, 1982; Palmer, 1991; Goh and Hutson, 1992). In the former study (Mieusset *et al.*, 1995) and in the present one we in fact describe an inverse pattern in adult men: the testis is in a *scrotal* position but ascends regularly into the supra-scrotal area and must be manipulated in most instances by the patients, who apply their hand on the groin to make the ascended testis descend back into the scrotum. Such a pattern in adult men would have been better referred to as 'inconstant ascending testis,' and is referred to as 'ascending testis' in the present paper. Indeed, the ascending testis was described as a spontaneous ascent of the testis occurring in boys either from a normally descended position (Villumsen and Zachau-Christiansen, 1966; Atwell, 1985; Schiffer *et al.*, 1987; Fenton *et al.*, 1990; Eardley *et al.*, 1994) or from a formerly retractile testis (Belman, 1988; Eardley *et al.*, 1994). No documented information exists about the childhood status of such inconstant ascending testicles, but most patients without any history of cryptorchism agreed this situation already existed during childhood.

Identification of clinical varicocele was performed by scrotal inspection and palpation in an upright position after prolonged standing (Saypol, 1981). No attempts were made to evaluate the so-called 'subclinical' varicocele. Then, the patient being in a supine position, calipers were used to measure dimensions of each testis. Testicular volumes were calculated according to the following formula: volume = $(p \times D^2/4) \times L \times K$, where D = width, L = length and $K = 0.9$, as previously described (Mieusset *et al.*, 1995).

Infertile patients with a history of cryptorchism, i.e. men who had been cryptorchid and then treated successfully to eliminate the condition, are referred to as 'cryptorchid men', while infertile men without any history of maldescended testes are referred to as 'infertile men' hereafter.

Biological investigations

Sperm characteristics of both fertile and infertile men were studied on semen samples collected by masturbation at the laboratory after a recommended period of 3–5 days without ejaculation. Volume of semen was measured using a graduated pipette. Sperm concentration was measured on a Malassez cell (Rogo et Cie, Arcueil, France) as previously described (Mieusset *et al.*, 1989). Total sperm count was calculated as volume×sperm concentration. Semen samples were maintained at 37°C and assessment of motility was made within 1 h after ejaculation; spermatozoa crossing the microscope field with linear motility were recorded as motile (progressive motility) and results expressed as percentage of motile spermatozoa (Mieusset *et al.*, 1989). Only results of the first ejaculate following clinical examination were used for any fertile or infertile men involved in the present study.

Statistical analysis

Statistical analysis was carried out using the PCSM™ package (Delta soft, Meylan, France). The comparisons between groups were carried out using the Mann–Whitney *U*-test. Comparisons of percentages were processed by χ^2 analysis or Fisher's exact test when appropriate. Odds ratio (OR) with exact 95% confidence intervals (95% CI) were calculated using the Epi Info™ package (CDC, Atlanta, USA). Results were considered statistically significant at $P < 0.05$.

Results

General characteristics of the populations

A history of cryptorchism was found more frequently in infertile (9.4%) than in fertile (2.4%) men [95/1014 versus 2/85: OR = 4.29 (1.12–36.55)]. The mean age did not differ between fertile (33.4 years; range: 21–49), cryptorchid (31.8 years, 20–56), and infertile men (32.4 years; 20–59). The duration of infertility was not significantly different between the cryptorchid (38.3 ± 26.3 months) and the infertile men (43.5 ± 31.6 months). Secondary infertility, defined as a history of pregnancy resulting in spontaneous or voluntary abortion, or a child, did not differ between cryptorchid (16.8%) and infertile men (20.1%). An orchidectomy had been undertaken in three (one right and two left) of the cryptorchid men during the surgical treatment, and in five (all right) of the infertile men for either testicular torsion or orchitis.

