Effects of Halothane Anesthesia on the Fetal Rabbit in Utero

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=국문초록=
전신마취제 할로탄이 자궁내의 가토에 미치는 영향

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최승훈1, 한석주1, 김영수1, 박종세1
김진수2, 안덕선3, 이철4
박용원4, 송창호1, 황의호5

가토에서 산모에게 할로탄으로 마취를 하였을 때 태아수술중 태아가토의 혈중에 미치는 영향을 체험하였 다. 18마리의 임신중인 뉴질랜드 가토를 세 군으로 나누어 60분간 각각 0.25%, 0.5%, 0.75%의 할로탄으로 마취하였다. 마취 중 호기와 흡기의 할로탄농도 호기중의 이산화탄소농도를 SARAcap 기계를 사용하여 측정하였다. 산모가토는 네두동맥에 넣은 도관을 통하여 10분마다 혈액을 채취하였고 태아가토의 혈액은 제대정맥에서 10분마다 채취하였다. 채취한 혈액은 원심분리 후 mass spectrometer를 이용하여 혈중 할로탄농도를 측정하였다. 산모가토의 혈중 할로탄농도는 마취시의 할로탄농도와 비례하였으나 태아와 산모의 혈중 할로탄농도의 비율은 통계적으로 차이를 보이지 않았다. 이것은 태아수술시 이용한 할로탄이 태반을 통하여 직접 태아에게 전달됨을 의미하며 태아에서도 마취를 인하하는 농도에 이르는 것을 보여주었다. 할로탄은 현재 태아수술시 가장 많이 사용하는 마취제로 자궁이완과 사용이 쉽다는 이점이 있으나 태아에서 높은 혈중농도를 나타내기 때문에 사용에 있어서 주의가 필요함을 알 수 있었다.

Key Words: Halothane, Fetal surgery

*This paper was supported by a nondirected research fund, Korean Research Fund Foundation, 1993
INTRODUCTION

Halothane is one of the most popular anesthetic agents for fetal surgery because it can easily be administered to the mother and it improves surgical exposure by relaxing the uterus. It also has a tocolysis effect on the uterus during surgery. But recent reports\textsuperscript{1,3,8,10} showed maternal halothane anesthesia has detrimental effects on the fetus by reducing fetal cerebral blood flow, fetal cardiac output and shunting of blood away from the placenta. The effect of maternal halothane administration during fetal surgery on fetal blood has not been rigorously studied. Maternal safety is an overriding issue for fetal surgery. We tried to demonstrate the maternal fetal correlation of halothane in the rabbit.

The aim of the this study was to assess the effect of maternal halothane administration on fetal blood and to determine the optimum concentration of halothane during fetal surgery.

MATERIALS AND METHODS

1) Animal preparation

Eighteen New Zealand White rabbits with time-dated gestations of 23 to 25 days were fasted 24 hours. Anesthesia was induced in all animals with intravenous administration of ketamine 10 to 20 mg/kg. The tracheostomy was preformed. And the animal was ventilated with halothane and oxygen to maintain their PaCO\textsubscript{2} in the physiologic range of 30 to 40 mmHg. Right femoral arterial catheter was placed to collect blood during the operation. The animals were divided into three groups, each group consisted of 6 rabbits and they were received 0.25%, 0.5% or 0.75% halothane respectively. SARAcap A.G. was placed between endotracheal tube and anesthetic tube line, inspired and expired halothane and expired PCO\textsubscript{2} were monitored every 10 minutes.

2) Procedure

After a midline laparotomy the fetus was exposed through a longitudinal hysterotomy incision. Maternal blood was collected via femoral arterial catheter and the fetal blood was collected by sacrificing a fetus every 10 minutes. Fetal blood was obtained in the umbilical vein. During the procedure, maternal inspired and expired halothane and expired PCO\textsubscript{2} were monitored continuously by SARAcap A.G. When both maternal and fetal blood were aspirated, tubes were covered with parafilm which was punctured to obtain serum. Maternal and fetal blood were centrifuged for 10 minutes at 3,000 rpm in the air tight tubes. Minimum requirement of the serum volume was 0.2 ml in each specimen. The tubes of the serum were capped, and stored in the deep freezer.

3) Serum halothane measurement

1) Chemicals: Halothane (100\% of halothane containing 0.01\% of thymol, II sung Pharmaceutical Company, Seoul, Korea), Toluene-d8 (99+ atom %D, Sigma Chemical Co., St. Louis, MO), and Methanol (J.T. Baker, Philipsburg, NJ) were used. All other chemicals and solvents used were of the highest grade purity available and were used without further purification.

2) Preparation of standard solutions: Stock solution (10 ug/ml, 10 ppm, w/v) of halothane and toluene-d8 were prepared by dissolving weighed quantities of each compound in methanol. Working solutions were prepared immediately prior to use by serial dilution of the