Our study shows that the Paratrend 7 sensor can be inserted easily into the amniotic cavity or into the placenta early in pregnancy and can provide quantitative information about the metabolic status of the fluid and tissues. Measurement of amniotic fluid gases revealed a 2.4-fold increase in the PO$_2$ when compared with the sensors compared with the sensors (Table I). All other measurements were similar using both systems and comparable to those reported by other authors having also investigated amniotic fluid samples from early pregnancies in humans (Table II). In the placental bed, the increase in PO$_2$ with the change from sensor to cartridge systems was less pronounced, but there was also an increase in pH and a decrease in PCO$_2$ (Table I). This may be due to the fact that the blood aspirated from the placental bed was probably a mixture of arterial and venous blood.

There is little information on in-vivo fetal tissue or fluid gas measurements in the literature. The PO$_2$ of amniotic fluid has been measured at term by inserting a PO$_2$ needle electrode into the amniotic cavity (Vasika and Hutchinson, 1964). More recently, we have measured placental and endometrial PO$_2$ in the first trimester of pregnancy using an umbilical artery polarographic electrode introduced transvaginally into the uterine cavity under ultrasound guidance (Rodesch et al., 1992). Using these electrodes, a wider range of PO$_2$ measurements was obtained than in the present study.

The multipurpose Paratrend sensor has been validated and used mainly for continuous intra-arterial monitoring in intensive care units (Venkatesh et al., 1994). Recently this sensor has been evaluated in direct tissue measurements in order to provide information on the adequacy of brain tissue oxygenation in neurological patients at risk of ischemia (Hoffman et al., 1996). In human pregnancy, the adequacy of placental perfusion and fetal oxygenation has been indirectly evaluated using ultrasound Doppler investigation (Bower et al., 1993) and directly by fetal blood sampling (Soothill et al., 1986).

Measurement of amniotic or placental PO$_2$, PCO$_2$, pH, and bicarbonate may allow better assessment of substrate delivery, clearance, and metabolism than has hitherto been possible with any other method. However, due to the size of the sensor we do not anticipate that it will find many applications in fetal monitoring in utero. For practical reasons, we have evaluated this instrument early in pregnancy when there is limited direct access to the fetal circulation. A shorter and thinner version (Neotrend; Diametrics Medical, Inc.) of the original sensor, which can be introduced via an umbilical artery catheter, is currently being evaluated in neonatology. This new sensor, which can be inserted through a 20-gauge needle, could be placed in the placenta and eventually in late gestation into the umbilical vein, where it can remain in place for several hours and be used to monitor continuing pregnancies. This may improve the management of fetal hypoxia and our understanding of the pathophysiology of placental-related disorders of pregnancy, such as fetal growth restriction and pregnancy-induced hypertension. As a research tool, we are currently investigating other applications using an animal model.

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References


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