There was no difference between fertile, cryptorchid and infertile men as regards the frequency of orchitis, either on the right or left side or bilaterally (5.9, 7.4 and 5.3% respectively) and the frequency of right varicocele (5.9, 3.2 and 7.6% respectively). However, there was a higher frequency of left varicocele in infertile (294/919) than in fertile (12/85) men (32.0 versus 14.1%; $P < 0.0001$) or cryptorchid (19/93) men (32.0 versus 20.4%; $P = 0.022$), while fertile and cryptorchid men did not significantly differ. In the 919 infertile men, 97 were azoospermic, of whom 51 (5.5%) had secretory azoospermia, as defined by the lack of spermatozoa in the seminiferous tubules from testicular biopsies. In the 95

Table I. Distribution of men with right and/or left ascending and high located testes in fertile, cryptorchid, and non-cryptorchid men

		Infertile men	
	Fertile men	Cryptorchid	Non-cryptorchid
No. of men	85	92[a]	914[b]
Right and/or left ascending testes (%)	10[c] (11.8)	28[d] (30.4)	167[e] (18.3)
Right and/or left high located testes (%)	14[f] (16.5)	25[g] (27.2)	155[h] (17.0)

Values in parentheses are percentages.
[a]Three orchidectomized men excluded.
[b]Five orchidectomized men excluded.
Ascending testis: global χ^2: $P = 0.004$.
[c]Fertile versus non-cryptorchid men: P = not significant.
[d]Cryptorchid versus fertile men:
Corrected χ^2: $P = 0.005$; OR = 3.28 (95% CI = 1.41–8.12).
[e]Cryptorchid versus non-cryptorchid men:
Corrected χ^2: $P = 0.007$; OR = 1.96 (95% CI = 1.17–3.20).
High located testis: global χ^2: $P = 0.048$.
[f]Fertile versus non-cryptorchid men: P = not significant.
[g]Cryptorchid versus fertile men: P = not significant.
[h]Cryptorchid versus non-cryptorchid men:
Corrected χ^2: $P = 0.022$; OR = 1.83 (95% CI = 1.07–3.04).

Table II. Testicular ascent and sperm characteristics in cryptorchid and non-cryptorchid men

	Cryptorchid		Non-cryptorchid	
Testis ascent	No	Yes	No	Yes
No. of patients	64	28	747	167
Total sperm count (10^6/ejaculate)	61.7[a] (±98)	45.8 (±83.6)	118.8 (±163.6)	80.7[b] (±116.8)
Motility (1 h; %)	27.5 (±10.5)	23.4 (±20.3)	30.4 (±18.5)	25.9[c] (±18.6)
Right testis volume (ml)	23.1 (±11.2)	19.1 (±11.3)	28.2 (±11.4)	26.3 (±9.5)
Left testis volume (ml)	20.7 (±10.9)	16.8 (±9.8)	24.7 (±10.6)	24.0 (±9.0)

Comparisons between means (± SD) carried out using the Mann–Whitney *U*-test.
Cryptorchid: [a]P = 0.044. Yes versus No.
Non-cryptorchid: [b]$P = 0.006$; [c]0.009. Yes versus No.

Table III. Ascent of right or left testis as a function of left varicocele in cryptorchid and in non-cryptorchid men

Populations	Cryptorchid ($n = 92$)		Non-cryptorchid ($n = 914$)	
Left varicocele	Absent	Present	Absent	Present
Ascending left testis	17/73[a] (23.3)	3/19 (15.8)	110/625[b] (17.7)	23/294 (7.8%)
Ascending right testis	14/73 (19.2)	5/19 (26.3)	116/622[c] (18.6)	32/292 (11)

Values in parentheses are percentages.
Left testis
[a]Cryptorchid men: varicocele absent versus present:
Corrected χ^2: $P < 0.0003$; OR = 3.55 (95% CI = 1.66–7.44).
[b]Infertile men: varicocele absent versus present:
Corrected χ^2: $P < 0.001$; OR = 2.51 (95% CI = 1.55–4.23).
Right testis
[c]Infertile men: varicocele absent versus present:
Corrected χ^2: $P < 0.005$; OR = 1.86 (95% CI = 1.21–2.93).

cryptorchid men, 13 cases of secretory azoospermia (13.7%) were found, which was a significantly higher rate than in infertile men [OR= 2.70 (1.29–5.29)].

Ascending testis

The percentage of men with right and/or left ascending testes did not differ between fertile and infertile men [OR = 1.68 (0.84–3.72)]. However, this percentage was significantly higher in cryptorchid than in fertile men, or in infertile men (Table I). Ascent of one or both testes was associated with a more depressed spermatogenesis than when both testes were never ascending, with a lower total sperm count in cryptorchid men and a lower total sperm count and percentage of motile spermatozoa in infertile men. Testicular volumes were not significantly reduced (Table II).

