1. Operationsmønsteret og ventetider ved danske sygehuse 1988, *Sundhedsstyrelsen (The Danish Medical Board)* 1988.
2. Heaton JM, and Maclennan KA. Vasitis nodosa — a site of arrest of malignant germ cells. *Histopathology* 1986, **10**, 981–989.
3. Thornhill JA, Bulter M, Fitspatrick JM. Could vasectomy accelerate testicular cancer? The importance of prevasectomy examination. *Br J Urol* 1987, **59**, 367.
4. Thornhill JA, *et al.* An evaluation of predisposing factors for testis cancer in Ireland. *Eur Urol* 1988, **14**, 429–433.
5. Cale ARJ, *et al.* Does vasectomy accelerate testicular tumour? Importance of testicular examinations before and after vasectomy. *Br Med J* 1990, **300**, 370.
6. Skakkebaek NE. Possible carcinoma-*in-situ* of the testis. *Lancet* 1972, 516–517.
7. Skakkebaek NE, Berthelsen JG. Carcinoma-*in-situ* of the testis and invasive growth of different types of germ cell tumours. A revised germ cell theory. *Int J Androl* 1980, **4**, 26–34.
8. Skakkebaek NE, Berthelsen JG, Müller J. Histopathology of human testicular tumours: carcinoma-*in-situ* germ cells and invasive growth of different types of germ cell tumours. *INSERM* 1984, **123**, 445–462.
9. von der Maase H, *et al.* Carcinoma-*in-situ* of the contralateral testis in patients with testicular germ cell cancer: study of 27 cases in 500 patients. *Br Med J* 1986, **293**, 1398–1401.
10. Skakkebaek NE, Berthelsen JG, Müller J. Carcinoma-*in-situ* of the undescended testis. *Urol Clinics North Am* 1982, **3**, 377–385.
11. Skakkebaek NE. Atypical germ cells in the adjacent "normal" tissue of testicular tumours. *Acta Path Microbiol Scand* 1975, **83**, 127–130.
12. Jacobsen GK, Henriksen OB, von der Maase H. Carcinoma *in situ* of testicular tissue adjacent to malignant germ-cell tumors. A study of 105 cases. *Cancer (Philadelphia)* 1981, **47**, 2660–2662.
13. Skakkebaek NE, *et al.* Carcinoma-*in-situ* of the testis: possible origin from gonocytes and precursor of all types of germ cell tumours except spermatocytoma. *Int J Androl* 1987, **10**, 19–28.
14. Johnson AL, Howards SS. Intratubular hydrostatic pressure in testis and epididymis before and after vasectomy. *Am J Physiol* 1975, **228**, 556–564.
15. Jarow JP, *et al.* Quantitative pathologic changes in the human testis after vasectomy. A controlled study. *New Engl J Med* 1985, **313**, 1252–1256.

Acknowledgements—This study was supported by the Danish Cancer Society, grants 91-032 and 74-9/89.

Eur J Cancer, Vol. 29A, No. 7, pp. 1064–1066, 1993.
Printed in Great Britain

0964–1947/93 $6.00 + 0.00
Pergamon Press Ltd

Vasectomy and Testicular Cancer: Epidemiological Evidence of Association

Elsebeth Lynge, Lisbeth B. Knudsen and Henrik Møller

INTRODUCTION

INFORMATION ON the possible relation between vasectomy and subsequent risk of testicular cancer is available from eight studies. An additional three studies provide information on the overall cancer risk following vasectomy. These eleven studies are summarised below. Some of these studies have been covered by two recent reviews [1, 2].

VASECTOMY AND TESTICULAR CANCER

The Scottish Hospital Inpatient Statistics system was used to identify all of the 1764 men aged 25–49 years who had undergone vasectomy as inpatients in Scotland between 1968 and 1974. A total of 14641 men who had undergone meniscectomy, resection for benign nasal conditions or operations on haemorrhoids were chosen as controls. All subsequent discharges from Scottish hospitals until the end of 1976 were identified for these two groups by a matching procedure based on surname, initials, sex and date of birth. 1 testicular cancer case occurred in the vasectomy group (0.12 cases per 1000 man-years), and 4 cases occurred in the control group (0.04 cases per 1000 man-years). The cancer incidence rates for Scotland during 1963–1966 and 1970–1972 show 0.06 cases of testicular cancer per 1000 man-years [3, 4]. This gives an expected number of 0.5 testicular cancer case in the vasectomy group, and the finding of 1 case is therefore not unexpected.

