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Cognitive Outcome and Quality of Life after Aneurysmal Subarachnoid Haemorrhage - Part I: Cognitive Outcome

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Abstract

Thirteen patients who were operated for aneurysmal subarachnoid haemorrhage (SAH) were prospectively studied (prospective study group) at regular intervals in the post-operative period for cognitive deficits by complex neuropsychological tests. They were compared with 13 aneurysmal SAH patients operated on an average 2 years earlier (retrospective study group), 11 patients of lumbart disc proplase (patient control group) and 15 subjects (normal control group). The prospective study group as compared to the patient control and normal group had significant impairment in all the cognitive functions at discharge, which however, showed a constant improvement and reached near normal levels at the end of one year study period. The patients of the retrospective study group still had residual cognitive deficits.

Key words -

Subarachnoid Haemorrhage,
Cognition,
Quality of life,
Outcome
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There has been persistent efforts to improve on the mortality and morbidity following surgery for ruptured intracranial aneurysms. Recent studies indicate that thorough and careful examination of those surviving this catastrophical illness, can detect impairment in cognitive functions [1], [2], [3], [4], [5], [6], [7], [8], [9], [10]. Changes in quality of life and return to the previous work are also considered as yard sticks of an outcome assessment [1]. Studies done at periodic intervals have shown that these impairments improve over a period of time [1].

The present study was carried out at National Institute of Mental Health & Neuro Sciences, Bangalore during the period

1988-1990, to detect:

(1) The presence of neurophycological abnormalities in patients who were operated for ruptured cerebral aneurysms and at discharge had no significant neurological deficits.

(2) To know the pattern and quality of life in these patients.

In this report the result of the cognitive tests administered to these patients is analysed. The quality of life, social outcome and return to work will form the basis of a subsequent report.

Material and Methods

A. A prospective study was conducted between the following two groups:

(i) Patient study group (Prospective): This comprised of 13 patients who were operated for aneurysmal subarchnoid heamorrhage, had uneventful post-operative periods and were cooperative for neuropsychological tests emphasizing on intelligence, memory, reasoning, language and perceptual difficulties. They were examined at discharge, after 6 months and after one year.

(ii) Patient control group: Eleven patients of prolapsed intervertebral disc disease, operated during the same period were taken as the control group and were evaluated with the same battery of tests, once at discharge and after 6 months. Most of these patients were educated, the reason being that they were easily accessible for the followup studies.

B. Also a retrospective study was conducted among those patients who were operated earlier for aneurysmmal subarachnoid haemorrhage and were leading a normal life. 13 patients were thus evaluated once for the cognitive deficits by neuropsychological tests. The average interval was of 2 years following the surgery. These patients were grouped as retrospective patient study group.

C. Fifteen subjects were examined by the same neuropsychological tests to form a normal control group.

The following tests were used:

1. Visual scanning test.
2. Kinetic melody test: to measure the psychomotor ability
   (a) Fist and ring test
   (b) Fist and outstretched finger test
   (c) Tapping test
3. Koh's block design test
4. Alexander's passalong test

Both the above tests (3 and 4) were used to calculate performance quotient.

5. Visual learning and memory function tests [11].
6. Verbal learning and memory function tests function tests [11], [12].
7. Delayed response ability test [11], [12].
8. Digit symbol substitution test.

It is of considerable significance that many of these tests were devised and standardised by one of the co-authors specifically for the Indian Population [11], [12].

Results

a) The demographic analysis is given in Table I and the breakup as per the aneurysmal location in Table II.

Table I - Demographic analysis

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Table II - Breakup as per aneurysmal groups

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b) The arithmetic mean and the standard deviation was calculated for each of the above groups separately for each of the scoring tests viz. performance quotient, verbal learning and memory function test, visual learning and memory function test delayed response ability test and digit symbol and substitution test. The data is presented in Tables III and IV. The results of the non scoring tests viz. visual scanning and kinetic melody tests is presented as a percentage of impairment in Table V.

