

## Special Article

# *Incidence of Cancer among Michigan Nurse-anesthetists*

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A survey of the 621 female nurse-anesthetists in Michigan was performed to determine the incidence of malignancy in this group. Two separate mailings and telephone interviews resulted in a response rate of 84.5 per cent. A total of 33 malignancies in 31 nurse-anesthetists was reported. Several unusual types were noted. Ten malignancies, including three skin cancers, were diagnosed during 1971. Excluding skin cancers, the expected incidence adjusted for age distribution, based on statistics from the Connecticut Tumor Registry, is 402.8/100,000. The adjusted incidence in Michigan nurse-anesthetists is 1,333.3/100,000. This difference is significant at the 3.1 per cent level.

CHEMICAL CARCINOGENESIS in workers exposed to certain chemicals is a matter of great concern to industrial toxicologists. As early as 1775, Percival Pott described the occurrence of scrotal cancer among English chimney sweeps.<sup>1</sup> Since that time, numerous chemical agents have been identified as carcinogens, mutagens, teratogens, and embryotoxins. In most cases, the harmful effects were found in a specific population first, and later the carcinogen was identified by laboratory study. Notable examples include induction of skin

and lung cancer by certain soots, tars, oils and cigarette smoke, bladder cancer by benzidine, 2-naphthylamine and 4-amino-biphenyl, and lung and paranasal sinus cancers by nickel compounds.<sup>2</sup>

In a survey of causes of death of anesthesiologists, Bruce *et al.*<sup>3</sup> found a trend toward a higher-than-normal incidence of reticuloendothelial and lymphoid malignancies.

Operating room personnel are chronically exposed to low doses of volatile chemicals and gases the toxicity of which has not been definitely determined. The possibility exists that certain of these agents may be carcinogenic, embryotoxic, teratogenic and/or mutagenic. Other potential carcinogenic hazards in the operating room include exposures to oncogenic viruses and radiation.

A survey of all the female nurse-anesthetists in Michigan was undertaken to determine whether there was a higher-than-expected incidence of new malignancies in this group. A list of all currently active members of the American Association of Nurse Anesthetists living in Michigan was obtained through this organization. A questionnaire asking questions concerning the diagnosis of any type of malignancy and the date of diagnosis was prepared. These questions were interspersed with others regarding age, training, and general health of the individual. Questionnaires were sent to the 621 female nurse-anesthetists in Michigan. Those who had not responded within three weeks were sent a second questionnaire. Those who had not responded to either the first or second mailings were contacted by telephone when feasible.

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TABLE 1. Information Obtained in Response to a Questionnaire Designed to Elicit Information about the Incidence of Cancer in 621 Nurse-anesthetists

Year Diagnosed	Tumor Type	Age at Diagnosis (Years)	Year Started Administering Anesthesia	Number of Years from Start of Training to Tumor Diagnosis
1971	Breast	50	1947	24
1971	Cervix	31	1968	3
1971	Thyroid	28	1966	6
1971	Thyroid	39	1954	17
1971	Endometrial	43	1952	19
1971	Pancreas	45	1950	21
1971	Hepatocellular	50	1950	21
1971	Skin (basal cell)	44	1963	8
1971	Skin (basal cell)	40	1964	7
1971	Skin (upper lip, type unknown)	53	1941	30
1970	Breast	58	1955	15
1970	Breast	50	1946	24
1970	Malignant thymoma	31	1961	9
1970	Leiomyosarcoma	51	1943	28
1969	Breast	32	1959	10
1969	Breast	41	1961	8
1969	Skin (basal cell)	34	1959	10
1966	Cervix	37	1951	15
1966	Breast	62	1926	40
1966	Breast	39	1955	11
1965	Malignant melanoma	52	1937	28
1965	Skin (basal cell)	44	1950	15
1964	Leukemia	27	1959	5
1963	Breast	44	1948	15
1961	Breast	43	1953	8
1961	Breast	37	1960	1
1961	Lymphoid	37	1946	15
1961	Breast	43	1943	18
1960	Thyroid	28	1955	5
1957	Cervix	53	1926	31
1956	Colon	46	1955	1
1956	Breast	49	1941	15
1952	Breast	44	1954	0
1946	Breast	28	1950	0
1935	Breast	36	1932	3

### Findings and Comments

Of the 621 questionnaires, 525 (84.5 per cent) were eventually completed and returned. A total of 35 malignancies in 33 anesthetists was reported. Of these, 33 malignancies in 31 nurse-anesthetists were diagnosed after be-

ginning anesthesia training. Two nurse-anesthetists began anesthesia training after adenocarcinomas of the breast had been diagnosed at the ages of 36 and 44 years, respectively. The earliest reported tumor was an adenocarcinoma of the breast diagnosed in 1935, when the nurse-anesthetist was 36 years old.

The year of diagnosis, tumor type, age at diagnosis, the year the nurse-anesthetist started training, and the years elapsed between onset of training and diagnosis of tumor are listed in table 1. Of the tumors reported, several were unusual types, including malignant thymoma, hepatocellular carcinoma, and leiomyosarcoma of subcutaneous tissue.

