ing closed-chest cardiac massage. Also, the relatively low pressures produced can be accurately determined if the doppler transducer is placed over a distal artery and a blood pressure cuff is used as described above.

When using the doppler it must be remembered that the signal heard or recorded is a manifestation of flow, not pressure. The pressure measurement is derived by using a blood pressure cuff to interrupt the flow that is heard or recorded. Effects to quantitate pressure and volume flow using instrument output alone have not been rewarding.

**Reference**


**Electric Shock Hazard Associated with Pressure Transducers**

**Peter Graystone, M.I.E.E., and Molly E. Towell, F.R.C.S. (C)** *

In a series of experiments measuring the effects of asphyxia on fetal goats in utero, two of the values routinely recorded were arterial and venous pressures. Cannulae were attached to two Statham pressure transducers which were connected to a Beckman Type R Dynograph by means of the regular shielded cables supplied with the transducers. In the course of one of the experiments in which fetal ECG and fetal heart rate were being monitored, an arterial cannula was connected to one of the Statham gauges; at the time of connecting the venous cannula gross irregularities appeared in the previously-stable heart rate. This was found to be due to ventricular fibrillation, which eventually resulted in the death of the fetus. An arterial blood sample obtained immediately before cardiac arrhythmia was observed showed pH 7.4, $P_{CO_2}$ 28 mm Hg, base excess $-6.3$ mEq/l and $O_2$ saturation 66 per cent; these values are all within the normal range for fetal goats. Subsequently, it was found that the shielding wire had broken loose in the plug connecting the venous pressure transducer cable to the Beckman Dynograph. Analysis of the experimental record led to the conclusion that fetal death was due to electric shock.

Recent articles about electric shock hazards in hospitals have stressed the danger of leakage of current in intravenous recording techniques. A current flow between arterial and venous cannulae as low as 20 microamperes may be sufficient to cause ventricular fibrillation. Measurements of arterial-venous resistance of other fetal goats were made using the cannulation technique used in the fatal experiment. The A-V resistance was found to be approximately 400,000 ohms. From Ohms law, by simple calculation, the A-V voltage difference required to give a current of 20 microamperes is 8 volts.

The arterial-venous pressure recording system used with the fetal goat is shown in figure 1. The venous pressure transducer was connected to a Beckman strain gauge coupler, Type 9872, in which one of the connections carried an excitation voltage of as much as 15 volts dc with respect to ground. The arterial transducer was connected to a Type 9803 coupler in the same recorder. The point at which the shielding wire had broken in the venous pressure transducer cable is indicated in figure 1. If the shielding wire in the plug contacted the pin carrying the excitation voltage, this transducer housing would be raised to 15 volts with respect to the arterial transducer which was at ground potential. This

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would have caused a current in excess of 20 microamperes, sufficient to cause ventricular fibrillation, to flow through the heart.

Elimination of this type of electric shock hazard can be achieved by connecting a wire between the two transducer housings to provide a low-resistance pathway for current. This eliminates the possibility that current will flow through the heart if there is a break in the shielding wire of one of the transducer cables and ensures that no potential difference between the arterial and venous cannulae can develop.

REFERENCES