Table III - Mean and standard deviation of the tests for the patient study group (prospective), patient control group and normal control group

Table III - Mean and standard deviation of the tests for the patient study group (prospective), patient control group and normal control group

((Mean of) x =Mean, SD=Standard Deviation)

Table IV - Mean and standard deviation of the tests for the patient study group (retrospective), patient control group and normal control group

Table IV - Mean and standard deviation of the tests for the patient study group (retrospective), patient control group and normal control group

(x (Mean of)=Mean, SD=Standard Deviation)

Table V - Number of patients having impairment of kinetic melody and visual scanning in the patient group (prospective), patient control group and patient group (retrospective)

Table V - Number of patients having impairment of kinetic melody and visual scanning in the patient group (prospective), patient control group and patient group (retrospective)

Table Va - Number of patients having impairment of kinetic melody and visual scanning in the patient group (prospective), patient control group and patient group (retrospective)

Table Va - Number of patients having impairment of kinetic melody and visual scanning in the patient group (prospective), patient control group and patient group (retrospective)

c) The 't' values for the significance of the difference between the means was calculated for the following groups:

(i) Patient study group (prospective) and normal control group (Table VI).

Table VIa - 't' values of significance of the difference between means, of the patient group and the control group and the normal control group in the different followup stages

Table VIa - 't' values of significance of the difference between means, of the patient group and the control group and the normal control group in the different followup stages

Table VIb - 't' values of significance of the difference between means, of the patient group and the control group and the normal control group in the different followup stages

Table VIb - 't' values of significance of the difference between means, of the patient group and the control group and the normal control group in the different followup stages

(ii) Patient study group (prospective) and patient control group (Table VII).

Table VIIa - 't' values of significance of the difference between means, of the patient study group (Prospective) and the patient control group in the different followup stages

Table VIIa - 't' values of significance of the difference between means, of the patient study group (Prospective) and the patient control group in the different followup stages

Table VIIb - 't' values of significance of the difference between means, of the patient study group (Prospective) and the patient control group in the different followup stages

Table VIIb - 't' values of significance of the difference between means, of the patient study group (Prospective) and the patient control group in the different followup stages

(iii) Patient control group and normal control group (Table VIII).

Table VIIIa - 't' values of significance of the difference between means, of the patient control group and the normal control at various stages of followup

Table VIIIa - 't' values of significance of the difference between means, of the patient control group and the normal control at various stages of followup

Table VIIIb - 't' values of significance of the difference between means, of the patient control group and the normal control at various stages of followup

Table VIIIb - 't' values of significance of the difference between means, of the patient control group and the normal control at various stages of followup

*: $p < 0.01$, **: $p < 0.05$, + :p=Not significant

(iv) Patient study group (retrospective) and normal control group (Table IX).

Table IXa - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table IXa - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table IXb - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table IXb - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

(v) Patient study group (retrospective) and normal control group (Table X).

Table Xa - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table Xa - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table Xb - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

Table Xb - 't' values of significance of the difference between means, of the patient group (retrospective) and the normal control group

d) The significance of the mean gain from the first to the final assessment for the patient study group (p [13] (Table XI).

Table XI - 't' test for within the group (n=13, 11, 7) for the prospective study group of patients

Table XI - 't' test for within the group (n=13, 11, 7) for the prospective study group of patients

(N.S=not significant)

Many of the subjects could not be evaluated for some of the tests due to various reasons (illiteracy, ptosis). Hence these subjects were deleted for these tests, while calculating for mean and standard deviation.

Observations

(a)Comparison between the Patient study Group (Prospective and Normal Control Group (Tables VI and V)

Significant impairment was detected in all the group in all the tests when the patients were examined at discharge. However, when assessed at the 1st followup, they showed a significant improvement in the verbal learning and memory tests. At the 2nd followup the difference was insignificant compared to the 1st followup in the digit symbol substitution tests and verbal learning and memory test. There was

significant reduction in the difference in the rest of these tests. Keeping with these findings, 54% had impairment in the kinetic melody and visual scanning tests at discharge which also improved at subsequent followup assessments.

