Temporal Trends in Orchidopexy, Great Britain, 1992–1998

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Concern has been expressed in recent years about worsening male reproductive health, possibly mediated by increasing exposures to environmental endocrine-disrupting agents. Trends suggested large increases in cryptorchidism in Britain and the United States between the 1950s and 1980s, although published data on recent trends have been scarce. We examined numbers of orchidopexy procedures, as a marker for cryptorchidism, using routine hospital admission data for England, Wales, and Scotland for fiscal years 1992–1993 through 1998–1999. Annual trends in orchidopexy rates were analyzed by age, in-patient admission versus day case, and geographical region. Orchidopexy rates were also obtained from the General Practice Research Database (GPRD) for England to cross-validate the hospital admissions data. Orchidopexy rates for boys 0–14 years old fell by 33% (from 23.5 to 15.8 per 10,000 population) between 1992 and 1998, with the steepest decline (50%) in 5–9-year-olds. The decreasing trend for 0–14-year-olds was evident in every region in England, in Wales, and in Scotland. Rates remained stable for men 15 or more years old, at 0.7 per 10,000. There was a marked shift from in-patient to day-case procedures. Rates from the GPRD showed a similar downward trend to the hospital data. Our findings could represent either an underlying decrease in the frequency of undescended testis or a fairly dramatic improvement in the diagnosis of cryptorchidism—resulting in fewer orchidopexies performed for retractile testis—in Great Britain during the 1990s, or both. Either way, our findings do not support the postulate of a recent worsening of male reproductive health of the scale suggested by some recent commentators on the endocrine disruptor hypothesis. Key words: cryptorchidism, endocrine, orchidopexy, routine health data, temporal trends, testes. Environ Health Perspect 111:129–132 (2003). [Online 6 November 2002] doi:10.1289/ehp.5446 available via http://dx.doi.org/
50 from 1996 were examined, with approval of the Scientific Expert Advisory Group for the GPRD.

Results

Hospital data. In 1992–1993 there were 13,054 orchidopexy episodes for boys 0–14 years old in hospitals in Great Britain; by 1998–1999 there were only 8,762—a 33% decline over the study period. Corresponding rates also fell by 33% from 23.5 to 15.8 per 10,000 population. Rates for men ≥ 15 years old remained stable at 0.7 per 10,000 over the study period.

Annual trends by age. As shown in Figure 1, the rates of orchidopexy declined in all age groups in boys < age 15. However, although there was a 15% decline in the rate for boys 0–4 years old and a 30% decline in those 10–14 years old, the steepest decline (50%, from 29.1 to 14.4 per 10,000) was seen in boys 5–9 years old. Thus, at the beginning of the study period, the highest orchidopexy rate was in boys 5–9 years old, but from 1995 onward the highest rate was among those 0–4 years old.

Annual trends by region. The decreasing trend for those 0–14 years old was evident in every region in England and in Wales and Scotland (Table 1), although in some regions rates in 1998–1999 were higher than those in the preceding year. In 1992–1993, regional rates for 0–14-year-olds ranged from 16.5 to 34.7 per 10,000, whereas by 1998–1999 regional rates ranged from 13.5 to 18.5 per 10,000 (Table 1). Except in the most recent year (1998–1999), the highest rates were found for Scotland, and North Thames had the lowest rates.

Annual trends by type of admission. As well as a decline in episodes, a shift from in-patient to day-case procedures was seen (Table 2). This pattern was observed in all regions and across all age groups. Among those 0–14 years old, there was a 60% decline in in-patient episodes between 1992 and 1998, with a contemporaneous 18% rise in the number of day-case episodes. The largest proportional increase (51%) in day-case episodes in those < 14 years old was seen among 0–4-year-olds. By the end of the study period, some 200 episodes for those ≥ 15 years old were shifted from in-patient to day-case procedures, resulting in an increase of (almost) 150% over the small number of day-case procedures in 1992–1993.

GPRD data. Orchidopexy rates for 0–14-year-olds in the GPRD fell by 47% from 18.1 per 10,000 per year in 1992 (relating to 267 patients) to 9.5 per 10,000 per year in 1996 (163 patients). Results by age showed similar trends to those seen in the hospital data: The decline was less steep for 0–4-year-olds than for 5–9-year-olds, leading to a crossover between these two age groups in 1994. Analysis by region showed that each region experienced a time trend similar to that seen nationally (not shown).

Examination of anonymized patient records (all ages) showed that the percentage of orchidopexies performed for undescended testis in 1994 and 1995 was 70% (26 of 37 records where a diagnosis was listed) and in 1996 was 72% (31 of 43 records with a diagnosis).

