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We may return unduly long letters to the author for shortening so that we can offer readers as wide a selection as possible. We receive so many letters each week that we have to omit some of them. Letters must be signed personally by all their authors. We cannot acknowledge their receipt unless a stamped addressed envelope or an international reply coupon is enclosed.

Health problems of anaesthetists and their families

SIR,—Dr P J Tomlin's conclusion, recently reported in the *BMJ* (24 March, p 779), that employment as an anaesthetist involves an occupational hazard of cancer both for the anaesthetist and his or her children would be of grave concern if it were justified by the evidence. The evidence is, however, very frail. Dr Tomlin's data consist of two cases of cancer in 277 children of various ages up to 20 years and two cases of cancer of the breast at some time in the lives of 76 female anaesthetists. These numbers, he concludes, are respectively 60 and 50 times more than would be expected from national experience. If this were indeed so, it would be of some interest despite the smallness of the numbers. In fact it is not, as the conclusion is derived from an inappropriate comparison of cumulative rates over the whole of the subjects' life with national incidence rates for a single year.

Dr Tomlin does not say whether any of the adult anaesthetists had suffered any other type of cancer, nor does he refer to the

somewhat larger study by Peto and myself,¹ in which 547 male anaesthetists were followed for approximately 20 years. Twenty-nine died of cancer whereas about 32 would have been expected from the experience of all the doctors observed in the study. Our study had several failings, but it is surprising that Dr Tomlin made no reference to its results as he cited the paper as providing an example of the way statistical critics sometimes dismiss the finding of a probability of 0.05 as a "quirk."

RICHARD DOLL

Department of the Regius
Professor of Medicine,
Oxford OX2 6HE

¹ Doll, R, and Peto, R, *British Medical Journal*, 1977, 1, 1433.

SIR,—I should like to comment on certain of the statistical aspects of Dr P J Tomlin's survey of health problems of anaesthetists and their families (24 March, p 779) insofar as the

data relate to the outcome of pregnancy.

Firstly, while the rate of spontaneous abortion occurring in women who were exposed to anaesthetics during pregnancy was significantly higher than that in the control series (17 of 58 v 10 of 102, $\chi^2_{(1)} = 8.69$, $P < 0.01$), this was not true for the unexposed wives of practising male anaesthetists (44 of 280 v 10 of 102, $\chi^2_{(1)} = 1.69$, $P \approx 0.2$). These findings are in line with those of other published studies, which have been reviewed in detail elsewhere.¹ Like other retrospective studies of this sort, the interpretation of the results is bedevilled by possible biases in the recall of past events.

With regard to the data on birth weight, the comparison of information gathered from anaesthetists with that published in *British Births—1970*² is of doubtful validity. It may be noted, for example, that the control infants in Dr Tomlin's survey had a mean birth weight well below the 3420 g which he regards as the "norm" for social class I children. If internal comparisons are made between the "exposed" infants and the control infants in Dr Tomlin's survey, those means which are based on any appreciable number of observations show little variation.

The comparison between the "congenital abnormality" rates reported by the anaesthetists and the rates obtained in other surveys must also be regarded as of doubtful

validity because of differences of definition. Internal comparison between the "exposed" and control infants in Dr Tomlin's survey shows no overall significant difference in malformation rates (26 of 277 v 4 of 92, $\chi^2_1 = 1.72$, $P=0.2$).

In summary, Dr Tomlin's survey, while provocative, adds little that is concrete to the existing literature on the possible relationship between exposure to anaesthetic agents and outcome of pregnancy.

M P VESSEY

Department of Social and Community
Medicine,
Oxford OX1 3QN

¹ Vessey, M P, *Anaesthesia*, 1978, **33**, 430.

² Chamberlain, R, in *British Births—1970*, p 81. London, National Birthday Trust, 1975.

SIR,—Dr P J Tomlin (24 March, p 779) does a great disservice to those seriously engaged in the assessment of probable effects of anaesthetic atmospheric pollution.

