

Abstracts

Work in Progress

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The following are abstracts of papers presented on the WORK IN PROGRESS program of the Annual Meeting of The American Society of Anesthesiologists, Los Angeles, California, October 24, 25 and 26, 1961.

Combined Use of Fe-59 and Cr-51 Radioisotope Tracers for Simultaneous Measurement of Plasma and Red Cell Volume and Index of Erythropoiesis. S. N. ALBERT, M.D., R. P. MEACHER, M.D., H. ODA, M.D., W. BRUNER, M.D., and C. A. ALBERT, M.D., *Anesthesiology Research Laboratory, Washington Hospital Center, Washington, D.C.* In man, the rate of red cell production is depressed with an oxygen tension above the normal level of $150 \pm$ mm. Hg partial pressure and increased with a reduced oxygen tension (*i.e.* high altitude) (Lawrence, J. H., and others: *Acta Med. Scand.* 142: 117, 1952). In this study, the hematopoietic effect of high oxygen tension in conjunction with various depressant agents and anesthetic techniques was explored. The clearance rate of plasma iron is a qualitative index of change in the rate of hemoglobin production, and measurement of the half-life of radioactive Fe-59 in plasma, when administered intravenously as a ferrous salt, is a reflection of the rate of erythrokinesis (Spencer, R. P., Mitchell, T. G., and King, E. R.: *Amer. J. Clin. Path.* 28: 123, 1957). *Method:* The technique employed comprised measuring red cell volume with Cr-51 tagged cells (Albert, S. N., and others: *Tech. Inform. Serv. A.E.C., A.E.C.U.* 3614, March, 1958) with simultaneous measurement of plasma volume with Fe-59. After injection of Cr-51 cells and Fe-59, samples were drawn at 5, 15, 30, 60 and 120 minute intervals. The concentration of tracer elements in each sample was analyzed by differential radioisotopic methods. A random group of 30 patients, age ranging from 21-81 years, undergoing various surgical procedures, was studied. Anesthesia was induced with intravenous thiopental and maintained

by 50/50 nitrous oxide-oxygen mixture with halothane-ether azeotrope. Duration of the surgical procedure, the amount of blood loss and replacement were carefully noted to establish possible correlation between cause and effect. The preoperative rate of hematopoiesis was compared with results obtained 24 hours postoperatively. Six patients subjected to hypothermia were studied immediately postoperatively, while still hypothermic. *Results:* In all instances, the 50/50 nitrous oxide-oxygen-azeotropic mixture administered over a period of 1-5 hours produced no significant change in the rate of red cell production. There seemed to be a definite correlation between a reduced red cell volume (total blood hemoglobin) and erythrokinesis. In one group of patients, the rate of erythrokinesis was increased preoperatively when the patient was deficient in red cell volume and returned to normal range when the deficit was replaced during surgery. A second group of patients with a normal red cell volume preoperatively, showed an increased rate of erythrokinesis in the postoperative period when blood loss was not replaced during the surgical procedure. Finally, in the third group of patients, where the red cell volume was maintained at a preoperative level, there was no change in the erythrokinetic mechanism. In the hypothermic group, the response of red cell production to a reduced red cell volume was, on average, depressed. In one case, where there was a marked deficit in the immediate postoperative period, the rate of erythropoiesis was slower than the preoperative rate. In another instance, a normovolemic patient with a plasma Fe-59 half-life of 82 minutes preoperatively, following hypothermia of five-

hours duration at a temperature of 31° C., with adequate red cell replacement, showed a further decrease in the rate of erythropoiesis in the immediate postoperative period as measured by a Fe-59 half-life of 134 minutes. To establish whether the underlying cause for the decrease in rate of erythropoiesis was due to hypothermia or anesthetic agents, a small group of nonhypothermic patients was studied in the immediate postoperative period. The latter group showed no decrease in erythropoiesis—confirming that the reduction observed in the hypothermic patient is due to the subthermic state. *Summary:* The comparison of Cr-51 and Fe-59 isotope tracer studies preoperatively and postoperatively, substantiated the fact that Fe-59 half-life was satisfactory for measurement of erythrokinetics, and in this series, the increased rate of red cell production was synonymous with a reduction in the total body hemoglobin. [The Ferrutope was supplied by E. R. Squibb & Sons. The project was supported by an Atomic Energy Commission Grant, AT(30-1) 2486, and The American Red Cross.]

Effects of Experimental Subarachnoid Perfusion Cooling and Rewarming on the Spinal Cord. MAURICE S. ALBIN, M.D., ROBERT J. WHITE, M.D., DAVID E. DONALD, PH.D., COLLIN S. MACCARTY, M.D., and ALBERT FAULCONER, JR., M.D., *Mayo Clinic and Mayo Foundation, Rochester, Minnesota.* It was thought that an isolated selective technique to reduce spinal-cord temperature would provide information on the effect of cold on nervous tissue in an intact biologic preparation, provide a useful method for physiologic studies, and have clinical application in the treatment of spinal-cord trauma. *Method:* By a preferential cooling technique, 13 dogs were perfused via a plastic catheter inserted beneath and sealed in the dura following laminectomy at each site. Cold isotonic sodium chloride at 5.0° C. was used to perfuse 8 dogs from T-4 to L-5 levels, and two dogs from C-3 to L-5 levels. Three dogs served as controls: two were perfused with isotonic sodium chloride at normal cord temperatures from T-4 to L-5 levels, and one from C-3 to L-5 levels. Perfusion was achieved by gravity; flow rate was 10.0 ml./minute. Temperatures

were recorded with needle thermometers at inflow and outflow catheters and within the cord during perfusion. Rectal temperature, mean arterial pressure, and heart rate were monitored. In 7 animals, brain temperatures were taken with needle thermometers inserted through bilateral burr holes. *Results:* In the 8 dogs perfused from T-4 to L-5 levels, cord temperature was reduced to a mean of 14.4° C. at L-5 level and to a mean of 10.6° C. at T-4 level after an average of 68.3 minutes of perfusion. In the two dogs perfused from C-3 to L-5 levels, cord temperature reached a mean of 13.0° C. at L-5 level and a mean of 9.6° C. at C-3 level after an average of 40 minutes of perfusion. Cords of 4 animals previously cooled were allowed to rewarm spontaneously by immediately stopping perfusion. These cords reach preperfusion temperatures in an average of 13.2 minutes. On recooling, they reached lower temperatures sooner, averaging only 33 minutes of perfusion. In the three controls, cord temperature was unchanged after 2 hours of perfusion. Brain temperature in four cold-perfused animals declined 2.5°, 2.5°, 3.5°, and 4.0° C. respectively from levels observed before perfusion, but remained unchanged in controls. Rectal temperatures did not fluctuate significantly during perfusion in any animals. Three dogs perfused from T-4 to L-5 levels and two perfused from C-3 to L-5 levels showed significant fluctuations in both heart rate and mean arterial pressure during cooling. To test the effects of profound cooling of the cord on long-term survival, two animals were perfused from T-4 to L-5 levels for one hour; cord temperatures of 17.5° C. and 11.0° C. at L-5 and 10.5° C. and 8.5° C. at T-4 level were reached. The animals recovered completely with no subsequent neurologic damage.

Effects of Morphine and Curare on the Respiratory Response Curve. J. WELDON BELLVILLE, M.D., and ELLIS N. COHEN, M.D., *Department of Anesthesia, Stanford University Medical School, Palo Alto, California.* The respiratory depressant effects of morphine and curare and the combination of morphine and curare were evaluated in 8 healthy male subjects. Respiratory depression