Discussion

Recent concerns about possible environmental influences on trends of cryptorchidism have highlighted the need for a current appraisal of its epidemiology. Contrary to expectations, this study showed an overall 33% decline in orchidopexy rates in Great Britain in the 1990s using hospital admissions data, and a 47% decline in England using GPRD data. There were declines in all age groups (most marked in 5–9-year-olds) and in all regions.

Temporal trends in cryptorchidism. Reported worldwide incidence of undescended testis varies considerably as a result of differing study populations and diagnostic criteria (Toppari and Kaleva 1999), although introduction of a standardized definition of malecensure (Scorer 1964), reproduced in large cohort studies (Berkowitz et al. 1993; John Radcliffe Hospital Cryptorchidism Study Group 1986, 1992), has enabled meaningful comparisons. In London in the late 1950s, the prevalence of cryptorchidism was just under 1% at 3 months (Scorer 1964), but by the late 1980s in an Oxford study it was 1.8% (John Radcliffe Hospital Cryptorchidism Study Group 1992).

Information on time trends in cryptorchidism can also be obtained from congenital anomaly registers. Although data from the International Clearinghouse for Birth Defects Monitoring Systems indicated no general increase in cryptorchidism rates from 1970 to the mid-1990s (Paulozzi 1999), U.S. national rates increased markedly from approximately 20 to 40 per 10,000 total births between 1970 and 1993, and rates in the Canadian national system increased until about 1980 but thereafter stabilized (Paulozzi 1999). English data (Paulozzi 1999) showed a sharp drop in rates around 1990, coinciding with a change in reporting procedures (OPCS 1995).

Table 2. Number (%) of orchidopexy episodes (codes N08 and N09) in Great Britain by type of admission (% of year’s admissions), year, and age, 1992–1993 through 1998–1999.

| Year       | 0–14-year-olds | 15-year-olds and older |
|------------|----------------|------------------------|
|            | In-patient     | Day case               |
|            | In-patient     | Day case               |
| 1992–1993  | 8,653 (66)     | 4,401 (34)             |
| 1993–1994  | 7,152 (57)     | 5,423 (43)             |
| 1994–1995  | 5,982 (50)     | 6,039 (50)             |
| 1995–1996  | 5,025 (46)     | 5,897 (54)             |
| 1996–1997  | 4,429 (44)     | 5,268 (56)             |
| 1997–1998  | 3,630 (42)     | 5,059 (58)             |
| 1998–1999  | 3,581 (41)     | 5,180 (59)             |

Table 1. Orchidopexy rate per 10,000 (male) population by region and year in Great Britain, 0–14–year-olds, 1992–1993 through 1998–1999.

| Year       | Northern and Yorkshire | Trent | Anglia and Oxford | North Thames | South Thames | South and west | West Midlands | Northwest | Wales | Scotland |
|------------|------------------------|-------|-------------------|--------------|-------------|---------------|---------------|-----------|-------|----------|
| 1992–1993  | 25.1                   | 22.3  | 24.3              | 16.5         | 21.6        | 24.7          | 22.2          | 23.7      | 22.9  | 34.7     |
| 1993–1994  | 23.6                   | 23.3  | 23.4              | 14.8         | 19.7        | 25.0          | 22.3          | 24.5      | 21.4  | 31.4     |
| 1994–1995  | 22.7                   | 17.3  | 24.0              | 14.9         | 20.2        | 22.4          | 22.6          | 24.7      | 20.8  | 28.6     |
| 1995–1996  | 20.0                   | 17.6  | 26.4              | 14.8         | 19.3        | 19.2          | 21.0          | 20.3      | 18.3  | 22.3     |
| 1996–1997  | 16.5                   | 16.8  | 19.1              | 14.3         | 16.6        | 18.0          | 18.2          | 19.6      | 20.4  | 23.1     |
| 1997–1998  | 13.3                   | 17.6  | 17.5              | 11.4         | 15.1        | 15.5          | 16.3          | 16.4      | 21.4  |          |
| 1998–1999  | 12.9                   | 16.9  | 18.5              | 12.5         | 16.6        | 15.7          | 14.5          | 16.4      | 15.2  | 18.1     |
Interpretation of hospital and general practitioner data on orchidopexy. The use and interpretation of hospital admission data are complex. Hospital activity in the United Kingdom depends not only on the underlying prevalence of disease but also on the diagnostic accuracy and referral practice of the primary care clinician, patient-specific factors such as individual preferences, distance of residence from hospital, and socioeconomic class and on hospital-specific factors, such as quality of the hospital data collected, supply of hospital beds, admission policies, and hospital access (Hansell et al. 2001). Given such complexities, we investigated whether the observed decline in orchidopexy rates could have been artifactual, related to changes in clinical coding or data-capture problems.

