Introduction. Controlled hypotension is used frequently during intracranial aneurysm surgery to facilitate surgical dissection and to minimize the risk of aneurysmal rupture. Based on cerebral blood flow (CBF) autoregulation thresholds and clinical experience, reduction of mean arterial pressure (MAP) to 50 mmHg is usually considered safe for the brain in normal individuals. CBF remained similar to baseline values during nitroprusside (SNP)-induced hypotension in man at MAP levels about 50 mmHg. But, an extremely low arterial pressure less than 50 mmHg is sometimes recommended. This study was designed to investigate the effects of SNP-induced hypotension to less than 50 mmHg on CBF and cerebral metabolic rate for oxygen (CMRO2).

Methods. After approval by our Local Subcommittee on Human Research, informed consent was obtained from the patients themselves and from a member of their own family. The study was performed on 8 patients (22-40 yr) with good neurologic function, anesthetized for correction of cerebral arterial aneurysms within 10 to 15 days following the initial subarachnoid hemorrhage. After droperidol (150 µg/kg), anesthesia was induced by thiopental (6 mg/kg) and phenoperidine (30 µg/kg), followed by suxamethonium (1 mg/kg) to facilitate tracheal intubation. Ventilation was controlled to maintain PacO2 between 28 and 35 mmHg. Anesthesia was maintained with repeated doses of phenoperidine and droperidol, and N2O in O2 (F102 0.5). Curarization was maintained by alcuronium. Heart rate (HR), MAP (radial artery cannula), jugular venous bulb pressure (JVP; polyethylene catheter), and right atrial pressure (RAP) and pulmonary wedge pressure (PCWP) (7 F thermodilution Swan Ganz catheter) were recorded continuously. MAP was referenced to the level of Circle of Willis. Cardiac output was determined with iced-injectate in triplicate. The 133Xenon intra-arterial injection technique was used to determine the regional (r) CBF. The isotope (1 mCi in 1 ml) was injected into the internal carotid, which was cannulated via the common carotid artery by a small polyethylene catheter (on the side contralateral to the aneurysm). The correct position of the catheter in the internal carotid artery was verified by fluoroscopic control. The wash-out of radioactivity was measured by a portable detector (Mecascerto MO 411) placed over the ipsilateral temporoparietal area level of the skull. Collimation was provided by a cylindrical lead tube and a (1 x 1") NaI crystal. The detector was connected to a ratemeter with a linear writing potentiometer. The rCBF was calculated from the slope of the logarithmically displayed first two minutes of the disappearance curve, according to the following equation: rCBF = r0.693 x T - 1, where T is the half-time of radioactivity and λ is the average blood-tissue partition coefficient. CMRO2 was obtained from arterial and jugular venous blood 02 contents. Cerebral perfusion pressure (CPP = MAP - JVP) and cerebral vascular resistance (CVR = MAP/CBF) were calculated. Data were collected during anesthesia before SNP (before), 5 min after stable hypotension to about 40 mmHg has been achieved with SNP (during), 20 min (after 20) and 40 min (after 40) after termination of SNP. Data were analysed by ANOVA and paired t test with Bonferroni correction. Results. Data are summarized in table. SNP was infused at 10.6 µg/kg/min (mean) during 20 min (mean). No cerebral dysfunction was apparent in the postoperative period.

Discussion. Regional CBF remained unchanged during profound SNP-induced hypotension despite an increase in CI, because CPP and CVR decreased to a similar degree. This seemingly constant flow suggests that the autoregulation was preserved. But, the slightly increased rCBF following discontinuation of SNP and reestablishment of MAP might be due to a prolonged direct SNP-induced vasodilation in brain vessels, and a redistribution of blood flow to the brain in the presence of impaired autoregulation. However, the existence of low-perfused regions, and local brain and cerebrospinal fluid lactacidosis cannot be excluded.

References