As the fertile and cryptorchid populations differed from the infertile one regarding the frequency of left varicocele, data were re-analysed taking into account this parameter. The distribution of left (8/42), right (9/33) or bilateral (2/17) cryptorchism was not different in the cryptorchid men with or without a left varicocele. As detailed in Table III, the frequency of left testis ascent was not different in the presence or absence of a left varicocele in cryptorchid men. But ascent was significantly more frequent in the infertile men without than with a left varicocele. Moreover, similar results were observed for ascent of the right testis as a function of left varicocele (Table III). Independently of varicocele, testicular ascent was associated with a more depressed spermatogenesis in the infertile population. Indeed, among men without a left varicocele ($n = 622$), those with a right and/or left ascending testis ($n = 130$) had a more impaired spermatogenesis than those with no ascending testes ($n = 492$), with a lower total sperm count ($91.0 \pm 122.2 \times 10^6$/ejaculation versus $133.1 \pm 177.9 \times 10^6$/ejaculation; $P = 0.045$) and percentage of motile spermatozoa (26.2 ± 18.3% versus 31.0 ± 18.7%; $P = 0.016$). Among men with a left varicocele ($n = 292$), those with a right and/or left ascending testis ($n = 37$) had a lower total sperm count than those ($n = 255$) with no ascending testes ($45.3 \pm 88.3 \times 10^6$/ejaculation versus $91.4 \pm 128.2 \times 10^6$/ejaculation; $P = 0.004$).

High location of the testis

The percentage of patients with a right and/or left testis in a high location did not differ between fertile and infertile populations, nor between fertile and cryptorchid groups, but was significantly higher in the cryptorchid than in the infertile populations (Table I). In infertile and in cryptorchid populations, there was no difference in total sperm count between men with a right and/or left testis in a high location and those with both testes in a permanent low scrotal position (data not shown). As detailed in Table IV, the frequency of a left testis high location was not different in the presence or absence of a left varicocele in cryptorchid men. However, the frequency of a left testis high location was significantly higher in the infertile men without than with a left varicocele. Similar results were observed for the right testis high location as a function of left varicocele (Table IV).

Relationships between testis location and ascent

Whether on the left or right side, testis ascent and high location of the testis were parameters independent of each other in fertile men; but these two parameters were related both in cryptorchid and in infertile men, with a testis more frequently ascending when in a high than in a low scrotal location (Table V). When both testes were simultaneously taken into account similar results were observed, with the number of testes ascending from a high location significantly higher in cryptorchid (18/39; OR = 9.43; 95% CI = 1.83–90.74) and in infertile (79/267; OR = 4.62; 95% CI = 1.09–41.34) men than in fertile men (2/24). In both cryptorchid and infertile men, such a relation between high location and ascent of the testes did remain in the absence of left varicocele, but disappeared when a left varicocele was present (Table VI).

Table IV. High location of right or left testis as a function of left varicocele in cryptorchid and in non-cryptorchid men

Populations	Cryptorchid (n = 92)		Non-cryptorchid (n = 914)	
Left varicocele	Absent	Present	Absent	Present
High location left testis	15/74 (20.3)	3/19 (15.8)	104/625[a] (16.6)	27/294[b] (9.2)
High location right testis	16/73 (21.9)	5/19 (26.3)	107/622[c] (17.2)	29/292[d] (9.9)

Left testis
[a]Non-cryptorchid men: varicocele absent versus present:
Corrected χ^2: $P < 0.004$; OR = 1.97 (95% CI = 1.24–3.22).
[b]Cryptorchid men varicocele absent versus non-cryptorchid men left varicocele present:
Corrected χ^2: $P < 0.014$; OR = 2.51 (95% CI = 1.16–5.24).
Right testis
[c]Non-cryptorchid men: varicocele absent versus present:
Corrected χ^2: $P < 0.006$; OR = 1.88 (95% CI = 1.20–3.03).
[d]Cryptorchid men varicocele absent versus non-cryptorchid men left varicocele present:
Corrected χ^2: $P = 0.010$; OR = 2.55 (95% CI = 1.20–5.21).

Multivariate analyses

Total sperm count and sperm motility were significantly reduced when testes were inconstantly ascending. However, because many of the variables being compared may be inter-related, multiple linear regression analyses were conducted, including, apart from testes ascent, the following variables: age, right and left testicular volumes and the presence or absence of right and/or left varicocele.

