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Spontaneous Subarachnoid Haemorrhage and Outcome – Results from Tan Tock Seng Hospital, Singapore

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ABSTRACT

Aim of Study: To ascertain the number of cases of spontaneous (aneurysmal) subarachnoid haemorrhage presenting to Tan Tock Seng Hospital, Singapore, over a one year period, the demographics of the patients involved, their treatment and their eventual outcome.

Method: A retrospective study from June 1995 to June 1996.

Results: There were 62 patients admitted over this period with an average of 5 patients per month. Their ages ranged from 9 to 85 years with a mean of 54 years. All 62 patients underwent 4-vessel cerebral angiograms. Forty-three patients (69%) underwent clipping of their aneurysms. Twelve patients (19%) had negative angiograms. Four patients (6%) underwent coiling of their aneurysms via interventional neuroradiology techniques. Patients with subarachnoid haemorrhage of Grades I to 3 on the WFNS (World Federation of Neurological Surgeons) grading had a favourable outcome (Glasgow Outcome Score of 4 and 5) in 85% of the cases. The overall mortality rate for the operated group (all grades) was 11%. However for the group with good WFNS grading, namely the Grade I to 2 groups, there were no deaths. Twenty-four percent of patients developed clinically symptomatic vasospasm. Eighteen percent of patients required ventriculo-peritoneal shunting for hydrocephalus secondary to the subarachnoid haemorrhage. The overall management mortality (operated and non-operated cases) was 14% for proven aneurysmal and angiographically-negative spontaneous subarachnoid haemorrhage. These results are comparable to that of other reputable centers reported in the literature.

Keywords: cerebral aneurysm, cerebral angiogram, cerebral haemorrhage, stroke, vasospasm

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INTRODUCTION

Subarachnoid haemorrhage is caused by bleeding from cerebral blood vessels in the subarachnoid space most commonly due to either trauma or spontaneous rupture of an arterial aneurysm. This particular study concentrates on spontaneous aneurysmal subarachnoid haemorrhage. A subgroup of angiogram negative spontaneous subarachnoid haemorrhage (ie. no aneurysm found on 4-vessel cerebral angiogram) will also be analysed.

Subarachnoid haemorrhage is the third most common cause of stroke after thrombotic and haemorrhagic stroke, with approximately 11 out of 100,000 suffering from this illness[1]. The peak age for the onset of this illness is at the fifth decade of life, and the female to male ratio is 1.6:1 in the Co-operative Study[2]. Headache is the most common presentation, with up to 97% of patients presenting with this at the time of rupture. Antecedent headache before the rupture of the aneurysm was found in 48% of patients[2].

Aneurysmal subarachnoid haemorrhage without treatment has a high mortality rate with 27% of these cases dying in the first week[2]. Rebleeding occurs in 50% of the aneurysms within the first six months, and subsequently at a rate of 3% per year. About 50% of patients die after a rebleed and 20% become disabled after that[2].

Hence the main aim of treatment for an aneurysmal subarachnoid haemorrhage is to prevent rebleeding. Since the advent of cerebral angiography by Moniz in 1933[4], the results of definitive treatment by open surgical clipping of aneurysms (first performed by Dandy in 1937[5]) has improved a great deal. This has been due to advances in neuroradiology, neuroanaesthesia, neurointensive care, microneurosurgical technique and use of instrumentation like the operating microscope.

Management studies of all subarachnoid haemorrhage victims in a defined region are rare[6]. The aim of this study was to determine the characteristics, management and overall outcome (ie. operative and non-operative cases) of our own local patients with aneurysmal subarachnoid haemorrhage (as well as angiogram-negative subarachnoid haemorrhage) presenting to the Department of Neurosurgery, Tan Tock Seng Hospital, Singapore over one year. Recently, increasing number of investigations have focused on the overall management results (and not just

operative results), and this study reflects this current trend of reporting in the management of these patients here.

