in all three seals studied. The magnitude of the arteriovenous oxygen differences were so small that it appeared unlikely that blood in the extradural vein was draining a site of active oxidative metabolism during diving.

In addition, the lactic acid concentration in one of the seals showed a rise in the extradural vein samples indicating that the site of origin of blood in the extradural vein had been a locus of anaerobic glycolysis.

These findings suggest that the extradural venous system is not the major route of venous drainage for the brain. The precise anatomy of this venous system and its function require further elucidation.

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CARDIAC OUTPUT DETERMINATIONS IN THE DOGFISH, Squalus acanthias, USING INDICATOR DYE CURVE TECHNIQUE

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Although the functional aspects of gas exchange in an aquatic media are of considerable biological interest, progress in quantitation of these parameters has been limited by methodological problems. A number of techniques have been utilized to approximate cardiac output in fish but have been handicapped by requiring unwarranted assumptions or by the necessity of manipulations of the animal that alter physiological status.

A modification of the dye dilution technique for measuring the cardiac output of the elasmobranch, Squalus acanthias makes available a method for quantitation of cardiac output in fish without altering the physiological state of the animal. In the present studies arterial blood was sampled via a catheter inserted into the dorsal aorta through a thin-walled excentrically tipped needle. Venous injection was performed into the duct of Cuvier. Indocyanine green was injected as a bolus into the duct of Cuvier and arterial blood was sampled by the dorsal aortic catheter using an automatic sampling and recording densitometer (Gilford). Cardiac output was calculated from the down slope of the dye dilution curve.

A total of 26 fish weighing between 1.3 and 7.0 kilograms were studied shortly after being obtained by trawl. The mean "resting" cardiac output was 1.60 ± 1.00 L/Kg/Hr. The oxygen consumption averaged 48.1 ± 34 ml/Kg/Hr, and carbon dioxide production averaged 33.3 ± 26 ml/Kg/Hr. The respiratory exchange ratio averaged 0.98 ± 0.1. "Resting" data were designated instead of "basal" conditions since the animals were swimming in place in an upright position. Accordingly the work of breathing and the work of maintenance of position must be considered in these "resting" values.