Particularly to be deplored in his claim that the dangers of a Type II error in this situation are so great that standard statistical tests should not be applied to his results. His argument here and his claim that his case is proved beyond doubt are greatly weakened by the numerous errors in the treatment of his results. Applying χ^2 tests (corrected where necessary for continuity) to the quantal data of his table II reveals that his claimed statistically significant increases in the number of female children born to exposed mothers and in the number of abortions when both parents were anaesthetists are untrue. The claimed significant reduction in birth weight of female children born to anaesthetists is in comparison with an expected birth weight gleaned from the literature. Dr Tomlin does not take into account the below-expected birth weight of his control infants. No significant differences exist between his control group and the children of anaesthetists.

In the handling of cancer incidence in his study Dr Tomlin gives a perfect example of the fallacies that can arise when deductions are drawn from small samples taken from a Poissonian distribution. He claims that the two cases of cancer occurring in 277 children of anaesthetists represent a 60-fold increase over the expected incidence. By the same token the single case of cancer occurring in 92 children in his control group represents a near 100-fold increase over expected incidence. The valid conclusion is not that in the West Midlands anaesthesia protects against cancer, but that the numbers studied are so small that no conclusions can be valid.

C M CONWAY

Magill Department of Anaesthetics,
Westminster Medical School,
London SW1P 2AP

SIR,—It is important to identify subpopulations where there is an increased risk of their offspring being born with a congenital malformation. Such identification not only assists in the search for aetiological factors contributing to multifactorial genetic disorders but also may benefit the subpopulation itself.

In his study on the health problems of anaesthetists and their families in the West Midlands Dr P J Tomlin (24 March, p 779) states that he has used the same criteria as ourselves with the exception of congenital hernia. May we quote details of the criteria used in our paper? ¹ "We have included defects detected up until the age of 5 years, the vast majority of which were confirmed by a hospital

consultant. Thus macroscopic, microscopic and metabolic defects were included, as were tumours of known genetic origin. . . . Talipes was included when treatment with plaster or by physiotherapy lasting for at least one year, was required. Hip dysplasia treated by splinting was included in the figures for true dislocation of the hip." In the light of these definitions, accepted by Dr Tomlin, we question whether in table III cases 2, 3, 6, 10, 12, 13, 18, 20, 21, 23, and 26 (first group) should be included. If they are excluded the rate of affected offspring falls from 26 out of 277 (9.4%) to 15 out of 277 (5.4%).

We have continued our study on 33 035 children born in Devon from March 1967 to February 1972 inclusive until their 7th birthday, except for cases of diabetes and undescended testes, which are still being ascertained (a further paper is in preparation). The incidence of congenital malformations in this study now stands at 1754 out of 33 035 live births and stillbirths (5.3%). Had we included cases similar to those mentioned in Dr Tomlin's paper the incidence would be considerably greater. Even if we exclude "hernias only" (213) from our series, the rate of malformation only falls to 4.7%.

It would not appear therefore that Dr Tomlin has produced evidence of a statistically significant difference in incidence rate of congenital malformations between the children of anaesthetists and that found in our study. This conclusion is of particular interest when one reflects that Dr Tomlin's study applies to a subpopulation of social class I only, as compared with our study which covered all five social classes, and that the probands in the two series were resident in different areas of the UK.

MARY VOWLES

R J PETHYBRIDGE

FREDERIC BRIMBLECOMBE

Royal Devon and Exeter Hospital
(Heavitree),
Exeter EX1 2ED

¹ Vowles, M, Pethybridge, R J, and Brimblecombe, F S W, in *Bridging in Health*, p 201. Oxford, Nuffield Provincial Trust, 1975.

SIR,—We will leave it to others better qualified to comment on the epidemiological and statistical aspects of the article by Dr P J Tomlin (24 March, p 779), but his selective citation of the experimental studies of the toxicity of anaesthetics cannot pass unchallenged. He has referred to much of the earlier work which yielded positive results but has totally ignored more recent studies, which have almost without exception produced negative results—in many cases causing the original investigators to reverse their conclusions.