MATERIAL AND METHODS

This is a retrospective descriptive study of all the patients with spontaneous subarachnoid haemorrhage who were admitted to the neurosurgical unit in Tan Tock Seng Hospital, Singapore, over one year from June 1995 to June 1996.

A review of all computed tomography (CT) brain scan reports, cerebral angiogram reports and the neurosurgical operative record book over this one year period was done. Subsequently all case notes of patients with spontaneous subarachnoid haemorrhage were traced to collect the data retrospectively.

Data collected included patient characteristics, presence of hypertension, mode of presentation, clinical grade of patient at presentation, type of aneurysm, mode of treatment and outcome of these patients.

Table I – World Federation of Neurologic Surgeons (WFNS) Grading of subarachnoid haemorrhage

WFNS grade	GCS	Major focal deficit*
0#	–	–
1	15	absent
2	13 – 14	absent
3	13 – 14	present
4	7 – 12	present/absent
5	3 – 6	present/absent

GCS = Glasgow Coma Scale
* = aphasia and/or hemiparesis or hemiplegia
\# = intact unruptured aneurysm

Table II – Glasgow Outcome Scale (GOS)

Scale	Outcome
5	Good recovery
4	Moderate disability (disabled but independent)
3	Severe disability (conscious but disabled)
2	Persistent vegetative state
1	Death

Table III – Types of presentation

Presentation	Number of patients (%)
Headache	36 (58%)
Loss of consciousness	14 (23%)
Drowsiness/dizziness	7 (11%)
Epilepsy	1 (2%)
Others	4 (6%)
Total	62 (100%)

The clinical grading of the patients at presentation was based on the WFNS (World Federation of Neurological Surgeon) Scale (Table I)[6].

The outcome at a mean follow-up period of 9 months was graded according to the Glasgow Outcome Scale (Table II)[7].

RESULTS

Sixty-two patients presented with subarachnoid haemorrhage over this one year period. The ages of the patients ranged from 9 to 85 years with a mean of 54 years. There was an equal number of male and female patients.

There was a total of 30 patients with hypertension (based on the history provided) which accounted for 45% of the total number of cases. Twenty patients were noted to be compliant with their anti-hypertensive medication, which was 80% of those who were hypertensive. There were no cases with any family history of cerebral aneurysms and none with a history of connective tissue disease.

The type of presentation of these patients is as tabulated in Table III. The number of patients according to each grade is as tabulated in Table IV. The most common presentation was headache which occurred in 58%, while the most frequent presenting grade was Grade 1 which accounted for 40% of all patients.

The number of each grade of patients undergoing operation and their outcome at a mean follow-up of 9 months is tabulated in Table V. There was no mortality in Grades 1 and 2.

Forty-three patients underwent conventional microneurosurgical operations for clipping of their aneurysms. Nineteen patients did not undergo surgical clipping of their aneurysms (1 failed repeated endovascular coiling, 2 refused operation, 4 underwent coiling via interventional neuroradiology technique, 7 had no aneursyms seen despite repeat 4-vessel cerebral angiograms, and the last 5 had only a single 4-vessel cerebral angiogram done showing no aneurysms, but for a variety of reasons, these 5 did not undergo a repeat angiogram).

The type of aneurysms found on cerebral angiograms are tabulated in Table VI. Like that reported in the literature, the most common were anterior and posterior communicating artery aneurysms, with 18 and 17 cases respectively. Both of these comprised 70% of the total number of confirmed aneurysms. There were 11 middle cerebral artery aneursyms. In the posterior circulation, there were 3 basilar artery and 1 vertebral artery aneurysms. There were 2 patients with multiple aneurysms.

