Brit. J. Psychiat. (1982), **141**, 614–617

Pneumo-Encephalographic and Computerized Axial Tomography Scan Changes in Affective Disorder

H. M. A. S. STANDISH-BARRY, N. BOURAS, P. K. BRIDGES and J. R. BARTLETT

Summary: The pneumo-encephalographs and computerized axial tomography scans of fifty patients with severe affective disorder were studied. Measures of ventricular size were compared with those reported by other workers. Findings suggested that some patients suffering from severe affective illness showed abnormalities of brain structure as demonstrated by ventricular enlargement.

The aetiological relationship of organic brain dysfunction to affective disorder is an unresolved question. Jacoby and Levy (1980) have demonstrated a sub-group of elderly patients (mean age 76 years) with late onset affective disorders who showed cerebral ventricular enlargement on CAT scans. Pearlson and Veroff (1981) have demonstrated cerebral atrophy on CAT scans in younger manic-depressive patients (aged 16 to 50 years). The present study was carried out with the aim of extending this discussion. A group of patients undergoing stereotactic subcaudate tractotomy who had a CAT scan performed before the procedure and pneumoencephalography during the procedure were studied.

Endogenous or psychotic depression seems to be the psychiatric condition most likely to respond favourably to ventro-medial psychosurgery. Phobic anxiety and obsessional symptoms may present in the setting of an affective disorder and can also be helped by the procedure (Goktepe *et al*, 1975; Bridges *et al*, 1981). During assessment for psychosurgery many patients give a history of earlier episodes of illness responding satisfactorily to either antidepressant medication or ECT, with the treatments becoming less effective until there is no therapeutic response. In other cases ECT continues to produce improvement but only for a limited period of time, so that it has to be given increasingly frequently. Absence of signs of an organic cerebral abnormality, including the absence of clinically significant dementia, is necessary for the case to be accepted for operation. Thus a psychosurgical unit presents an unusual opportunity to study the pneumonoencephalograms and CAT scans of a group of patients with severe affective illnesses in whom the presence of an organic cerebral condition is unlikely.

Method

Fifty patients (14 males and 36 females) consecutively admitted to the Geoffrey Knight Psychosurgical Unit, Brook Hospital, London SE18, were studied. The mean age for the male patients was 55.5 years (SD 11.5) and for females was 52.2 years (SD 14.8). The combined mean age was 52.1 years (SD ±13.9). The difference in mean age between males and females was not statistically significant. The vast majority of patients (79 per cent of males and 89 per cent of females) suffered from endogenous depression. Three patients suffered from anxiety neurosis and four patients suffered from obsessional neurosis.

The patients were selected for psychosurgery according to the criteria of Bridges and Bartlett (1977) and Bridges *et al* (1981).

Stereotactic subcaudate tractotomy has been described by Knight (1965) and the clinical results have been reported by Goktepe *et al* (1975). During the operation, which is always carried out under full anaesthesia, the patient's head is held in a standard position, a burr hole is made immediately above the frontal nasal air sinuses on each side and air is injected into the anterior horn of the lateral ventricles through a canula after the removal of CSF. In this way the anterior horns are visualized in order to facilitate calculations for the stereotactic placement of the array of small radioactive yttrium rods which produce the lesion in the ventro-medical quadrants of the frontal lobe. Anterior-posterior and lateral radiographs are taken in a standard way during the

https://doi.org/10.1192/bjp.141.6.614 Published online by Cambridge University Press

operation in order to monitor the siting of the rods, the films of the ventricles being taken before placement of the lesion, which thus will not affect ventricular size.

The following measurements were taken of the pneumo-encephalographs (PEG):

(1) the septum-caudate line,
(2) the distance between the lateral extremities of the tips of the frontal horns,
(3) the width of the cellae mediae measured across the superior aspects of the lateral ventricles, and
(4) Evans' ratio—the ratio of the distance between the lateral extremities of the tips of the frontal horns of the lateral ventricles to the maximum internal diameter of the skull (Evans, 1942).

CAT scanning always preceded PEG. Within a short time of admission to the unit each subject was examined by an EMI CT1010 Head Scanner. All cuts were made parallel to the orbito-meatal line. Photographs were made from the visual display using a Stanley Albrit planimeter. One of us (HSB) measured the area of the ventricle on the 'cut' showing the maximum ventricular area.