Dr Tomlin implies that anaesthetists are mutagenic. With the exception of fluoroene (which has not been used in the UK), inhalational anaesthetics have not been found to cause chromosome breaks or to be mutagenic.¹⁻⁵ For his statement "Several anaesthetics are carcinogenic" Dr Tomlin cites the study of Corbett,⁶ who in fact only investigated the one anaesthetic, isoflurane, not yet released in either the USA or the UK. The more recent and very carefully controlled study by Eger *et al.*,⁷ which included Corbett as a coauthor, did not support Corbett's earlier suggestion and, furthermore, no evidence was found for the carcinogenicity of enflurane, halothane, methoxyflurane, or nitrous oxide.

For experimental evidence of anaesthetics causing fetal abnormalities, Dr Tomlin relies

mainly on work by Fink published more than 10 years ago. However, Fink and Cullen⁸ have more recently stated that "it is premature to conclude that long-continued trace exposure probably causes abortion, congenital malformation, and cancer. Although such a relationship may eventually be proven, in our opinion the present evidence is wholly inconclusive." We would draw your readers' attention to recent studies during which animals have been exposed throughout gestation to concentrations of anaesthetics at least 500 times higher than are likely to be found in the atmosphere of an operating theatre. No evidence of teratogenicity and no significant increase in fetal loss were found.^{9,10}

We are in no disagreement with Dr Tomlin's recommendation to scavenge waste anaesthetic gases from operating theatres and we have, in fact, operated an efficient system for three years.¹¹ Scavenging is a sensible precaution while the possibility of harmful effects is under investigation. However, it is quite another matter to present a one-sided review of the literature and suggest that a causal relationship has been proved between the inhalation of trace concentrations of anaesthetics and the variety of conditions referred to by Dr Tomlin.

JOHN NUNN

MICHAEL HALSEY

JEAN STURROCK

Division of Anaesthesia,
Clinical Research Centre,
Northwick Park Hospital,
Harrow, Middx HA1 3UJ

¹ Baden, J M, *et al*, *Anesthesiology*, 1976, **45**, 311.

² Baden, J M, *et al*, *Anesthesiology*, 1976, **45**, 695.

³ Sturrock, J, *British Journal of Anaesthesia*, 1977, **49**, 207.

⁴ Sturrock, J, *British Journal of Anaesthesia*, 1977, **49**, 777.

⁵ Waskell, L, *Mutation Research*, 1978, **57**, 141.

⁶ Corbett, T H, *Annals of New York Academy of Science*, 1976, **271**, 58.

⁷ Eger, E I, II, *et al*, *Anesthesia and Analgesia*, 1978, **57**, 678.

⁸ Fink, B R, and Cullen, B F, *Anesthesiology*, 1976, **45**, 79.

⁹ Lansdown, A B G, *et al*, *Teratology*, 1976, **13**, 299.

¹⁰ Pope, W D B, *et al*, *Anesthesiology*, 1978, **48**, 11.

¹¹ Davenport, H T, *et al*, *British Medical Journal*, 1976, **2**, 1219.

Anaesthetic deaths and caesarean section

SIR,—Following your recent leading article (17 March, p 703), I write to say I am disturbed that deaths are still occurring in patients submitted to anaesthesia for caesarean section.

If all junior anaesthetists considered sufficiently experienced to be anaesthetising patients for caesarean section were expert at endotracheal intubation in the lateral head-down position (to the point of being 100% confident at all times and seen to be so to the satisfaction of their tutors), I feel certain that one could eliminate completely the acid aspiration syndrome. I would not wish to detract from the importance of starvation in labour and regular antacid administration, or wish to dissuade the enthusiasts of emptying the stomach from so doing, but I would warn those who trust cricoid pressure implicitly that it does not always work and often is incorrectly applied to a semiflexed neck.

In summary, I wish to make a plea to the teachers of obstetric anaesthesia to unite in their policies and teach the lateral head-down induction technique in order to avoid the unnecessary loss of life which still occurs.

B H GOODRICH

Poole, Dorset