One of the well-known delayed complications subarachnoid haemorrhage is vasospasm, which occurs usually between the fourth and eleventh post-bleed day. This vasospasm can lead to delayed cerebral ischaemia and infarction and hence increases morbidity and mortality despite

Table IV – Number of patients according to WFNS grades

Grade	Operated	Conservative	Coiled	Total (%)
1	18	4	2	24 (39%)
2	7	1	0	8 (13%)
3	4	0	-	4 (6%)
4	8	6	-	14 (23%)
5	6	4	2	12 (19%)
Total	43	15	4	62 (100%)

Table V – Number of each type of aneurysm

Aneurysm location	Number
Anterior communicating artery	18
Posterior communicating artery	17
Middle cerebral artery	9
Basilar artery	3
Vertebral artery	1
Multiple aneurysms	2
Negative angiogram	12
Total	62

Table VI – Grades of subarachnoid haemorrhage versus Glasgow Outcome Scale (GOS) in operated cases

GOS	5 (Good) recovery)	4	3	2	1 (Death)
G1	15	0	3	0	0
G2	3	4	0	0	0
G3	2	0	1	0	1
G4	2	4	1	0	1
G5	0	0	2	1	3
Total	22	8	7	1	5

Table VII – Outcome of angiogram negative cases, Glasgow Outcome Score (GOS) versus WFNS grades

GOS	G1	G2	G3	G4	G5
5 (Good recovery)	1 (1)			1	1 (1)
4				2 (1)	
3	1			2	1 (1)
2					1
1 (Death)	2 (1)				
Total	4			5	3

( ) Indicates the number of patient in that cell that did not have a repeat angiogram

technically successful surgery. There were 15 such cases in this series with clinically recorded delayed neurological deterioration. This was 24% of the total number of cases studied. The other known complication was hydrocephalus and there were 11 cases that needed temporary ventricular drainage (18%) and another 11 (18%) cases that needed permanent ventriculo-peritoneal shunts.

The outcome of operated patients was assessed using the Glasgow Outcome Scale (as outlined in Table II). This was correlated to the grade of the aneurysmal subarachnoid haemorrhage at admission as shown in Table VII. As seen from Table V, 24 out of the 29 patients (85%) with good grades (Grades 1 to 3) had a good outcome (ie. GOS 5 or 4) while only 6 out of the 14 (43%) of Grades 4 and 5 patients had a good outcome. Total operative mortality was 5 out of 43 (11%) and overall management mortality (operated and non-operated cases) was 14%.

Most of the patients with no aneurysm found on the angiogram did not do well. Two of the 5 Grade 1 subarachnoid haemorrhage patients died of rebleeding. These 2 patients had repeat 4-vessel cerebral angiograms which were negative and did not reveal the presence of aneurysm despite the pain-staking and meticulous performance of multiple views on repeat angiogram.

Of the 4 cases who underwent endovascular coiling of their aneurysm, 2 were cases of basilar artery aneurysms. One presented with a Grade 1 and another with a Grade 5 subarachnoid haemorrhage. Both were bedridden and non-ambulant when discharged. The other 2 cases were both cases of posterior communicating artery aneurysms, one a Grade 1 and the another a Grade 5. The former case (who refused surgery) unfortunately experienced a rupture during coiling and died, while the latter case made a spectacular and full recovery despite her poor grade at presentation.

DISCUSSION

The number of patients with spontaneous subarachnoid haemorrhage admitted to our unit averaged about 5 cases per month or approximately 1 case per week. The mean age of the patient at presentation was 55 years and this was found to be similar to other studies[2].

In the Co-operative Study[2], headaches and dizziness were the most common antecedent symptoms. At the initial presentation, our results showed that 58% of patients had headaches, 23% presented with loss of consciousness; and 11% had dizziness/drowsiness.

Computed tomography (CT) scan of the head was used as the definitive diagnostic investigation of choice in all our cases except for one case. Ninety-five percent of patients will have a positive CT scan if the scan was done within 24 hours of a subarachnoid haemorrhage. However, 5% of the patients will have a normal CT scan even if it is

done within the first 24 hours. Lumbar puncture will show xanthochromia in all cases between 12 hours and 2 weeks after subarachnoid haemorrhage[8]. Lumbar puncture can hence also be used to diagnose subarachnoid haemorrhage if the history is suggestive and the head computed tomography scan rules out a mass lesion.