The area of the ventricle was traced three times and the average of these readings recorded. There was a highly significant correlation between the three measurements ($r = +.92$). The internal area of the skull was measured in the same manner ($r = +.93$). A ratio of ventricular to internal skull area (VSR) which gives a simple numerical value was made. This gives a useful measure of ventricular size on CAT scans to compare with other workers' results. It has been shown to correlate well with computer derived ventricular volume (Penn *et al*, 1978).

Results

Pneumo-encephalographic (PEG) measurements (Table I)

The mean of this distance between the lateral extremities of the tips of the frontal horns was significantly greater for males than females ($t = 2.5$, $P < 0.01$). This was also so for the mean of the width of the cellae mediae ($t = 2.6$, $P < 0.01$) and for Evans' ratio ($t = 2.01$, $P < 0.05$).

For the entire sample a statistically significant positive correlation was found between the width of the cellae mediae and age ($r = +.30$, $P < 0.05$) and Evans' ratio and age ($r = +.21$, $P < 0.05$). This indicates that the width of the cellae mediae and Evans' ratio tended to increase with age. However, it is interesting to note that for female patients there was a significant position correlation between all PEG measurements and age ($P < 0.05$) but this was not so for male patients.

CAT scan measures (Table II)

As we have described, a ventricular skull ratio (VSR) was calculated. The mean ratio for the entire sample was 12.3 (SD 1.9) with a range from 8.6 to 16.6. There was no significant difference in the mean VSR between males and females. A significant relationship was found between VSR and age ($r = +.36$, $P < 0.01$) indicating that VSR tended to increase with age.

Discussion

This finding confirms work by Barron *et al* (1976). They studied 135 normal volunteers and found a gradually progressive increase in ventricular size. It can be clearly seen from Table II that VSR values for each decade in the present study were considerably greater than those reported by Barron *et al* (1976).

We have firstly compared our PEG measurement

TABLE I
PEG measures—mean width in mms

Septum-caudate line	16.4 (SD 1.6)
Distance between lateral extremities of the top of the frontal horns	42.5 (SD 3.6)
Width of the cellae mediae	34.8 (SD 2.3)
Evans' ratio	29.0 (SD 2.5)

TABLE II
Ventricular-skull ratio and age

	Present study			Barron *et al* (1976)		
Age	Mean	SD	No.	Mean	SD	No.
30–39	10.9	1.9	11	4.2	0.6	15
40–49	11.6	2.6	9	4.4	0.8	15
50–59	12.8	0.9	12	5.2	0.6	15
60–69	13.2	1.5	12	6.4	0.8	15
70–80	13.6	1.4	6	11.5	1.2	15

https://doi.org/10.1192/bjp.141.6.614 Published online by Cambridge University Press

results with those described by Gawler *et al* (1976) who studied 11 'normal' subjects. In our study the mean width of the lateral ventricles to the tips of the frontal horns (42.5) was greater than the mean (40.5) reported in that study. The mean Evans' ratio (29.4) in our study was greater than the mean (27.0) given by Gawler *et al*, and also greater than the mean (23.0) described by Evans (1942). However, the sample of Gawler and colleagues had an age range from eight months to 73 years but the ages of the 11 'normal' subjects were not stated in that paper. Evans in his classic paper merely refers to a sample of children and a sample of adults. The mean Evans' ratio in our study was also significantly greater than the mean (26.0) given by Synek *et al* (1976) in his series of 15 normal subjects ($t = 5.07$, $df = 63$, $P < 0.001$). We have found that the mean septum-caudate line for all our patients was 16.4 mm with a range of 14 to 20 mm. Troland *et al* (1946), Engest and Lonnum (1958) and Knudson (1958) all agreed that a value of 16 mm and above is to be regarded as definite dilation. However, it is interesting to note that Mann (1973) found that a cut-off point for the septum-caudate line of 18 mm differentiated demented from non-demented patients in a follow-up study.

We have compared out CAT scan measurements with those of Jacoby and Levy (1980), Weinberger *et al* (1979) and Pearlson and Veroff (1981). The comparative values are shown in Fig 1.