(b)Comparison between the mean values of the first assessment and third assessments within the prospective study group of patients (Tables XI and V)

There was a significant improvement in the performance from the 1st to 3rd assessment in this group of patients in all the tests except in the 1st trial for visual learning (p: not significant) and digit symbol substitution test (p:<0.05). The patients also showed significant improvement in kinetic melody test and visual scanning tests.

(c)Comparison between the patient study group (prospective and patient control group) Tables VII and V)

Significant difference was detected in delayed response ability, digit symbol substitution, verbal learning and memory tests, kinetic melody and visual scanning tests. However, there was no significant difference in performance quotient and visual learning and memory tests. This difference was observed in both the first and second assessment and there was no significant improvement in the second as compared to the first assessment.

(d)Patient control group as compared to the normal control group: (Table VIII)

No significant difference was observed in all the tests except the visual learning and memory tests in which, the patient control group had impairment in all the subtests.

(e)Patient study group (retrospective) as compared to the normal control group (Table IX)

On comparison, the former group had imppairment in all the tests administered.

(f)Patient study grou (retrospective) as compared to patient control group (Tables X and V)

Impairment was noticed in the patient study group in the delayed response ability, verbal learning and memory tests (p<0.01), the kinetic melody and visual scanning tests. Both groups were comparable on performance quotient, digit symbol substitution tests and visual learning and memory ability.

Discussion

A considerable percentage of patients who survive as aneurysmal SAH without any major neurological deficits however, suffer from less obvious cognitive deficits [1], [2], [3], [4], [5], [6], [7], [8], [9], [10]. Since the last two decades, there is a considerable improvement in the operative results. Hence, there has been a growing awareness of the necessity to include the cognitive outcome and quality of life in determining the final outcome of such patients. However, only a scanty literature is available on the subject, mostly by the Swedish and the British groups [1], [2], [3], [4], [5], [6], [7], [8], [9], [10].

Norlen in 1953 was the first to report cognitive dysfunction in the form of an amnestic syndrome associated with anterior communicating artery aneurysms [14]. Later in 1966, he had Lindquist detected that 17 of their 33 patients were amnestic after operation, out of which 5 had a clinically

severe case [15]. Subsequently cognitive dysfunction was reported by Luria [16], Okawa et al [17] and Teisser du Cross and Lhermittle et al [9].

Senugupta et al [2] analysed the quality of survival in 26 patients whose anterior communicating artery aneurysms were clipped. He did not detect any memory impairment or intellectual deficits but noted personality changes, loss of interest, initiative and energy in them. He detected significant correlation between the clinical grading before operation and loss of interest in them post-operatively.

Ropper and Zervas [3] studying 100 patients with delayed surgery detected emotional and psychological disturbance interfering with daily living in 25% of them. Only 46% had fully recovered.

Bornstein and Weir et al [4] testing 48 patients having aneurysmal SAH, concluded that 26 out of the 37 patients who had good neurological outcome had only mild cognitive deficits. 11 patients had good neurological but poor neuropsychological outcome.

Vilkki et al [5] reported the results of 98 out of 118 patients, who were operated for ruptured aneurysms and could be adequately examined neuropsycholgically after 1 year. They had 17 orthopaedic control patients. Correlating the CT scan findings and cognitive deficits they detected that the patients cognitive deficit had strong relationship to the findings on computed scans.

Mckenna et al [1] studied 100 patients with subarachnoid haemorrhage prospectively and assessed them at discharge, at 3 months and at 1 year. They compared the results with a control group of 50 patients of myocardial infarction, assessed at discharge and at one year. They could not find any remarkable difference in the results and cognitive testing between the test group and the control group. They described the significant difference in the results of their study as compared to the other due to use of an appropriate control which matched the test group adequately.

