CONTROLLED PNEUMOENCEPHALOGRAPHY
A CONSIDERATION OF HEAD POSITION AND GAS-FLUID REPLACEMENT

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The purpose of this paper is to reemphasize techniques for pneumoencephalography originally developed by Robertson and Lindgren, which in this country seem to have escaped the attention they merit. These methods assure adequate visualization of the 3rd ventricle, aqueduct of Sylvius and 4th ventricle in most cases, as well as anatomical delineation of the subarachnoid cisternae (Figs. 1 and 2). Review of the radiologic litera-


ture shows that the problem of visualizing the posterior midline structures is a significant one as evidenced by the numerous complicated positional maneuvers that have been devised and the recent extensive use of tomography.

The technique of encephalography varies considerably; this is true of the actual roentgenological technique as well as the methods of gas-fluid replacement. The common practice appears to be the drainage of a variable amount of spinal fluid before gas is introduced into the lumbar subarachnoid space. Thus, Davidoff recommended the initial removal of 10 cc. of cere-
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Brospinal fluid prior to replacement with 5 cc. of gas. Thereafter, 5 cc. aliquots of fluid and gas are alternately removed and injected. With this method, 50–70 cc. of gas are employed for routine pneumoencephalography. Other examiners use even larger quantities of gas and, in some clinics, it is not uncommon for encephalography to be done with complete replacement of the cerebrospinal fluid by gas.

As early as 1933, Gardner and Nichols\(^3\) stated that satisfactory filling of the ventricular system could be obtained if air were injected into the lumbar theca prior to removal of fluid. More recently, Lindgren\(^4\) has demonstrated that ascent of gas to the 4th ventricle and aqueduct is enhanced when no fluid is initially removed. Similarly, Lindgren\(^4,5\) and Robertson\(^9\) have shown that ascent of gas into the ventricular system depends upon the position of the head. Nevertheless, these observations do not appear to be generally known nor appreciated.

**PRINCIPLES OF TECHNIQUE**

Gas introduced into the lumbar theca ascends to the cisterna magna when the patient is seated with the head flexed. Thereafter, its course is determined by the position of the head (Fig. 3). Thus, with the head in the neutral or slightly extended position, most of the gas passes ventrally into the basilar cisternae. From there, it may either go posteriorly into the cisterna ambiens or anteriorly into the cisterna chiasmatis (Fig. 4). However, if the head is flexed acutely, gas tends to enter the posterior portion of the cisterna magna and pass over the dorsal aspect of the cerebellum; from there it proceeds forward under the tentorium to the cisterna venae magnae cerebri and finally upward over the cerebral convexity. Little gas enters the basilar cisternae in the position of hyperflexion of the head; also there is little opportunity for ventricular filling with the head in this position. The ideal position is one

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**Fig. 3.** Tracing of a lateral view of a roentgenogram showing the basilar cisternae. A=Cisterna chiasmatis. B=Cisterna interpeduncularis. C=Cisterna pontis. D=Cisterna vena magna cerebri. E=Cisterna ambiens. F=Cisterna magna.