The mean VSR (12.3) in our sample was lower at a statistically significant level than the mean VSR (14.2) reported by Jacoby and Levy (1980) ($t = 3.17$, $df = 98$, $P < 0.01$) for a sample of elderly controls. Jacoby and Levy state that they found no significant differences between affective patients and controls on measurement of Evans' ratio, planimetric ratio and mean cortical atrophy score. They state that nine patients had enlarged ventricles but do not report the numerical data. The mean age of our sample was considerably (24 years) lower than the mean age of Jacoby's sample.

Other studies have shown no significant correlations between ventricular enlargement and medication (Weinberger *et al*, 1979; Johnstone *et al*, 1976; Haug,

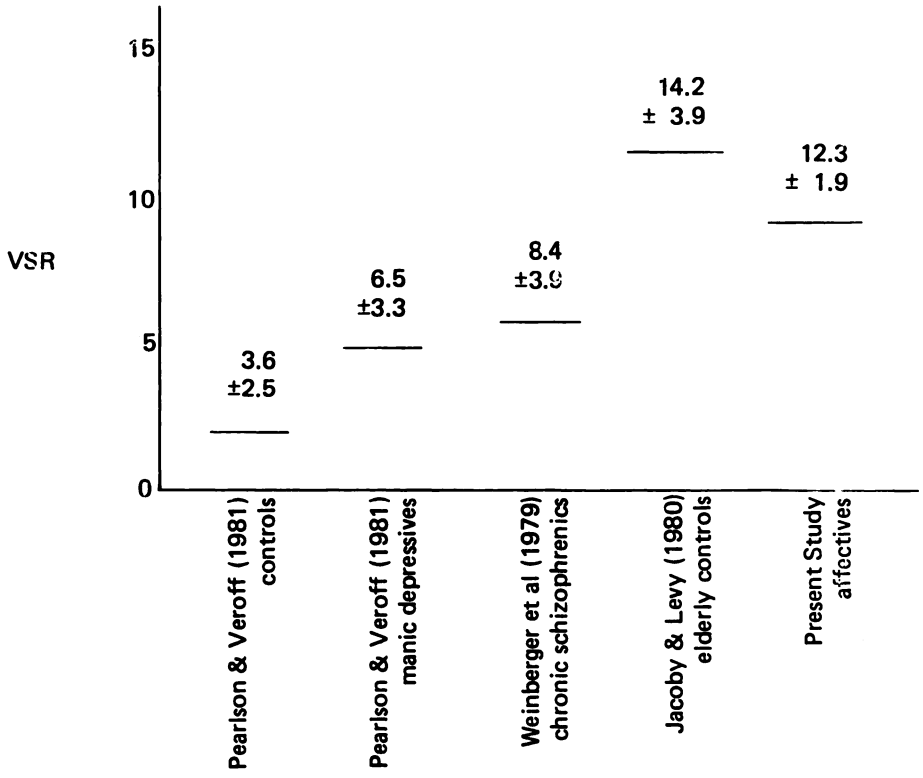


FIG 1

https://doi.org/10.1192/bjp.141.6.614 Published online by Cambridge University Press

1962) or between length of hospitalization and ventricular enlargement (Pearlson and Veroff, 1981; Weinberger *et al*, 1979).

In a similar group of patients (Van Boxel *et al*, 1978) increasing amounts of ECT were not associated with ventricular enlargement nor did Johnstone *et al* (1976) find any relationship between ECT and ventricular enlargement.

These findings suggest that some patients suffering from severe affective illness show abnormalities of brain structure as demonstrated by ventriculomegaly on CAT scans and PEG.

Acknowledgements

We are grateful to Professor W. A. Lishman for allowing one of us (H.S.B.) to use the planimeter at the Institute of Psychiatry and to Dr C. C. Penney for helpful radiological advice.

References

BARRON, S. A., JACOB, L. & KINKEL, W. R. (1976) Changes in size of normal lateral ventricles during ageing determined by computerised tomography. *Neurology*, **26**, 1011–13.

BRIDGES, P. K. & BARTLETT, J. R. (1977) Psychosurgery: yesterday and today. *British Journal of Psychiatry*, **131**, 249–60.

—— —— GILLMAN, P. K. & STANDISH-BARRY, H. (1981) Selecting patients for psychosurgery. *Biological Psychiatry* (eds. C. Perris, G. Struuve and B. Jameson). Elsevier North-Holland. Biomedical Press.