Age did not contribute significantly to total sperm count. The relationships between total sperm count and the other variables are given in the following equation: total sperm count = 3.0×right testis volume + 2.4×left testis volume – 31.4×varicocele – 34.2×testes ascent + 21.1 (multiple r = 0.38; r^2 = 0.14; $P < 0.001$). As regards sperm motility, only total sperm count and testes ascent significantly contributed to it, with the following equation: sperm motility = 0.03×total sperm count − 3.23×testes ascent + 30.04 (multiple r = 0.25; r^2 = 0.06; $P < 0.0001$).

Discussion

It is now largely accepted that a normally descended testis is a testis located in the scrotum (John Radcliffe Hospital Cryptorchism Study Group, 1988). If such a definition is a basic part of the clinical examination of newborn boys and children in the search for a maldescended testis, the location of the testis has drawn little attention in adult men. In the present work, a systematic and standardized clinical examination revealed that the frequency of one or both testes in a high scrotal location was similar in fertile (16.5%) and infertile men (17%) but higher in cryptorchid men (27.2%). It seems obvious that this difference is due to cryptorchism, as recently

Table V. Relationships between testis location and ascent in fertile and cryptorchid and non-cryptorchid infertile men

				Infertile men			
		Fertile men (n = 85)		Non-cryptorchid (n = 919)		Cryptorchid (n = 95)	
Scrotal position of testis	Ascent	Low	High	Low	High	Low	High
Right testis	No	65	10	671	95	63	11
	Yes	9 (12.2)	1[a] (9.1)	107 (13.8)	41[c] (30.1)	10 (13.7)	10[e] (47.6)
Left testis	No	65	12	693	93	63	10
	Yes	7 (9.7)	1[b] (7.7)	95 (12.1)	38[d] (29.0)	12 (16.0)	8[f] (44.4)

Values in parentheses are percentages.
Fertile men
[a]Right testis: Fisher's exact test: $P = 0.618$; not significant.
[b]Left testis: Fisher's exact test: $P = 0.646$; not significant.
Non-cryptorchid men
[c]Right testis: Corrected χ^2: $P < 0.0001$; OR = 2.71 (95% CI = 1.73–4.18).
[d]Left testis: Corrected χ^2: $P < 0.0001$; OR = 2.98 (95% CI = 1.87–4.68).
Cryptorchid infertile men
[e]Right testis: Fisher's exact test: $P = 0.013$; OR = 5.73 (95% CI = 1.67–19.33).
[f]Left testis: Fisher's exact test: $P = 0.014$; OR = 4.20 (95% CI = 1.16–14.60).

Table VI. Relationship between testis location and ascent in cryptorchid and in non-cryptorchid men as a function of a left clinical varicocele

Infertile populations	Right and left testes	
	Low and ascending	High and ascending
Non-varicocele cryptorchid	15/116 (12.9)	16/31[a] (51.6)
Left varicocele cryptorchid	6/30 (20)	2/8[b] (25)
Non-varicocele non-cryptorchid	154/1036 (14.9)	72/211[c] (34.1)
Left varicocele non-cryptorchid	48/530 (9.1)	7/56[d] (12.5)

Values in parentheses are percentages.
Comparisons 'low and ascending' versus 'high and ascending':
[a]Non-varicocele cryptorchid men:
Corrected χ^2: $P < 0.00001$; OR = 7.18 (95% CI = 2.68–19.13).
[b]Left varicocele cryptorchid men:
Fisher's exact test: not significant; OR = 1.33 (95% CI = 0.11–10.36).
[c]Non-varicocele non-cryptorchid men:
Corrected χ^2: $P < 0.00001$; OR = 2.97 (95% CI = 2.09–4.18).
[d]Left varicocele non-cryptorchid men:
Corrected χ^2: not significant; OR = 1.43 (95% CI = 0.52–3.42).

reported (Sack *et al.*, 1993). In infertile men, high location of the testes was without any effect on the sperm output, as in cryptorchid infertile men (Mieusset *et al.*, 1995), which seems to indicate that a scrotal location of the testis, either low or high, is a physiological one. However, high scrotal location of the testis could not be a variant of the physiological situation, as the length of the spermatic cord as well as the anatomical structures that constitute the spermatic cord could differ. Indeed, testis ascent was more frequent in cases of high than low scrotal location, and both ascent and high location were more frequent when a left varicocele was absent; also, the relation between ascent and high location, i.e. more frequent ascent when a testis was in a high location, that existed in the absence of a varicocele disappeared when varicocele was present. In connection with varicocele, there is a close relation between a clinical varicocele and both the scrotal position and inconstant ascent of the testis in the infertile population. While this inverse relationship seems to indicate that some of the anatomical structures of the spermatic cord are involved, we have no documented explanation for this phenomenon.

