

TRACE CONCENTRATIONS OF HALOTHANE IN HUMAN BREAST MILK

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SUMMARY

Halothane concentrations of 2 p.p.m. have been found in the breast milk of a lactating, practising anaesthetist. This concentration was consistent with the operating theatre environment. The authors feel that, in spite of the limited scope of the study, this is an additional reason for the elimination of waste anaesthetic agents from the operating theatre.

Exposure to trace concentrations of inhalation anaesthetic agents has been associated with, though not conclusively proved to cause, increased hepatic and renal disease (Ad Hoc Committee, 1974), spontaneous abortions, possible teratogenesis (Cohen, Belville and Brown, 1971), enzyme induction (Cascorbi, Blake and Helrich, 1970; Cohen, 1971), impairment of the immune response (Bruce and Wingard, 1971), and changes in short-term memory as measured by psychological testing (Bruce, Bach and Arbit, 1974; Bruce and Bach, 1975). Recently, Quimby and colleagues (1974) demonstrated learning deficits in rats exposed to halothane 10 p.p.m. from conception to the sixtieth day of life.

We wished to determine whether trace concentrations of volatile anaesthetic agents could be transmitted through human breast milk to the neonate of a lactating, practising anaesthetist.

MATERIALS AND METHODS

Human breast milk specimens were obtained from N. B. K. anaerobically, in an area apart from the operating room, using a rubber nipple shield with a three-way stopcock and glass syringe. The halothane concentrations were determined by a modification of the method for blood developed by Butler, Kelly and Zapp (1967). On each specimen, duplicate 5-ml aliquots of breast milk were equilibrated with anaesthetic-free air at 37 °C in 10-ml glass serum bottles of known volume. The inner surface of the rubber caps was covered with aluminium foil to prevent

absorption of halothane. Equilibration of the gas phase with milk was accomplished by ultrasound vibration for 20 min. The gas was sampled directly, four times from each serum bottle, by inserting through the rubber cap a 75-mm, 25-gauge needle on a No. 1001 Hamilton syringe (Hamilton Company, Whittier, California) with Chaney modification. Gas samples (200 µlitre) were immediately injected into the sampling port of a gas chromatograph for comparison with gases of known trace concentrations. The standards of trace concentrations were sampled in an identical manner through serum bottle caps from 50-ml ground-glass syringes in which they had been prepared from a commercial standard of halothane 11 p.p.m. (Scott Research Inc., Plumstead, Pa). For both the standards and the milk-gas phase specimens, the closest three out of four chromatograph peak heights were averaged to obtain a mean value for subsequent calculations.

Calculations of anaesthetic content were performed using a partition coefficient specific for the milk of that day. The concentrations of anaesthetic in milk are expressed as anaesthetic volume per volume of milk.

Milk-gas partition coefficients were determined in duplicate on two occasions following equilibration of that day's milk in a tonometer with halothane 11 p.p.m. The resultant halothane concentrations in those milks were measured by the same method as described above.

Ambient air specimens were obtained by aspirating operating room air at the face level of the anaesthetist in the 50-ml ground-glass syringes, stored overnight with the plunger downwards. Samples (200 µlitre) were injected into the sample port of the chromatograph at room temperature, and the closest three out of four chromatograph peak heights were averaged to obtain a mean value.

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The analysis of all samples was conducted on a Varian Aerograph model 940 gas chromatograph using a hydrogen flame ionization detector and a 1-mV Linear Instruments Corporation recorder. The Varian installed column was a 3-mm × 152.5-cm OV-101 column (GC Grade methyl silicone (OV-101) on chromasorb W). The flows and temperatures used were as follows: air flow 300 ml/min; hydrogen flow 15 ml/min; helium flow 25 ml/min; column temperature 50 °C; injection port temperature 150 °C; detector temperature 150 °C.

The percentage standard deviation of chromatograph peak heights for determining anaesthetic concentrations in the gas phase from the serum bottle was approximately 5%. The large standard deviation and the variation between duplicate samples demonstrate that in using this chromatograph the method was approaching its limit of applicability.