All testicular cancer patients reported to the California Tumour Registry between 1979 and 1981 were contacted for interview. Of 171 eligible cases, 131 were interviewed. In addition, 247 cases were contacted as clinical referrals from various hospitals primarily from 1976 to 1979, 193 were interviewed. The patients were asked to name "peer controls". The analysis was based on 273 pairs of cases and controls and their mothers. Information on vasectomy was provided only by 173 cases and 212 controls. 15 and 30 men, respectively, had had a vasectomy (RR 0.6, 95% C.I. 0.3–1.2) [5].

Review (probably of clinical notes) for all 240 testis cancer cases in Ireland between 1980 and 1985 showed that vasectomy had been performed within 2 months prior to diagnosis in 3 cases. The 3 cases had features in common including their age (range 35–38 years) and uncommon pathology with mixed seminoma and malignant teratoma intermediate. The expected number of testicular cancer cases in vasectomised men was 0.8 (SIR 3.8, 95% C.I. 0.8–11), assuming there were 23148 vasectomised man-years, and the incidence of testicular cancer was 3.52×10^5 males/year [6, 7].

A case–control study covered incident cases of testicular cancer diagnosed between Jan 1977 and Feb 1981 from the catchment areas of five radiotherapy centres in England. Only 259 out of 469 eligible patients were interviewed. One control group was 238 men treated in the same radiotherapy centers. Another control group was 251 men hospitalised with non-malignant diseases in the same towns as the radiotherapy centres.

Correspondence to E. Lynge.
The authors are at the Danish Cancer Society Strandboulevarden 49, DK-2100, Kobenhavn O, Denmark.
Received and accepted 23 Dec. 1992.

22 of the testis cancer patients previously had had a vasectomy. This represents a relative risk of 1.28 (0.62–2.63) compared with radiotherapy controls, and of 0.99 (0.50–1.98) compared with non-radiotherapy controls [8].

A case–control study was made up of white males aged 20–69 years old with germ cell testicular cancer diagnosed in the western Washington state 1977–1983. The study was carried out in 1981–1984 and a telephone interview was obtained for 333 out of 459 eligible cases. A total of 729 controls were identified by a 2-step random dialling procedure, where 88% of eligible households were surveyed, and where 65% of eligible controls in the surveyed households were interviewed. The analysis of vasectomy was restricted to ever-married men who reported no history of cryptorchidism. 46 cases and 88 controls reported vasectomy (RR = 1.5, 95% C.I. 1.0–2.2). The relative risk varied by religious group and the only significant excess risk was seen for Catholic men (RR = 8.7, 95% C.I. 2.8–27.1). The authors conclude therefore that the most plausible explanation for this association is an underreporting of vasectomy by Catholic controls [9].

Among 3079 men who had vasectomy in the West Lothian district of Scotland between 1977 and 1987, 8 men were found to have developed testicular cancer. The expected number of testicular cancers was 1.9 based on age-specific incidence rates for the district. Thus the Standardised Incidence Ratio was 4.2 (95% C.I. 1.8–8.2). The average time from vasectomy to testicular cancer was 1.9 years (range 0.25–4 years). The authors conclude that the study suggests an association between vasectomy and subsequent development of testicular tumours, but that the results require classification concerning confounding factors such as smoking and social class [10].

A study based on the Oxford record linkage study included 25–49-year-old residents recorded with either vasectomy or three elective operations, appendicitis or injuries in the period 1970–1986. For the 13 246 vasectomised men and the 22 196 control persons the records were also searched for subsequent cancer diagnoses. 4 of the vasectomised men were registered with testis cancer as compared to 17 of the controls. The relative risk of testis cancer for vasectomised men as estimated in a Cox's proportional hazard model was 0.46 (0.1–1.4) [11].