ENGEST, A. & LONNUM, A. (1958) Third ventricles of 12 mm width or more. *Acta Radiologica*, **50**, 5–11.

EVANS, W. A. (1942) An encephalographic ratio for estimating ventricular enlargement and cerebral atrophy. *Archives of Neurology*, **47**, 931–7.

GAWLER, J., DU BOULAY, G. H., BULL, J. W. D. & MARSHALL, J. (1976) Computerised tomography (the EMI Scanner): a comparison with pneumo-encephalography and ventriculography. *Journal of Neurology, Neurosurgery and Psychiatry*, **39**, 203–11.

GOKTEPE, E. O., YOUNG, L. B. & BRIDGES, P. K. (1975) A further review of the results of stereotactic subcaudate tractotomy. *British Journal of Psychiatry*, **126**, 270–80.

HAUG, J. O. (1962) Pneumo-encephalographic studies in mental disease. *Acta Psychiatrica Scandinavica*, **38**, (Suppl. 165), 1–114.

JACOBY, R. J. & LEVY, R. (1980) Computed tomography in the elderly. *British Journal of Psychiatry*, **136**, 249–55, 270–5.

JOHNSTONE, E. C., CROW, T. J., FRITH, C. D., HUSLAND, J. & KREEL, L. (1976) Cerebral ventricular size and cognitive impairment in chronic schizophrenia. *Lancet*, *ii*, 924–6.

KNIGHT, G. (1965) Stereotactic tractotomy in the surgical treatment of mental illness. *Journal of Neurology, Neurosurgery and Psychiatry*, **28**, 304–10.

KNUDSON, P. A. (1958) *Ventriklernes Storrelsesferhold i anatomisk normale*. Hjerner fra viknsne mennesker. Copenhagen: Medicinsk-anatomiske Institutter.

MANN, A. H. (1973) Cortical atrophy and air encephalography: a clinical and radiological study. *Psychological Medicine*, **3**, 374–8.

PEARLSON, G. O. & VEROFF, A. E. (1981) Computerised tomographic scan changes in manic-depressive illness. *Lancet*, *ii*, 470.

PENN, R. D., BELANGER, M. G. & YASNOFF, W. A. (1978) Ventricular volume in man computed from CAT scans. *Annals of Neurology*, **3**, 216–23.

SYNEK, V., REUBEN, J. R. & DU BOULAY, G. H. (1976) Comparing Evans' Index and computerised axial tomography in assessing relationship of ventricular size to brain size. *Neurology*, **26**, 232–3.

TROLAND, C. E., BAXTER, D. H. & SCHATZKI, R. (1946) Observations on encephalographic findings in cerebral trauma. *Journal of Neurosurgery*, **3**, 390–8.

VAN BOXEL, P., BRIDGES, P. K., BARTLETT, J. R. & TRAUER, T. (1978) Size of cerebral ventricles in 66 psychiatric patients. *British Journal of Psychiatry*, **133**, 500–6.

WEINBERGER, D. R., FULLER TORREY, E., NEOPHYTIDES, A. N. & WYATT, R. J. (1979) Lateral cerebral ventricular enlargement in chronic schizophrenia. *Archives of General Psychiatry*, **36**, 735–9.

H. M. A. S. Standish-Barry, M.R.C.Psych., *Research Registrar, Guy's Hospital Medical School, London SE1 9RT; Current appointment: Lecturer in Psychiatry, University of Leeds, Leeds LS2 9LT*

N. Bouras, M.D., Ph.D., *Honorary Senior Registrar, Department of Psychiatry, Guy's Hospital Medical School*

P. K. Bridges, M.D., Ph.D., F.R.C.Psych., *Consultant Psychiatrist, Guy's Hospital, Brook General Hospital, Bexley Hospital; Senior Lecturer, Guy's Hospital Medical School*

J. R. Bartlett, M.A., F.R.C.S., *Consultant Neurosurgeon, The Geoffrey Knight Psychosurgical Unit, Regional Neurosurgical Centre, Brook General Hospital, Shooters Hill Road, London SE18 4LW*

(*Received 12 May; revised 18 June 1982*)

https://doi.org/10.1192/bjp.141.6.614 Published online by Cambridge University Press