To our knowledge, there have been no reports on the modifications in the position of a scrotal testicle in adult men while an acquired permanent ascent of the testis was reported in children (Villumsen and Zachau-Christiansen, 1966; Atwell, 1985; Schiffer *et al.*, 1987; Fenton *et al.*, 1990; Eardley *et al.*, 1994). An ascending testis, i.e. a testis normally located in the scrotum but that ascends spontaneously and regularly (at least once a week) to a supra-scrotal position, was more frequently encountered in cryptorchid (30.4%) than in infertile (18.3%) or in fertile men (11.8%). As regards cryptorchid men, and as stated previously (Mieusset *et al.*, 1995), the high frequency of ascending testis may reflect a failure of either medical or surgical treatment permanently to secure the testis in a scrotal position, which is not surprising. There was, however, no history of maldescended testis, i.e. cryptorchism, retractile or late descending testis (Bremholm Rasmussen *et al.*, 1988) in infertile men. But in this infertile population, sperm output and sperm motility, i.e. spermatogenesis, were more depressed in cases of testicular ascent than when both testes were never ascending. This association between ascending testis and impaired spermatogenesis could result from two factors.

Firstly, in adult men, the ascending testis, which is a *scrotal* testis that becomes spontaneously and regularly a supra-scrotal one, could be a crude pattern of the retractile testis which is defined in children as a *non-scrotal* (i.e. a supra-scrotal) testis that becomes a scrotal one only when manipulated (Schoorl, 1982; Palmer, 1991). Retractility was reported to be associated with histological anomalies during childhood such as a reduced mean diameter of the seminiferous tubules, a decreased number of spermatogonia per tubule and various alterations in Sertoli cell morphology (Ito *et al.*, 1986; Saito and Kumamoto, 1989; Nistal *et al.*, 1991; Rune *et al.*, 1992; Cinti *et al.*, 1993). Furthermore, recent reports have suggested rather an active treatment for retractile testes in boys (Wyllie, 1984; Goh and Hutson, 1992, 1993). While some authors have reported normal fertility, mainly based on questionnaire interview, in adult men with former retractile testes during childhood (Puri and Nixon, 1977), other reports indicated both reduced sperm counts (Abyholm and Gordeladze, 1986; Raboch and Pondelickova, 1988) and testicular histological alterations in such men (Nistal and Paniaga, 1984).

Secondly, when ascending from a scrotal to a supra-scrotal location, the testis is submitted to thermic modifications in its environment, as the temperature of the supra-scrotal location is about 2°C higher than the scrotal cavity (Kitayama, 1965). When testes of fertile men were located and maintained in such a supra-scrotal location, testicular temperature was increased about 2°C (Shafik, 1991). And such an increase in testis temperature repeated daily for 16h is known to result in a severe depression of spermatogenesis within 3 months (Mieusset *et al.*, 1987; Mieusset and Bujan, 1994). However, it is obvious that the increase in temperature of such an ascending testis only lasts for rather short daily periods, even though this phenomenon is regularly repeated for many years and certainly since childhood, as reported by most of the patients. This brief increase in testis temperature, repeated for years, could be the main cause of the impaired spermatogenesis and/or an additive factor to the potential histological anomalies if an ascending testis is a crude pattern of rectractility.

Whereas further studies are required to substantiate these hypotheses, the main practical result of the present study is that an inconstant ascending testis appears to be a risk factor for spermatogenesis in infertile men with or without a history of cryptorchism. If such a risk factor is confirmed in other studies, conditions in which a surgical fixation (Nistal and Paniaga, 1984) of the inconstant ascending testis in the low scrotum could be beneficial to spermatogenesis remain to be defined.

References

Abyholm, T. and Gordeladze, J.O. (1986) True cryptorchism and retractile testes in infertile men. *Acta Eur. Fertil.*, **17,** 15–18.