The Nurses' Health Study from the United States provided the basis for a cohort study of vasectomised men. In 1976, 121 700 female nurses aged 30–55 years reported themselves as married as of 1972, and 14 607 of these reported their husband's vasectomy as the couple's method of contraception. A matched group of husbands who had not had a vasectomy was selected as controls. Questionnaire data on medical history, etc. were collected for 13 124 and 12 392 of the men, respectively. The two groups were followed-up of deaths until the end of 1989. No death from testis cancer occurred in the vasectomised men, where 1.0 death was expected based on the mortality rates among the non-vasectomised controls [12].

VASECTOMY AND CANCER IN GENERAL

Group Health Cooperative of Puget Sound (GHC) is a group practice in Seattle. GHC had a total of 6092 members aged 25–54

Table 1. Studies on vasectomy and testicular cancer

Study and population	Number of testis cancers or vasectomised men	Estimate of relative risk and 95% CI	Ref.
Scottish Hospitals 1968–1974			
1764 vasectomised	1 testis cancer	SIR 2.1 (0.05–11.6)	3, 4
14 641 controls	4 testis cancers		
National rate	0.06/1000		
California Tumour Registry 1979–1981			
173 testis cancers	15 vasectomised	OR 0.6 (0.3–1.2)	5
212 controls	30 vasectomised		
Ireland 1980–1985			
240 testis cancers	3 vasectomised	SIR 3.8 (0.8–11)	6, 7
23 148 vasectomised man-years	0.8 testis cancers		
England 1977–1989			
259 testis cancers	22 vasectomised	OR 1.13 (0.63–2.04)	8
489 controls	36 vasectomised		
Washington State, U.S.A. 1977–1983			
333 testis cancers	46 vasectomised	OR 1.5 (1.0–2.2)	9
729 controls	88 vasectomised		
West Lothian, Scotland, 1977–1987			
3079 vasectomised	8 testis cancers	SIR 4.2 (1.8–8.2)	10
National rate	1.9 testis cancers		
Oxford, England, 1970–1986			
13 246 vasectomised	4 testis cancers	RR 0.46 (0.1–1.4)	11
22 196 controls	17 testis cancers		
Nurses' Health Study, U.S.A., 1976–1986			
13 124 vasectomised	0 testis cancers	—	12
12 392 controls	not available		

years who were vasectomised between 1963 and 1978. For each of these men the number of person years as a vasectomised GHC-member during 1972–1978 was calculated. The person years for the remainder of GHC-member were also calculated. New hospitalisations were sought in the GHC-records. There were 31 first-time hospitalisations for malignant neoplasms in the vasectomised group, which was as expected based on the hospitalisation rates for the non-vasectomised. No data is provided on specific cancers [13].

The Northern California Kaiser Permanent Medical Care Program has computerised records from questionnaires provided at health check-ups. In the period 1977–1980, 4392 men indicated that they had had a vasectomy. Each man was matched with 3 men who did not report having had a vasectomy. 7 men could not be matched. The two groups of men were compared based on information reported on the questionnaires. 3.8% of vasectomised men, and 3.0% of controls reported that a doctor ever said they had cancer or a tumour (RR 1.3, 95% C.I. 1.1–1.6) [14]. Hospitalisations through 1980 were also sought for the two groups. The incidence of hospitalisation for malignant neoplasms was 3.0 per 1000 in the vasectomised men, and 3.8 per 1000 in the controls (RR 0.8, 95% C.I. 0.5–1.3) No information is provided on specific cancers [15], but data on prostatic cancer was later reported [16].