First, an alternative code to those examined here could have been used for orchidopexy (“other operations on testes—fixation of testis,” OPCS-4 code N132) (OPCS 1990). Although the number of episodes given this code fluctuated annually, there was an overall decline of 17% over the study period, and it is unlikely that simple coding transfer could explain our findings because the largest annual decline in orchidopexy episodes was four times greater than the largest annual decline in the number of operations given this code. Ideally, our examination would have included English hospital admissions data from the 1970s and 1980s and allowed us to compare time trends in hospital admissions with those from an individual cohort study (John Radcliffe Hospital Cryptorchidism Study Group 1992). Unfortunately, hospital admissions data between 1987 and 1991 are of variable quality (Aylin et al. 2001), whereas U.K. national data for the 1970s and 1980s are not readily available.

Second, increasing use of day-case procedures may have led to incomplete capture of the frequency of orchidopexy in hospital episode records. To investigate this possibility, we used an alternative source of data, the GPRD, which has proven valuable for examining rates over time (Kay et al. 2000). In validation studies for a range of conditions, the GPRD has been shown to capture a high proportion of patient referrals and hospitalizations (Jick et al. 1991; Kaye et al. 2000). There seems no obvious reason why these results should not also apply to orchidopexy. The GPRD also showed a decline in orchidopexy rates, which was comparable with, but larger than, that seen in HES, with similar age-specific trends.

The recorded rates of orchidopexy in the GPRD were within the range of those reported by region in 1992–1993 but declined to approximately two-thirds the rate of the lowest region by 1996. There are a number of possible explanations for the discrepancies in rates between the two data sources. Although broadly representative, GPRD practices are self-selected with underrepresentation in inner London and of single-handed (one practitioner) practices (Walley and Mangani 1997), and it should probably not be surprising that prevalence and/or referral rates differ from national or regional rates. It is also possible that, through computerization, these general practitioners were more readily able to access records showing that the testes were descended after birth and thus less likely to misdiagnose retractile testes as cryptorchidism. Another explanation is that improvements in diagnosis occurred faster than that seen nationally. A final possibility is that the HES data used overestimate the true prevalence of orchidopexy: GPRD rates were based on patients, whereas HES records are based on episodes. Although we attempted to remove duplicate episodes and readmissions from the HES records, it is possible that some were missed.

Changes in surgical practice. By 1995, the orchidopexy rate was highest for boys 0–4 years old, in contrast to 5–9 years in the earlier period. The trend for earlier age at orchidopexy may be a reflection of both academic (Kass et al. 1996) and, more recently, policy recommendations (Hall 1996) that cryptorchidism be detected and corrected operatively before 2 years of age. In fact, late orchidopexy rates (orchidopexies done after the age of 5 years) are used to monitor the adequacy of child health screening programs, and regional rates are routinely published each year (Department of Health 1997). If, however, such changes in surgical practice during the early 1990s were the sole cause of the observed decline in orchidopexy, we would expect to see an increase in the number of operations performed in the 0–4-year-old group, whereas a decrease was observed. While shifting age trends may reflect changes in surgical practice, they could also be indicative of an underlying birth cohort effect, although with the limited numbers of years of data available to us, we were unable to explore this possibility further.

Over the past two decades, hormone therapy has been proposed in the treatment of undescended testes, with equivocal reports of its efficacy (Behrman et al. 2000; Madden 2002). Although the introduction of such treatment could affect orchidopexy rates, use in the treatment of cryptorchidism is not standard practice in the United Kingdom (Madden 2002) and therefore could not have greatly influenced the observed declining trends in orchidopexy reported here.

Use of orchidopexy as a proxy for cryptorchidism. The use of orchidopexy rates as a marker for the prevalence of cryptorchidism is not straightforward, because interpretation involves untangling factors that can directly influence the prevalence of cryptorchidism from those that influence the relationship between orchidopexy and cryptorchidism.

Gestational age at delivery will affect prevalence of cryptorchidism, because physiologic descent of the testes takes place in the third trimester of pregnancy (O’Rahilly and Muller 2001). In recent years obstetric care, especially regarding high-risk pregnancies, has improved, and this may be a factor influencing the observed declining trends in orchidopexy—for example, if there were fewer prematurely born babies during the late 1980s and 1990s than previously. Information from a large maternity database in London [St Mary’s Maternity Information System (SMMIS); for a general account of the system, see Chapple (1997)], however, indicated no systematic change in the incidence of preterm labor for those babies born at 32 weeks or later over this time period (Philip Steer. Personal communication). SMMIS data also showed a small increase in the number of babies born with <32 weeks of gestation, which, in contrast to the findings presented here, has the potential to slightly increase the frequency of undescended testes.