Interestingly, an almost equal proportion of our patients were found to either have, or not have, hypertension. Of those who were hypertensive, most were found to be compliant with their medication. Previous studies have shown that there was no association between hypertension and subarachnoid haemorrhage[9]. Others have shown that hypertension increased the risk by 3.4 times[10,11]. It is thought that the most likely cause of aneurysm may be due to anatomical variants of the intracranial arteries, like a side being more dominant, causing change to the haemodynamics of blood flow[12].

Overall care of the patient with subarachnoid haemorrhage is of paramount importance. Specialised neuro-intensive care is needed for the comatose patient. Endotracheal intubation is done to protect the airway. Adequate hydration for haemodilution (to decrease the viscosity of blood), and volume expansion (to increase cerebral perfusion) should be started. In cases where the aneurysm has been clipped, ionotropes can be used to increase the cerebral perfusion. Gianotta and Kassell have shown reversal of neurologic deficits caused by vasospasm in each of their studies[13,14]. Triple H therapy (hypertension, hypervolaemia, and haemodilution) was routinely employed in a specialised neurointensive care setting in all our patients suffering from vasospasm. Selective intra-arterial papaverine was also employed if the neurological deficit failed to reverse with triple H therapy, and this was done by our interventional neuroradiologist. Nimodipine, a cerebro-selective calcium antagonist, is routinely started in all our cases of spontaneous subarachnoid haemorrhage on admission, and is continued for a total of 21 days (unless death supervenes before that) as its use has been shown in several large studies to improve outcome by decreasing the incidence of delayed ischaemic deficit caused by vasospasm[15,16]. We had 15 cases (24%) manifesting with delayed ischaemic deficit. Angiographic vasospasm has been reported in the literature to occur in up to 60% of patients; however ischaemic neurologic deficits occurred in only 30% of the cases[17]. This is in agreement with our figure of 24%.

Eleven patients needed permanent ventriculo-peritoneal shunts and this accounted for 18% of the cases. This is also comparable to the report by Heros which showed that 20% of patients needed shunting after spontaneous subarachnoid haemorrhage[18].

Outcome of aneurysmal surgery varies from institution to institution, depending for example, on the skills of the surgeons operating and the availability of good neurointensive care facilities and expertise. It also depends very much on the selection of patients for surgery and the timing of the operation. Those surgeons who operate only on good grade patients would of course have better surgical results compared to those who operate on patients with both poor grades as well as good grades. Moreover, those who operate later (ie. not within the first 48 hours) will also show improved operative outcome (but not overall improved outcome) as the more sick cases would have succumbed earlier to rebleeding or vasospasm, and hence the operative figures in isolation would look more impressive compared to those who operate early, where operative conditions are much less optimal compared to delayed surgery.

Eighty-five percent of the patients with good grades (Grades 1 to 3) had a good outcome in this present study, while only 43% of Grades 4 and 5 patients had a good outcome. Saveland et al, in their Swedish prospective study on the overall outcome in aneurysmal haemorrhage, showed that Hunt and Hess Grades 1 to 3 subarachnoid haemorrhages (approximately equivalent to WFNS Grades 1 to 3) which were treated within 72 hours, made a good recovery in 81 of cases[1]. This is almost equivalent to our figures.

Our mortality was 11% in the operated group as a whole, due primarily to death in 4 poor grade (WFNS Grades 4 or 5) patients. One Grade 3 patient succumbed due to technical reasons (it was a difficult giant aneurysm). The total management mortality of the 62 patients was 14%.