RESULTS

Breast milk samples taken on two separate occasions during two different halothane anaesthetics revealed concentrations of approximately 2 p.p.m. (table I). The concentrations found were consistent with the concentrations in the environment. The different milk-gas partition coefficients of 2.3 and 1.4 on the

TABLE I. *Anaesthetic concentrations in human breast milk. The operating theatre air was "replaced" 13 times per hour*

Date	Time in operating theatre (h)	Halothane concentration (p.p.m.)		
		Air	Milk	
			Duplicate	Average
Jan 3, 1975*	5.0	—	A. 1.96 B. 2.10	2.03
Jan 9, 1975†	1.5	1.54	A. 2.10 B. 1.70	1.90
	4.0	0.27	A. 1.03 B. 0.63	0.83

*Halothane 0.25% 5 litre/min.

†Halothane 0.5% 2.5 litre/min.

TABLE II. *Milk-gas partition coefficient. SD expressed as a percentage of chromatograph peak heights for each aliquot*

Date	Average	Duplicate	SD (%)
3.1.75	2.27	A. 2.04	2.2
		B. 2.50	3.9
9.1.75	1.37	A. 1.54	5.7
		B. 1.20	5.2

two different days probably reflect the changing fat content in the breast milk (table II).

DISCUSSION

Although the method for obtaining breast milk specimens and the measuring technique itself are liable to cause substantial error, trace concentrations of halothane were clearly demonstrated in human breast milk. Errors in methodology, such as loss of halothane to air at the time of collection and during processing itself, would tend to produce an underestimate rather than an overestimate of the anaesthetic concentrations in breast milk.

Fat content varies considerably with each individual and with her diet (Barnett and Einhorn, 1972). The fraction analysed in this study was foremilk and this may contain as little as 1% fat, while hindmilk may contain up to 8% fat (Petersen, Palmer and Eckles, 1929). Although the milk-gas partition coefficients were close to those of blood, we feel that this reflects the low fat content of foremilk and the fasting state of the mother.

It has been shown that respiratory excretion of halothane by operating room personnel continues for up to 72 h after routine exposure (Corbett and Ball, 1973). Therefore diffusion of halothane from blood to milk would be likely to continue for a similar time. With this in mind, one may only speculate on possible adverse effects to the neonate from trace exposure to anaesthetic agents via breast milk. Probably all volatile anaesthetic agents should be added to the long list of drugs which enter human breast milk (Vorherr, 1974). If operating room air were free of anaesthetic gases there would be none to contaminate breast milk. This is, therefore, an additional reason to encourage proper and scrupulous elimination of anaesthetic agents from the operating room.

ACKNOWLEDGEMENTS

We would like to thank Dr Harry Wollman for reviewing this manuscript.

Supported in part by U.S.P.H.S. research grant 5-PO1-GM-15430-08 and research training grant 5-TO1-GM-00215-17 from the National Institute of General Medical Sciences, National Institutes of Health.

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CONCENTRATIONS DE TRACES D'HALOTHANÉ DANS LE LAIT DE NOURRISSAGE HUMAIN

RESUME

Des concentrations d'halothane s'élevant à 2 p.p.m. ont été décelées dans le lait de nourrisage d'une anesthésiste en exercice. Cette concentration était en rapport avec l'atmosphère ambiante de la salle d'opération. Les auteurs estiment que malgré la portée limitée de l'étude cette découverte constitue une raison supplémentaire d'éliminer des salles d'opération les résidus de produits anesthésiques.

SPURENKONZENTRATIONEN VON HALOTHAN IN DER MUTTERMILCH

ZUSAMMENFASSUNG

In der Muttermilch einer praktizierenden Narkoseärztin wurden Halothankonzentrationen von 2 p.p.m. gefunden. Diese Konzentration entsprach dem im Operationssaal. Die Autoren glauben, daß trotz des begrenzten Bereichs dieser Studie damit ein zusätzlicher Grund gefunden wurde, Narkosemittel-Abfallprodukte aus dem Operationssaal zu entfernen.

CONCENTRACIONES INDICIARIAS DE HALOTANO EN LA LECHE DE MAMA HUMANA

SUMARIO

Se han hallado concentraciones de halotano de 2 p.p.m. en la leche de mama de una anestesista lactante en ejercicio. Dicha concentración fue consistente con el medio ambiental del quirófano. Los autores opinan que, a pesar del limitado alcance del estudio, ello constituye una razón adicional para la eliminación de excedentes de anestésicos en el quirófano.