used whenever there was the likelihood of angiography and a mobile image intensifier linked to a videotape recorder was available. Catheterization angiography was favoured. Four instances in which this technique was used were described to illustrate its value.

1. For localization of intracranial vascular lesions—for example, a small, deeply placed arteriovenous malformation.

2. To increase the precision and to reduce the time taken in dissecting the lesion.

3. To check the stages of a procedure, such as embolization of a carotico-cavernous fistula.

4. To obtain immediate information on the efficacy of the surgical procedure, particularly (a) where the surgery was of more than usual magnitude, as in the anterior approach to an aneurysm of the basilar artery, and (b) where there was reason to suspect inadequate occlusion, as in some cases of aneurysm.

5. The immediate recognition of complications of surgery—for example, the inadvertent occlusion of a major vessel with an aneurysm clip.

The authors mentioned the following potential disadvantages of operative angiography: (1) an increased operating time (angiography took 20 to 70 minutes) which might be offset by facility in localizing the lesion; (2) the recognized hazards of angiography; (3) an increase in theatre personnel and equipment.

They concluded, in the light of their experience of this technique and from the reports of others, that it could play an important part in the surgical management of A-V malformations, aneurysm, carotico-cavernous fistula, occlusive vascular disease, and of vascular tumours.

AN OBSERVATION ON POST-OPERATIVE SPASM AND ITS POSSIBLE SIGNIFICANCE

JASON BRICE (Southampton) showed a series of immediate post-operative angiograms in cases of aneurysmal sub-arachnoid haemorrhage, demonstrating little or no arterial spasm in the period of an hour or so after operation. During the next few days arteriography revealed an increasing proportion of such cases with intense vasospasm. He suggested that this late, or secondary spasm, was the principal factor responsible for post-operative morbidity and mortality in this group of cases. It could be avoided by increasing the interval between sub-arachnoid haemorrhage and surgery with a corresponding loss of patients from recurrent haemorrhage.

The author speculated on the significance and possible causes of this biphasic post-operative vasospasm. A comparable observation had been reported in the animal experiments of Brawley, Strandness, and Kelly (*J. Neurosurg.*, 1968), in which the consequences of damage to cerebral arteries had been followed for longer periods than in the more common acute preparations. It was

suggested that the first phase results from the release of normally occurring vasoconstrictive substances (catecholamines) from the large adrenergic fibres in the walls of the arteries of the circle of Willis, previously shown by the fluorescent histochemical studies of Nielson and Owen. He quoted Yasargil that this material was seen in abundance only in the anterior half of the circle of Willis was sparse in the vertebro-basilar system, and absent from the vessels of A-V malformations. This observation correlated well with the occurrence of spasm as judged clinically and on angiography.

A variety of possible aetiological factors were considered in relation to the secondary phase and it was suggested that partial ischaemia of large segments of brain tissue might release a vasoconstrictor substance which could diffuse along the fine perivascular spaces to the basal subarachnoid cisterns giving rise to a self-perpetuating cycle of both local and distant spasm. Suggestions for future lines of investigation of this problem were made as follows:

1. An attempt to counteract the first phase with alpha-blockers or by drugs depressing catecholamine release using the experimental models of Brawley, Strandness and Kelly.

2. A search for effective vasodilator substances in the second phase, repeating the experiments of Odom on dogs and the trials of Pribram on humans during angiography.

3. Biochemical analysis of the products of ischaemic brain to identify vasoconstrictor substances.

4. An extension, eventually, of such studies to human in an endeavour to block this biphasic system at its earliest stages.

ECHOENCEPHALOGRAPHY WITH SIMULTANEOUS A- AND B-MODE DISPLAY

E. KAZNER (München) described the combination of simultaneous one- and two-dimensional echoencephalography in the diagnosis of intracranial lesions. Although this method did not have such a large field of indication as the simple A-mode—since it was unsuitable for the examination of restless head-injured patients, for example—it did increase the objectivity and the information of echoencephalographic findings in many cases. The best results had been achieved in infants and in children where the skull was relatively thin. Here it was frequently possible to display soft tissue structures which were almost impossible to demonstrate using neuroradiological methods. Already in its present form, combined A-B-mode echoencephalography as a screening test in children and as a method of progressive observation of patients having had tumour or shunt operations was an important additional investigation which could be carried out on an out-patient basis.