These are comparable to other reputable centers which operate early on their patients and which had results similar to ours, with good outcome in Grades 1 to 3 of 62% to 93%, operative mortality of 7% to 12.9% and management mortality of 23 to 30%[19-21]. We did not encounter any mortality in our Grades 1 and 2 subarachnoid haemorrhage patients. Operative mortality also varies according to the timing of the surgery. Yasargil reported that for the group which was operated on less than 7 days after rupture, the mortality was 15%, while for those who were operated on more than 14 days after rupture, it was 2%, with an overall mortality of 4%[2]. All our patients were operated on early ie. between 24 and 48 hours of aneurysm rupture except for one case of a giant vertebral artery aneurysm.

The conservatively treated group comprised of those who were angiogram negative, those who did not undergo clipping, or those who failed radiological intervention. There were 13 cases of angiogram negative cases initially, accounting for 19% of the total. This is consistent with the results of others who reported between 13% and 22% of angiogram negative cases in their series[22]. Repeat angiograms were performed in 7 cases with a positive case being found at 2 weeks after the first angiogram ie. 13%. This rate is lower than those reported (33% at a mean of 16 days after the first angiogram)[22]. We believe that some of these patients did actually harbour an aneurysm despite

repeat 4-vessel cerebral angiograms showing no aneurysm, eg. two Grade 1 patients died of rebleeding, despite undergoing repeat 4-vessel cerebral angiograms, which did not show any aneurysm. Another reason for our suspicion was that only one of our angiogram-negative patients showed a perimesencephalic distribution of subarachnoid haemorrhage, a distinct entity which is known for its good prognosis due to a presumed venous origin of the subarachnoid haemorrhage[23]. The other 5 cases did not undergo repeat angiogram. This was due to poor clinical status in 3 patients while two Grade 1 patients did not have repeat angiograms due to rebleeding occurring before the appointment date of the repeat angiogram, and the last case might have been due to a fall (ie. traumatic instead of spontaneous subarachnoid haemorrhage) and recovered very well. This accounted for 12 of 15 cases of the conservatively managed group. The other remaining 3 cases consisted of a re-rupture occurring in a patient within 24 hours of the first bleed and before an operation could be done, while another one refused operation and the third was a basilar artery aneurysm in an elderly woman who failed endovascular coiling despite multiple attempts by the interventional neuroradiologist.

Endovascular treatment of aneurysms is used mainly for high risk or inoperable aneurysms[24]. This procedure can be performed here in the Radiology Department at Tan Tock Seng Hospital by our interventional neuroradiologist and involves the insertion of platinum coil(s) inside the aneurysm sac to cause thrombosis. This treatment has also been used recently for good grade subarachnoid haemorrhage patients, with good outcome of 85% at 1-year follow-up, a morbidity of 4.2% and a mortality of 11%[24]. Although this procedure is considered less invasive, it does have some complications, eg. aneurysm rupturing during the procedure of coil insertion, embolisation causing occlusion of a cerebral blood vessel distally, aneurysm itself enlarging and re-rupturing later[25]. Only 4 patients (68%) in this series underwent endovascular treatment via coiling. (However, we only had the services of this new technology available since February 1996, a point in time about half way through the present reported series).

CONCLUSION

The neurosurgical unit in Tan Tock Seng Hospital attends to about one case of subarachnoid haemorrhage per week on the average. The majority of our patients presented with headaches. This is a very serious disease which needs to be diagnosed and treated early for improved outcome.

Aggressive treatment with early surgery and meticulous neurointensive care pre- and post-operatively is still the main way to improve outcome in the majority of these patients. Endovascular treatment via coiling may play a bigger role in the future.

In our hands, a good outcome (Glasgow Outcome Score of 4 and 5) was obtained in 85% of Grades 1 to 3 subarachnoid haemorrhage patients. Mortality for all the operated cases (all grades) was 11%. Overall management mortality (operated and non-operated cases) was 14%. Results of early surgery (ie. within 48 hours of aneurysm rupture) in our service compares very favourably with the results of others from reputable centers who advocate early surgery[19-21].

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