The incidence of new malignancies was highest in 1971. The incidences for years before 1971 may be less accurate, since some anesthetists with malignancies diagnosed earlier could have died or withdrawn from the active list of nurse-anesthetists. Ten malignant tumors were diagnosed in 1971, a rate of 1,905 cases per 100,000 per year for all malignancies. For comparison with data from the Connecticut Tumor Registry, which excludes skin cancers, three skin cancers were excluded. The modified incidence of seven cases diagnosed in 1971 was 1,333/100,000 per year. In 1970, four malignancies were reported: two breast cancers, one malignant thymoma, and one leiomyosarcoma. The incidence rate for 1970 is 762/100,000. Two breast cancers and one skin cancer were diagnosed in 1969, for a rate of 381/100,000, excluding the skin cancer.

Silverberg and Holleb<sup>4</sup> estimate that 1972 death rates from cancer, including all sites, were 163 per 100,000 for Michigan and 165 per 100,000 for Connecticut, suggesting that overall incidences in the two states were similar. The state of Connecticut has compiled a uniquely complete tumor registry,<sup>5,6</sup> from which rates per 100,000 population for all types of cancer, excluding skin cancer, are available. Data are obtained from all hospitals in the state. All death certificates are examined and all diagnoses must be validated by histologic confirmation. The Connecticut Tumor Registry is the best available because of its almost complete sampling.

### Statistical Analysis

Among the Michigan nurse-anesthetists, seven new malignancies other than skin cancers were diagnosed in 1971, for a rate of 1,333/100,000 in the 525 nurse-anesthetists who responded (of 621 registered with the AANA). To compare this with the data of

"Cancer in Connecticut, 1969,"<sup>6</sup> the Michigan nurse-anesthetists were grouped into five-year age groups, and female cancer incidences for all sites except skin were weighted for age distribution to calculate an expected rate for Michigan nurse-anesthetists based on the Connecticut experience. This expected incidence rate was 402.8 per 100,000. The observed rate exceeded the expected rate, and the difference was significant at the 3.1 per cent level. Corresponding calculations using the highest Connecticut incidence rate recorded for each five-year age interval during 1966-1969 led to an expected incidence rate of 412.6 per 100,000. This slightly higher rate was exceeded significantly not only by the observed rate of 1,333.3 per 100,000 in the 525 respondents, but also by the incidence rate of 1,127.2 per 100,000, assuming that none of the nonrespondents had any malignancy diagnosed during 1971. The corresponding one-sided significance levels are 3.3 and 4.6 per cent, respectively. Thus, we conclude that Michigan nurse-anesthetists experienced a higher incidence of malignancies diagnosed during 1971 than did all the women of Connecticut during 1966-1969.

### Discussion

The findings of this survey of Michigan nurse-anesthetists, together with the survey of Bruce *et al.*,<sup>3</sup> which showed a trend toward a higher-than-expected incidence of reticulo-endothelial and lymphoid malignancies among anesthesiologists, suggest that anesthesia personnel may be at increased risk for the development of malignancies. In addition, the surveys of Vaisman,<sup>7</sup> Askrog,<sup>8</sup> and Cohen *et al.*<sup>9</sup> have shown higher-than-expected incidences of spontaneous abortion of pregnancies among operating room personnel. However, these studies have all been based on relatively small population samples, and they were performed in short periods. Genetic influences, personal habits, and other factors other than exposure to the operating room environment may have been responsible for the findings. The data obtained in all these studies emphasize the need for a nationwide survey of large numbers of operating room personnel, with a properly identified control group.

### References

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### Neonatology

#### BLOOD GAS EXCHANGE AND NEONATAL ERYTHROBLASTOSIS

The authors evaluated neonatal cardiorespiratory function ( $Pa_{O_2}$  and pH) and hematologic status in 61 premature infants with moderate-to-severe erythroblastosis fetalis. The data indicate that mortality among severely erythroblastotic infants was influenced by presence of hydrops, severity of the anemia, presence of asphyxia at birth, and rate of recovery from asphyxia. Death was due to progressive cardiorespiratory failure with pathologic changes characteristic of hyaline membrane disease, occasionally complicated by pulmonary or generalized hemorrhage. The data suggest that the pathophysiology is initiated by acute intrapartum asphyxia, possibly superimposed upon chronic mild asphyxia with prematurity and anemia as additional predisposing factors. The infant with hydrops is particularly prone to develop the respiratory distress syndrome.

Asphyxia, defined as a combination of hypoxemia and hypercarbia, is invariably associated with metabolic acidosis. Hypoxemia and acidosis result in pulmonary vasoconstriction and decreased pulmonary blood flow, a factor implicated in the pathogenesis of the respiratory distress syndrome.

The data appear to be in conflict with many of the already published findings concerning this problem. Although previous findings suggest that congestive heart failure is the principal cause of death in the severely erythroblastotic infant, studies like the present one emphasize the need for early recognition and treatment of respiratory distress syndrome. (Phibbs, R. H., and others: *Cardiorespiratory Status of Erythroblastotic Infants. I. Relationship of Gestational Age, Severity of Hemolytic Disease, and Birth Asphyxia to Idiopathic Respiratory Distress Syndrome and Survival*, *Pediatrics* 49: 5-16, 1972.) EDITOR'S COMMENT: Although a most interesting study, this paper epitomizes the perpetuation of an unexplained dichotomy: the congestive heart failure (CHF) and the respiratory distress syndrome are distinct clinical entities. Perhaps the failure to recognize that the child with CHF deserves therapy similar to that needed for respiratory distress, and *vice versa*, may still be responsible for the high mortality in both groups. For example, how often has right-sided heart failure been recognized (and treated) in the presence of RDS?