Letter to the Editor

AUTOMATIC MIDLINE ECHOENCEPHALOGRAPHY

SIR,—As early advocates and present proponents of automatic midline echoencephalography, my colleagues and I were most interested in the paper by Klinger *et al.* on this subject in the March issue (Klinger *et al.*, 1975).

Like Klinger and her colleagues, we were delighted to note the close agreement between her figures and our own (White and Hanna, 1974) for the accuracy of the technique, especially the low incidence of false negative errors in both series. It is encouraging, moreover, that the percentage of false positive errors in Klinger's series (8%) was lower than that reported by us. In fact, our false positive errors were calculated as the percentage of the total number of *echograms* performed rather than of the patients examined; they were inflated because of our predisposition to repeat the echograms when we became aware that an error had been made, almost always with the same erroneous result. In fact, our 40 false positive errors were made on 30 patients, an incidence of 15%. In our larger series of 6 667 patients not yet reported, this incidence has fallen to 12% which is in closer agreement with Klinger's figures.

The one marked discrepancy between Klinger's series and our own is in the incidence of histograms unsatisfactory for interpretation: 18% in her series and 3% in our own (2.7% in our larger series of 6 667 cases). Since Klinger bases her conclusion that automatic echoencephalography is of 'limited use for neurologists' and 'not reliable . . . in cases of head injury' upon the high percentage of unsatisfactory examinations in her series, it is both important and interesting to examine this matter more closely.

Klinger points out, probably very correctly, that there was a higher percentage of patients with cerebral disease in her series (80%) than in ours, although we did not calculate the percentage of the total number of patients we examined who had cerebral disease. Patients with cerebral disease are more difficult to examine and more prone to give rise to erroneous or unsatisfactory histograms. Is this the explanation for this marked discrepancy in the percentage of unsatisfactory results in the two series? We do not think so.

Firstly, if the increased incidence of cerebral disease in Klinger's series increased the number of unsatisfactory examinations, by the same token, it should have increased the percentage of errors made in her series. This was not the case.

Secondly, in all the cases reported by Klinger, the automatic examination was followed by an examination with the conventional video display with which it was compared. When the two results differed, the video display was assumed to be correct and the automatic technique in error. In the 585 cases in her series in which an independent neuro-radiological estimate was made of the position of the cerebral midline, Klinger reports only the errors made by the automatic technique in these cases. Is one to assume that the video technique was never in error? In these circumstances, there could hardly have been much incentive for the operator of the automatic technique to perform the examination to the best of his ability or even to complete it when readings were made slowly. In our series, on the other hand, the only echoencephalographic examination was made with the automatic technique. There was great pressure upon the operator to complete the examination satisfactorily because the neurosurgeons in our hospital, having discarded their initial scepticism, have learned to trust the echoencephalographic examination despite its predisposition to make false positive errors. The neurosurgeons now often base their subsequent management of the patient largely upon the results of midline echoencephalography.

Thirdly, while automatic techniques do not require the operator skill so essential for the video techniques, they do demand some degree of skill. At the hospital in Erlangen, where one-third of Klinger's series was compiled, totally unskilled students were used to operate the automatic technique in contrast with the skilled operators used for the video technique. The effect of such unskilled operation is shown by Table 6 in Klinger's paper; such an operator made 34 unsatisfactory examinations in the first 150 cases he examined (22%) and only 10 in the second 150 cases (7%).

Fourthly, the Neurosurgical Clinic in Munich, where another third of Klinger's series was compiled, is so highly organized for the investigation and treatment of neurosurgical emergencies that angiography or craniotomy can be commenced within 10 minutes of the patient's arrival. The echoencephalographic examination must therefore be completed within this time. If the automatic technique, which frequently makes individual measurements slowly in cases of cerebral disease or injury, appeared to be making its measurements too slowly

for completion within this 10 minutes, the examination was terminated and called unsatisfactory and the video technique used in its stead. In our series, because the Kingston General Hospital is a general hospital, it is rarely possible to free and prepare the angiographic room in the x-ray department or the neurosurgical operating room in less than an hour. This longer time was therefore available for the echoencephalographic examination which, in difficult cases, may take 30 or even 40 minutes.

Fifthly, at the Neurosurgical Clinic in Berlin where the remaining third of Klinger's series were compiled, the highest percentage of unsatisfactory examinations (30%) were made. She ascribes this to the high percentage of children in this series; 50% of examinations on patients below the age of 16 years were unsatisfactory. She attributes this 'to the setting of the Midliner scale which is limited to a head diameter of 13 to 18 cm'. This statement is incorrect. The smallest head diameter that can be measured by the Midline Computer corresponds to a go-and-return propagation time of 130 μ s, which is equivalent to a range in soft tissue of approximately 9.75 cm. No baby is likely to have a smaller head than this. There is no upper limit to the size of the head that can be examined (White, 1972). I have not had the opportunity to discuss their results with the group of authors from Berlin but I suspect there is some similar simple explanation for their high percentage of unsatisfactory results as there appears to be in both Erlangen and Munich. According to our experience, the examination of children should be no more difficult than that of adults but much less acoustic power is needed.

In view of these facts, we would like to suggest that, provided that the operator of the automatic technique is strongly motivated to make and complete a satisfactory examination, has some modicum of experience, and is not working against an unrealistic time limit, the percentage of unsatisfactory examinations will be low. Moreover, the accuracy of the automatic techniques appears to compare favourably with that of the video techniques, except in those very same German centres used in Klinger's series where an exceptional degree of skill has been developed leading to increased accuracy with the video technique. For these reasons, we believe that the automatic techniques will be found to provide an acceptable form of midline echoencephalographic examination in all emergency and neurosurgical

departments where the exceptional skill developed by Kazner and his colleagues is not available. This has certainly been our experience at the Kingston General Hospital. In those very few centres where this exceptional skill is available, the video technique would still appear to be preferable.

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P.S. Since writing the above letter, the group of workers from Berlin contributing to Klinger's study have published the results of their own separate series of automatic midline examinations of 385 children (Grumme, Th., Graef, G., Meese, W., Grauthoff, H. J., Amtenbrink, V., and Frommel, G. (1975). Experiences with the echo midliner. *Journal of Clinical Ultrasound*, 3, 215-218). In this series, which differs in number from the 629 cases included in Klinger's series, there were 198 cases of hydrocephalus and only 30 of head injuries. The overall rate of unsatisfactory examinations was 38%, while 58% of the cases with hydrocephalus were unsatisfactory. Grumme *et al.* suggest that the high rate of unsatisfactory examinations they found in children with hydrocephalus results from the confusion of the M-echo with the high amplitude echoes reflected by the ventricular walls in such cases and which will also fall within the 32 mm mid-gate. We would certainly agree with this interpretation.

It even seems possible that, in small babies, the high amplitude echoes from the lateral walls of undilated lateral ventricles might also fall within the 32 mm region of the mid-gate and give rise to similar confusion in identifying the M-echo. Certainly the decline in the incidence of unsatisfactory examinations in 151 healthy children in the series described by Grumme from 56% in children below the age of 1 year to 3% in children between the ages of 11 and 15 years, would support such a hypothesis.

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