A further issue is the relationship between orchidopexy and the underlying prevalence of cryptorchidism. Previous studies have suggested that orchidopexy rates might be double (Chilvers et al. 1984) or even several times (Campbell and Webb 1987; Cooper and Little 1985; Snick 1984) higher than the prevalence of cryptorchidism in infancy. Large differences in these rates increase the possibility that underlying trends in cryptorchidism will be masked.

The differences between orchidopexy and cryptorchidism rates might partly reflect either misdiagnosed cases of retractile testes (Chilvers et al. 1984; Cooper and Little 1985; Snick 1984) or the possibility that cryptorchidism is acquired after birth (Donaldson et al. 1996; Jackson and John Radcliffe Hospital Cryptorchidism Research Group 1988), for which various etiologies have been postulated (Atwell 1985; Clarinette et al. 1997; Hutson and Goh 1993; Rabinowitz and Hulbert 1997). The cremaster reflex cannot retract the testes from the scrotum to the superficial inguinal pouch until about 6 months of age (Cortes 1998). Peak prevalence of retractile testes is suggested to be between 5 and 8 years old (Cortes 1998), and improved diagnosis might therefore have resulted in a decline in orchidopexy performed on this age group. Although this may help explain the patterns in our data, our analysis of a small sample of general practitioner patient records reported here suggests that around 70% of orchidopexies were carried out for cryptorchidism, with no change in this proportion over time.
Nonetheless, it is conceivable that a reduction in inappropriate surgery for retractile tests could account for at least some of the declining trend in orchidopexy.

To illustrate the extent to which orchidopexy rates could provide us with an indication of the underlying frequency of cryptorchidism—given the complexities in the relationship between orchidopexy and cryptorchidism outlined above—a simple mathematical model was constructed for boys <15 years.

The relationship between the observed rates of orchidopexies and the true prevalence of cryptorchidism could be represented by the equation $y = x + \kappa x^2$, where $y$ represents the observed rate of orchidopexies and $x$ represents the rate of orchidopexies performed for cryptorchidism. The rate of orchidopexies performed because of misdiagnosed cryptorchidism (e.g., for retractile tests) can be expressed as $kx$, where $k$ is the multiplying factor for year $i$. We have assumed that the number of operations performed for reasons other than true or misdiagnosed cryptorchidism, for example, for torsion or hydrocele, in this age group is very small and constant and therefore of negligible impact.

The observed rate of orchidopexies in 0–14-year-olds in 1992–1993 was 23.5 per 10,000 males. If 50% of orchidopexies in that year were performed because of misdiagnosed retractile testes, a figure consistent with the John Radcliffe cohort study findings for the late 1980s (John Radcliffe Hospital Cryptorchidism Research Group 1986) and the calculations of Chilvers et al. (1984), then the value of $k_{1992–1993} = 1$ and the underlying rate of cryptorchidism could be estimated as 11.75 per 10,000.

The observed rate of orchidopexies in 1998–1999 in 0–14–year-olds was 15.8 per 10,000. If we assume no change in the underlying rate of cryptorchidism between 1992–1993 and 1998–1999, this gives the equation $15.8 = 11.75 + k_{1998–1999}(11.75)$, and therefore the value $k_{1998–1999} = 0.34$. This means that for each orchidopexy performed for true cryptorchidism, a further 0.34 were performed for misdiagnosed cryptorchidism; therefore, the proportion of orchidopexies performed for misdiagnosed retractile testes was 0.34/(1 + 0.34) or 25%, half that in 1992–1993. This would represent a fairly dramatic improvement in diagnostic ability affecting the whole country in the relatively short time period of 6 years.

If the underlying rate of cryptorchidism had actually increased over this time period, the corresponding improvement in diagnostic ability would have had to be even greater than this to result in the observed decline in orchidopexy rates. The data also allow for an interpretation of a decrease in the underlying frequency of cryptorchidism, accompanied by a smaller or no improvement in diagnostic ability.

**Conclusion.** Although the relationship between orchidopexy and cryptorchidism is complex, we believe that our findings may reflect either an underlying decrease in the frequency of undescended testis or a marked improvement in the diagnosis of cryptorchidism—resulting in fewer orchidopexies performed for retractile testes—in Great Britain during the 1990s, or both. An increase in the prevalence of cryptorchidism cannot be ruled out, but for this to be a possibility, given the observed trends in orchidopexy, a dramatic improvement in diagnostic ability would have had to have occurred simultaneously over a short period, which we regard as an unlikely scenario. Our findings warrant further investigation with individual-level studies, because this is a surprising finding given reported trends of large increases in cryptorchidism for previous decades and the postulate of a recent worsening of male reproductive health as suggested by the endocrine disruptor hypothesis.

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