

SHORT REPORT

Increased cancer risk among surgeons in an orthopaedic hospital

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Background	Five cancer cases over 7 years were reported in a small orthopaedic hospital where radiation protection practice was poor.
Aim	To investigate whether workers subject to routine radiation dosimetric assessment in that hospital had an increased cancer risk.
Methods	One hundred and fifty-eight workers subject to routine dose assessment and 158 age–sex-matched unexposed workers were questioned about cancer occurrence. All tumours were analysed as a single diagnostic category.
Results	Cumulative 1976–2000 cancer incidence was 29 (9/31), 6 (8/125) and 4% (7/158) in orthopaedics, exposed other than orthopaedics, and unexposed workers, respectively. At logistic regression analysis, working as orthopaedic surgeon significantly ($P < 0.002$) increased the risk of tumours.
Conclusion	These findings caution against surgeons' underestimation of the potential radiation risk and insufficient promotion of safe work practices by their health care institutions.
Key words	Cancer; dosimetric assessment; occupational exposure; orthopaedic surgeons; radiation.

Introduction

Five cancer cases over 7 years were reported in a small orthopaedic hospital (Villa Igea, Trento, Italy) in radiation-exposed workers. In that hospital, until August 1999, the use of radiation protective measures during intra-operative fluoroscopy was discontinuous, and 60% of the total post-operative radiographs were performed in a corridor in front of the operating rooms where, usually, the personnel used to take off their heavy and uncomfortable lead apron and dosimeter.

To investigate whether workers subject to routine radiation dosimetric assessment in that hospital had an increased cancer risk, an epidemiological investigation was conducted.

Methods

Using institutional records on personnel data available since 1976, we identified all the 158 workers subject to

dosimetric assessment and 158 unexposed workers, individually matched (1:1) for sex, birthdate and vital status. Each cohort included 62 women and 96 men. Cancer incidence was reconstructed from 1976 to 2000, by asking all subjects about date, hospital and histologic diagnosis in case of cancer (in decedents, the death certificate was obtained); moreover, exposed subjects were questioned regarding the use of dosimeter. Cumulative radiation dose estimated using statutory dosimeters was available.

In view of the low number of cases we collapsed all tumours into a single diagnostic category. Odds ratios with 95% confidence intervals were estimated by means of stepwise logistic regression analysis, where the independent variables were age, gender, cumulative X-ray exposure, length of exposure and occupation.

In the five cancer cases of interest, the cumulative radiation dose was reconstructed from the various hospital procedures used in the past. The cancer risk (P_e) corresponding to this dose was obtained by BEIR V [1]; knowing the natural cancer risk (P_n), the probability of causation ($PC = P_e/(P_e + P_n)$) was calculated [2].

Results

Information on disease was available in 99% of exposed and all (100%) unexposed workers. Twenty-six cancer

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Table 1. Malignant tumours and date of diagnosis among exposed and unexposed subjects by vital status

Exposed		Unexposed	
Year of diagnosis	Tumours	Year of diagnosis	Tumours
Decedents			
1988	Spinocellular carcinoma ^a	1989	Pancreatic tumour
1993	Lung tumour ^a	1996	Prostate, salivary gland, larynx tumours
1998	Lung tumour ^a		
2000	Pancreatic tumour		
Living subjects			
1993	Non-Hodgkin lymphoma ^b ; basal-cell carcinoma ^{a,b}	1992	Dermatofibrosarcoma
1995	Cervix intra-epithelial neoplasm	1992	Testis embryonic carcinoma
1995	Colon tumour ^a	1994	Testis embryonic carcinoma
1996	Colon tumour ^b	1996	Basal-cell carcinoma
1997	Colon tumour	1998	Non-Hodgkin lymphoma
1998	Ovary tumour ^b	1999	Breast tumour
1998	Non-Hodgkin lymphoma ^{a,b}	2000	Pancreatic tumour
1998	Rectum tumour		
1999	Thyroid carcinoma ^b		
2000	Basal-cell carcinoma ^a		
2000	Humerus condrosarcoma ^a		
2000	Pancreatic tumour		
2000	Basal-cell carcinoma ^a		

^a Tumours found in orthopaedics.

^b Tumours in initial cluster.

cases were identified, 17 in the exposed group and nine in the unexposed. Table 1 shows the diagnoses in these cases. Cumulative radiation dose averaged 35.2 (range = 0.04–517.8), 2.3 (0.00–17.9) and 7.5 (0.0–186) millisievert in orthopaedic surgeons, non-orthopaedic physicians and radiation-exposed non-physicians, respectively. In the corresponding groups, cumulative cancer incidence was 29 (9/31), 11 (2/18) and 6% (6/107), and it was 4% (7/158) in unexposed workers.

Table 2 shows that at logistic regression analysis, age ($P < 0.034$) and working as an orthopaedic surgeon ($P < 0.002$) were the variables significantly influencing the risk of tumours. We gathered all tumours to increase the statistical power; however, since outcomes were

Table 2. Logistic regression analysis: odds ratio (OR) with 95% confidence interval (CI) for all malignant tumours and two-tail probability of error (P), by age and occupation (Terms)

Terms	OR	CI	P
Age (years)	1.04	1.00–1.08	0.034
Occupational category ^a			
Health care workers other than physicians	1.07	0.37–3.13	0.901
Physicians other than orthopaedics	2.18	0.43–11.1	0.349
Orthopaedics	5.37	1.87–15.4	0.002

^a References: unexposed workers.

aetiologically unrelated, the gain probably came at the cost of underestimation of cancer risk in orthopaedics.

Except for 50 subjects (33%) who always used the dosimeter on the thorax and behind the apron, in other radiation-exposed workers the dosimeter use was irregular and inconstant. Therefore, radiation dose estimation using statutory dose meters was an unreliable indicator. This might account for radiation not being selected as a significant risk factor at logistic regression.

In two out of five cancer cases reported to the authorities (two non-Hodgkin's lymphomas in two orthopaedic surgeons), reconstructed radiation dose (to body areas excluding hands) was 685 and 360 millisievert and PC was 63 and 43%, respectively, using the multiple myeloma model since BEIR V treats myeloma and non-Hodgkin's as having equal radiation dose–response relationships. Reconstructed dose (and PC) was 168 (26%), 179 (14%) and 150 millisievert (8%) in the other cases.

Conclusion

These findings suggest that surgeons need to be aware of the potential radiation risk in orthopaedics [3] and that risk-taking behaviour needs addressing through promotion of safe work practices by their employing institutions [4].

Conflicts of interest

None declared.

References

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