Atwell, J.D. (1985) Ascent of the testis: fact or fiction. *Br. J. Urol.*, **57,** 474–477.

Backhouse, K.M. (1982) Embryology of testicular descent and maldescent. *Urol. Clin. North Am.*, **9,** 315–325.

Belman, A.B. (1988) Acquired undescended (ascended) testis: effects of human chorionic treatment. *J. Urol.*, **140,** 1189–1190.

Bremholm Rasmussen, T., Ingerslev, H.J. and Hostrup, H. (1988) Bilateral spontaneous descent of the testis after the age of 10: subsequent effects on fertility. *Br. J. Surg.*, **75,** 820–823.

Cendron, M., Keating, M.A., Huff, D.S. *et al.* (1989) Cryptorchism, orchidopexy and infertility: a critical long-term retrospective analysis. *J. Urol.*, **142,** 559-562.

Chilvers, C. and Pike, M.C. (1989) Epidemiology of undescended testis. In Oliver, R.T.D., Blandy, J.P. and Hope-Stone, H.F. (eds), *Urological and Genital Cancers*. Blackwell Scientific, Oxford, pp. 306–321.

Chilvers, C., Pike, M.C., Forman, D. *et al.* (1984) Apparent doubling of frequency of undescended testis in England and Wales in 1962–1981. *Lancet* , **ii**, 330–332.

Chilvers, C., Dudley, N.E., Gough, M.H. *et al.* (1986) Undescended testis: the effect of treatment on subsequent risk of subfertility and malignancy. *J. Pediatr. Surg.*, **21,** 691–696.

Cinti, S., Barbatelli, G., Pierleoni, C. and Cauci, M. (1993) The normal, cryptorchid and retractile prepuberal human testis: a comparative morphometric ultrastructural study of 101 cases. *Scann. Microsc.*, **7,** 351–358.

Davies, T.W., Williams, D.R.R. and Whitaker, R.H. (1986) Risk factors for undescended testis. *Int. J. Epidemiol.*, **15,** 197–201.

Eardley, A.B., Saw, K.C. and Whitaker, R.H. (1994) Surgical outcome of orchidopexy. II Trapped and ascending testes. *Br. J. Urol.*, **73,** 204–206.

Fenton, E.J.M., Woodward, A.A., Hudson, I.L. and Marschner, I. (1990) The ascending testis. *Pediatr. Surg. Int.*, **5,** 6–9.

Giwercman, A., Bruun, E., Frimodt-Möller, C. and Skakkebaek, N.E. (1989) Prevalence of carcinoma *in situ* and other histopathological abnormalities in testes of men with a history of cryptorchism. *J. Urol.*, **142,** 988–1002.

Goh, D.W. and Hutson, J.M. (1992) Is the retractile testis a normal physiological variant or an anomaly that requires active treatment? *Pediatr. Surg. Int.*, **7,** 249–252.

Goh, D.W. and Hutson, J.M. (1993) The retractile testis: time for a reappraisal. *J. Pediatr. Child Health*, **29,** 407–408.

Hazebroek, F.W.J., de Muinck Keiser-Schrama, S.M.P.F, van Maarschalkerweerd, M. *et al.* (1987) Why luteinizing-hormone-releasing-hormone nasal spray will not replace orchidopexy in the treatment of boys with undescended testis. *J. Pediatr. Surg.*, **22,** 1177–1182.

Hutson, J.M. (1994) Testicular descent: the first step towards fertility. *Int. J. Androl.*, **17,** 281–288.

Hutson, J.M., Baker, M., Terada, M. *et al.* (1994) Hormonal control of testicular descent and the cause of cryptorchism. *Reprod. Fertil. Dev.*, **6,** 151–156.

Ito, H., Kataumi, Z., Yanagi, S. *et al.* (1986) Changes in the volume and histology of retractile testes in prepuberal boys. *Int. J. Androl.*, **9,** 161–169.

John Radcliffe Hospital Cryptorchism Study Group (1988) Clinical diagnosis of cryptorchism. *Arch. Dis. Child.*, **63,** 587–591.

John Radcliffe Hospital Cryptorchism Study Group (1992) Cryptorchism: a prospective study of 7500 consecutive male births, 1984–8. *Arch. Dis. Child.*, **67,** 892–899.

