Thiopental and the Fetal Liver

To the Editor:—Finster et al. (Anesthesiology 36:155-158, 1972) suggest that the liver protects the fetal brain from high thiopental levels. Lest it be concluded that thiopental is therefore theoretically safe in childbirth, I must point out that their experimental results are entirely consistent with a delay-line theory of liver handling of the drug. According to this view, a rise to a peak in fetal brain concentration could occur at a time considerably later than any study to date has followed it. We still have no direct evidence on this point,
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as brain concentrations were not included in the anencephalic tissue levels measured, and spinal cord levels are not relevant because of differences in the origins of the perfusing blood. On the other hand, there is clinical evidence from the same laboratory 7 of depression not due to asphyxia following thiopental for elective cesarean section. This would indicate that the drug does indeed cause neonatal depression when circumstances are favorable.

From the guinea-pig experiments an approximate liver:blood partition coefficient of 6:1 or 7:1 can be calculated for the fetus. Thus, retention in the fetal liver is likely to be much longer than it is in the adult, where it has been shown that three minutes may elapse after injection before detectable levels appear in the hepatic vein blood.1

The delay-line theory postulates that the hepatic sinusoid from its portal to its hepatic-vein end functions for diffusible molecules in a manner analogous to a gas chromatography column. Entering blood is purged of thiopental which is moved along the sinusoid at a much slower rate than the blood flow itself. The retention time is proportional to the tissue:blood partition coefficient and can be calculated theoretically.

It is important to realize that the “liver chromatograph” can function perfectly only for substances which pass without hindrance across cell membranes. This would not include any fat-soluble drug, pentobarbital or lidocaine for example, which does not equilibrate completely during a single passage through a capillary bed. Again, the same laboratory has demonstrated this.2 Lidocaine traverses the liver rapidly and is found at high concentration in fetal heart blood as early as one minute after the end of maternal injection.

The experiments in which thiopental was injected into the guinea-pig umbilical vein showed that the liver held on to nearly all the injected dose for a full 2–3 minutes after presentation to it. This cannot be explained purely on the basis of a high tissue:blood partition coefficient and rapid equilibration if the normal model of exponential tissue filling is applied. The behavior of lidocaine disproved the authors’ theory of venous congestion of the liver to explain this (and, in fact, at birth the reverse actually occurs: blood leaves the liver *). Their only other explanation, that uptake by unidentified special pro-

teins might occur, would necessitate the drug’s later release again by some unknown mechanism to explain its subsequent reappearance in the general circulation. On the other hand, the delay-line theory fits all the observations, but does raise the question of how rapidly systemic levels may increase when the liver finally releases its store.

Because the umbilical vein blood is separated into three parts (ductus venosus blood, right-lobe blood diluted with portal-vein blood before entering the sinusoids, and left lobe blood not diluted this way), it does after all seem likely that in general the brain levels will rise slowly, to peak at a clinically safe level. However, I wish to make a plea that this may not always be so, that so far there is not nearly enough evidence to say that it is, even in the “normal” case, and in fact that in at least one circumstance, elective cesarean section, there is good evidence to suggest that central depression of the fetus due to thiopental can and does occur.

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REFERENCES


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To the Editor:—For a number of years we have been interested in the strategic position of the fetal liver, relevant to the uptake of anesthetic agents which cross the placenta,1–4 and in the possibility that late release of drugs from the liver might cause a secondary depression of the newborn. However, to date there