A total of 12 200 vasectomised men was identified from clinic and physicians' records in four cities, Minneapolis and Rochester (Minnesota) and Los Angeles and Eureka (California). All of the surgeries were performed before 1 January 1976, most of them after 1965. A matching non-vasectomised man was sought for each vasectomised man. Both groups were interviewed once during the period 1977–1982. Only death certificates were available for deceased subjects. Of the 12 200 vasectomised men, 1378 refused to participate, 189 could not be located, and 43 were not successfully paired. There were 44 deaths from cancer in the vasectomised group, and 88 in the control group. 7 and 28, respectively, of these cancer deaths, were due to lung cancer. No other specific cancers is mentioned [17].

CONCLUSION

The eight studies on vasectomy and testicular cancer are listed in Table 1. One study only indicates a statistical significant positive association. The risk estimates obtained in the other seven studies are all close to unity or are based on small numbers, and the 95% confidence intervals thus include unity. When the methodological limitations of most of the studies are taken into account it is too early to draw conclusions about possible associations between vasectomy and testicular cancer.

1. McDonald SW. Vasectomy and the human testis. *Br Med J* 1990, **301**, 618–619.
2. Peterson HB, Huber DH, Belker AM. Vasectomy: an appraisal for the obstetrician–gynecologist. *Obstet Gynecol* 1990, **76**, 568–572.
3. Goldacre MJ, Clarke JA, Heasman MA, Vessey MP. Follow-up of vasectomy using medical record linkage. *Am J Epidemiol* 1978, **108**, 176–180.
4. Goldacre M, Vessey M, Clarke J, Heasman M. Record linkage study of morbidity following vasectomy. In Lepow IH, Grozier R, eds. *Vasectomy: Immunologic and Pathophysiologic Effects in Animals and Man*. New York, Academic Press, 1979, 567–569.
5. Moss AR, Osmond D, Bacchetti P, Torti FM, Gurgin V. Hormonal risk factors in testicular cancer. A case–control study. *Am J Epidemiol* 1986, **124**, 39–52.
6. Thornhill JA, Butler M, Fitzpatrick JM. Could vasectomy accelerate testicular cancer? The importance of prevasectomy examination. *Br J Urol* 1987, **59**, 367.
7. Thornhill JA, Conroy RM, Kelly DG, Walsh A, Fennely JJ, Fitzpatrick JM. An evaluation of predisposing factors for testis cancer in Ireland. *Eur Urol* 1988, **14**, 429–433.
8. Swerdlow AJ, Huttly SRA, Smith PG. Testicular cancer and antecedent diseases. *Br J Cancer* 1987, **55**, 97–103.
9. Strader CH, Weiss NS, Daling JR. Vasectomy and the incidence of testicular cancer. *Am J Epidemiol* 1988, **128**, 56–63.
10. Cale ARJ, Farouk M, Prescott RJ, Wallace IWJ. Does vasectomy accelerate testicular tumour? Importance of testicular examinations before and after vasectomy. *Br Med J* 1990, **300**, 370.
11. Nienhuis H, Goldacre M, Seagroatt V, Gill L, Vessey M. Incidence of disease after vasectomy: a record linkage retrospective cohort study. *Br Med J* 1992, **304**, 743–746.
12. Giovannucci E, Tosteson TD, Speizer FE, Vessey MP, Colditz GA. A long-term study of mortality in men who have undergone vasectomy. *N Engl J Med* 1992, **326**, 1392–1398.
13. Walker AM, Jick H, Hunter JR, Danford A, Rothman KJ. Hospitalization rates in vasectomized men. *JAMA* 1981, **245**, 2315–2317.
14. Petitti DB, Klein R, Kipp H, Kahn W, Siegelaub AB, Friedman GD. A survey of personal habits, symptoms of illness and histories of disease in men with and without vasectomies. *Am J Publ Health* 1982, **72**, 476–80.
15. Petitti DB, Klein R, Kipp H, Friedman GD. Vasectomy and the incidence of hospitalized illness. *J Urol* 1983, **129**, 760–762.
16. Sidney S. Vasectomy and the risk of prostatic cancer and benign prostatic hypertrophy. *J Urol* 1987, **138**, 795–797.
17. Massey FJ, Bernstein GS, O'Fallon WM, *et al.* Vasectomy and health. Results from a large cohort study. *JAMA* 1984, **252**, 1023–1029.