It has been reported that the patients with anterior communicating artery aneurysmal ruptures have the highest percentage of cognitive deficits. Gade [6] reported 15 out of 48 A. Com. A aneurysmal patients to be having amnesia post-operatively. Affection of the medial septal nuclei, paraventricular nucleus of the anterior hypothalamus and medical forebrain bundle are considered to be the cause. Vilkki et al [5] detected that the patients of medial-frontal infarcts had low scores of memory tests.

This study included only the patients with relatively preserved neurological status following surgery hence those who were in poor neurological grade or were not co-operative for the study due to their illness were excluded. The study had two control groups: the patient control group and the normal control group. The patient control group comprising of eleven patients operated for acute lumbar prolapsed disc was chosen as it was considered that both the groups had sudden onset of illness with intense pain and had to undergo surgery for their illness. In both the groups the convalescent period was also prolonged. On the other hand, they were dissimilar on the following aspects:

(a) the study group had life threatening illness
(b) they had surgery of the brain which was more prolonged than disc operations and
(c) the surgery was considered to be of greater risk.

Also, the control group had chances of recurrence of their disease at the same level or at a different level, which was not there in the study group. Review of the literature on this subject reveals that out of many, only two studies had a control group; one study had taken patients of acute myocardial infarction from an adjacent hospital as controls [1], whereas the other compared their results with patients of disc prolapse [5]. This study used a normal control group matching the study group in age, sex and literacy. This helps to arrive at illness specific deficits, if any, in the patients who were subjected to brain surgery.

In this study, the performance status of the patients of the prospective group when analysed at discharge was found to be uniformly impaired, reflecting a diffuse brain involvement. This may be due to the fact that the patients were investigated within two weeks of surgery and thus had not recovered fully from the physical and psychosocial trauma after surgery.

Subsequent assessments and comparisons reveal the emerging trend of improvement and change in these patients. In cognitive field, with respect to verbal learning and memory functions and digit symbol substitution tests, the patients performance resumed to normal or near normal after the one year period. The same degree of improvement was however not observed in the other tests such as performance quotient, delayed, response ability or visual memory and learning ability. Considering the performance quotient, the prospective group had a mean value of 85.05 at the second follow up which can be considered as a low average (within normal range) level of performance when compared with the population normative data. However, in comparison with the normal control group, the difference is significant ($p<0.05$). A similar low performance quotient was also seen in the patient control group. One test in which both the patient study groups (prospective and retrospective) and the patient control group fared badly is the visual learning and memory function tests. The mean values show that the patient study group (prospective) had performed better than the patient control group, at the first followup (six months of surgery). The reason for the patient control group to perform poorly on this test is not fully clear. An evaluation of the verbal equivalent of this test, revealed that the performance of the patient control group was as good as the normal control group or even better, when assessed at discharge and at six months of assessment. Hence, the deficit shown by the patient control group cannot be attributed to general or motivational factors. It has been established in studies relating to recovery pattern of brain dysfunction in closed head injury patients that right hemispheric functions, recover slowly or poorly where as patients show marked and rapid improvement in verbal (left hemispheric) functions [11]. Visual learning and memory function test is suggested to elicit a right hemispheric dysfunction, in brain lesion patients.

Comparing the assessment results within the prospective study group of patients it is clearly evident that there is a significant profile of recovery of the cognitive dysfunctions over a period of time. A significant difference emerged in all the cognitive functions between the one year assessment and the assessment at discharge, reflecting definite improvement. This compares well with the results of McKenna et al [1].

Comparison between the prospective study group and the retrospective study group revealed that there was significant and persistent deficits in the latter group, though they were assessed on an average 2 years after the surgery. This finding is of considerable significance. First, it indicates that the cognitive deficits due to subarachnoid haemorrhage might be persistent and long lasting. Secondly, if the rapid recovery pattern of the prospective study group is considered, it might indicate that with improved technology and richer experience in aneurysmal surgery, along with better availability of new drugs, better neuropsychological outcome can be expected in the future.

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