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Reproductive Epidemiology in Radiographers Exposed to Diagnostic X-rays

T. Padmaja, U. Maddileti, M. Hema Prasad, A. Vasudha, V. Sridevi, L. Hema Bindu, P. Jharna, B. Siva Prasad, P. Usha Rani and P. P. Reddy

Institute of Genetics and Hospital for Genetic Diseases Osmania University, Begumpet, Hyderabad 500 016, Andhra Pradesh, India

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ABSTRACT In the present study reproductive performance of 195 workers employed in various hospitals in Hyderabad was evaluated using standard questionnaire. The workers were exposed to X-rays while handling the patients for diagnostic purposes. 210 individuals belonging to same age and socioeconomic group but not exposed to radiation and toxic chemicals were studied for control data. Statistical analysis revealed a significant increase in the frequency of stillbirths and neonatal deaths in the offspring of the exposed group when compared to the controls. There was an increase in the incidence of congenital defects but the increase was not statistically significant. A decrease in the frequency of live births was observed in the offspring of the exposed group when compared to the data from controls. The increase in abortions among the wives of exposed workers was significant.

INTRODUCTION

Application of X-rays is the most effective and accepted means for the therapy and diagnosis for human ailments. Due to the increasing use of ionizing radiation in medicine and diagnosis, radiographers are exposed indirectly to X-rays for prolonged periods of time.

Genotoxic effect of X-rays was reported in Yeast (Kiefer et al., 2002), Chinese hamsters (Xiao and Natarajan, 1999) and mice (Fomina et al., 2000; Dobrzynska, 2005). Jha and Sharma (1991) recorded an enhanced frequency of chromosomal aberrations in the workers occupationally exposed to diagnostic X-rays. Lalic et al. (2001) and Hagelstrom et al. (1995) reported a high frequency of chromosomal aberrations in the peripheral lymphocytes of workers who were occupationally exposed to X-rays and nuclear medicine areas. Elevated levels of chromosomal aberrations were reported by Kasuba et al. (1998) and Lalic et al. (2002) in the lymphocytes of medical staff occupationally exposed to X-rays. The genotoxic effects of X-ray radiation on human population such as DNA damage and abnormalities in human peripheral lymphocytes were assessed using comet assay and cytokinesis-blocked micronucleus test (He et al., 2000; and Maluf et al., 2001).

Address for Correspondence:
Dr. T. Padmaja, 1502, Green Hollow Village, ISELIN, NJ-08830.U.S.A.

All these reports suggest deleterious effects of X-rays on the genetic material. Mutations occurring in the gonadal cells may result in the impairment of reproductive performance of exposed persons and also transmissible genetic defects that may appear in the future generations. Hence present study was conducted to evaluate reproductive performance of workers who were professionally exposed to X-rays.

MATERIALS AND METHODS

In the present study 195 workers (age range 20-55 years) with duration of service ranging from 5-23 years formed the exposed group. The working hours were 8 hrs per day. 210 individuals (age range 20 -52 years) belonging to same age and socioeconomic status and not exposed to radioactivity and toxic chemicals formed the control group. Subjects in both the groups were non smokers and non alcoholics.

All the subjects were clinically examined and their family histories were collected using a standard questionnaire. The questionnaire included general information (name, age, sex, religion), occupational information (nature of work, duration of service, number of working hours), personal history (smoking, alcohol, tobacco habits), family history (marital status, age of wife, consanguinity), reproductive history (number of live children, abortions, still births, neonatal deaths, congenital defects) and medical history (occurrence of chronic diseases, recent

medication information, exposure to x-rays, etc.). Thus the data regarding age, sex, occupation, previous illness, habits, type of marriage, consanguinity and information on number of children, abortions, still births, and congenital malformations was recorded. Alcoholics, smokers and the workers exposed to chronic or acute doses of drugs were excluded from the study. The results obtained were tested for significance using chi-square ($\div^2$) test.