Kitayama, T. (1965) Study on testicular temperature in men. *Acta Urol. Jap.*, **11,** 435–437.

Lee, P.A., Bellinger, M.F., Songer, N.J. *et al.* (1993) An epidemiologic study of paternity after cryptorchism: initial results. *Eur. J. Pediatr.*, **152,** S25–S27.

Lipshultz, L.I. (1976) Cryptorchism in subfertile male. *Fertil. Steril.*, **27,** 609–620.

Mieusset, R. and Bujan, L. (1994) The potential of mild testicular heating as a safe, effective and reversible contraceptive method for men. *Int. J. Androl.*, **17,**186–191.

Mieusset, R., Bujan, L., Mondinat, C. *et al.* (1987) Association of scrotal hyperthermia with impaired spermatogenesis in infertile men. *Fertil. Steril.*, **48,** 1006–1011.

Mieusset, R., Bujan, L., Plantavid, M. and Grandjean, H. (1989) Increased levels of serum follicle-stimulating hormone and luteinizing hormone associated with intrinsic testicular hyperthermia in oligospermic infertile men. *J. Clin. Endocrinol. Metab.*, **63,** 419–425.

Mieusset, R., Bujan, L., Massat, G. *et al.* (1995) Clinical and biological characteristics of infertile men with a history of cryptorchism. *Hum. Reprod.*, **10,** 613–619.

Nistal, M. and Paniaga, R. (1984) Infertility in adult males with retractile testes. *Fertil. Steril.*, **41,** 395–403.

Nistal, M., Garcia-Rodeja, E. and Paniaga, R. (1991) Granular transformation of Sertoli cells in testicular disorders. *Hum. Pathol.*, **22,** 131–137.

Palmer, J.M. (1991) The undescended testis. *Endocr. Metab. Clin. North Am.*, **20,** 231–240.

Puri, P. and Nixon, H.H. (1977) Bilateral retractile testes – subsequent effects on fertility. *J. Pediatr. Surg.*, **12,** 563–566.

Puri, P. and O'Donnell, B. (1988) Semen analysis of patients who had orchidopexy at or after seven years of age. *Lancet*, **ii**, 1051–1052.

Raboch, J. and Pondelickova, J. (1988) Andrological findings in adolescents with retractile testicles. *Andrologia*, **20,** 417–421.

Rune, G.M., Mayr, J., Neugebauer, H. *et al.* (1992) Pattern of Sertoli cell degeneration in cryptorchid prepuberal testes. *Int. J. Androl.*, **15,** 19–31.

Sack, J., Reichman, B. and Fix, A. (1993) Normative values for testicular descent from infancy to adulthood. *Horm. Res*., **39,** 118–121.

Saito, S. and Kumamoto, Y. (1989) The number of spermatogonia in various congenital testicular disorders. *J. Urol.*, **141,** 1166–1168.

Saypol, D.C. (1981) Varicocele. *J. Androl.*, **2,** 61–71.

Schiffer, K.A., Kogan, S.J., Reda, E.F. and Levitt, S.B. (1987) Acquired undescended testes. *Am. J. Dis. Child.*, **141,** 106–107.

Schoorl, M. (1982) Classification and diagnosis of undescended testes. *Eur. J. Pediatr.*, **139,** 253–254.

Shafik, A. (1991) Testicular suspension as a method of male contraception: technique and results. *Adv. Contr. Deliv. Sys.*, **VII**, 269–279.

Strader, C.H., Weiss, N.S., Daling, J.R. *et al.* (1988) Cryptorchism, orchiopexy, and the risk of testicular cancer. *Am. J. Epidemiol.*, **127,** 1013–1018.

Swerdlow, A.J., Wood, K.H. and Smith, P.G. (1983) A case-control study of the aetiology of cryptorchism. *J. Epidemiol. Commun. Health*, **37,** 238–244.

Villumsen, A.L. and Zachau-Christiansen, B. (1966) Spontaneous alterations in position of the testes. *Arch. Dis. Child.*, **41,** 198–200.

Wyllie, G.C. (1984) The retractile testis. *Med. J. Aust.*, **10,** 403–405.

Yavetz, H., Harash, B., Paz, G. *et al.* (1992) Cryptorchism: incidence and sperm quality in infertile men. *Andrologia*, **24,** 293–297.

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