RESULTS

The data in the Table 1 represents the reproductive epidemiology recorded in the workers and control group. The data from the exposed subjects was compared with the data from the control subjects. There was a significant increase in the frequency of abortions (14.26%) and neonatal deaths (3.70%) among the wives of exposed group when compared to the frequency of abortions (6.54%) and neonatal deaths (1.96%) recorded in the wives of control subjects. There was a significant decrease in the frequency of live births (81.67%) in the exposed group when compared to the controls (91.50%). Frequency of stillbirths (3.88%) were significantly high in the offspring of exposed workers when compared to the data from the controls (1.14%). The difference in the frequency of congenital defects between the exposed and control groups is insignificant.

DISCUSSION

It is well known that radiations are one of the most important components of medical technology. Since few decades radiations have been put into use for innumerable purposes in physical, medical and industrial sciences. Evaluation of reproductive efficiency of couples exposed to a particular toxicant reveals in part the fatal toxicity of that toxicant. Several earlier studies reported toxic effects of X-rays in the occupationally exposed workers.

The effects of exposure to irradiation was studied in mice using comet assay by Dobrzynska et al. (2005) and observed an increase of DNA damage in bone marrow lymphocytes and in germ cells. Lalic et al. (2005) recorded a high frequency of acentric fragments, dicentric fragments and chromatid breaks in the peripheral lymphocytes of physicians and nurses who were occupationally exposed to ionizing radiations after analyzing 200 metaphases of each examinee. Aberration analysis per cell showed the highest frequency of structural aberrations in examinees exposed to gamma radiation. Wang et al. (2002) reported a significantly high incidence of leukemia and skin cancer among the workers occupationally exposed to X-rays.

DNA damage such as high frequency of micronuclei and dicentric bridges were recorded by Maluf et al. (2001) in the lymphocytes of workers exposed to X-radiation. X-rays belong to low level ionizing radiations. The genotoxic effects of various low level radiations were also recorded by various authors. A close relationship in the incidence of cancer and occupational exposure to ionizing radiations was reported by Sont et al. (2001). Schubauer et al. (2001) recorded a high risk of cancer in the hospital workers and patients who received therapeutic radiations. Abrahamson et al. (2001) reported two fold increase in the frequency of stillbirths among the offspring of men exposed to lonizing radiations.

Yadav and Seth (2000) reported a high frequency of chromosomal aberrations and sisterchromatid exchanges in the workers who were occupationally exposed to diagnostic Xrays. A significant increase in the frequency of centromere-positive micronuclei was revealed by Thierens et al. (2000) in the hospital workers occupationally exposed to X-rays.

All these reports suggest genotoxic effects of X-rays but reports on their effect on the reproductive performance of occupationally exposed persons are inadequate. In the present

Table 1: Data on reproductive epidemiology in radiographers exposed to X-rays.

Group	*Total no. studied*	*Age (yrs)*	*Live births*	*Abor-tions*	*Neonatal deaths*	*Still births*	*Congen-ital defects*	*Premature births*	*Pregnancies*	
									Total no.	*Per female*
Unexposed Group	210	20-52	560 (91.50)	40 (6.54)	12 (1.96)	7 (1.14)	9 (1.47)	7 (1.14)	612	2.91
Exposed Group	195	20-55	44 (81.67)	77 (14.26)	20 (3.70)	12 (3.88)	12 (2.2)	6 (1.11)	540	2.77

study there was a significant increase in the frequency of abortions and still births among the wives of exposed group when compared to the controls. There was an increase in the incidence of neonatal deaths and stillbirths among the offspring of the exposed workers. These results suggest an adverse effect of X-rays on the reproductive performance of workers who were occupationally exposed to X-rays.

Thus our study suggests that prolonged exposure of man to X-rays may result in genetic damage and impairment of reproductive performance. Further we suggest that appropriate precautionary measures should be adopted by the workers to minimise exposure to X-rays in the work environment.

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