MANAGEMENT OF SPONTANEOUS ANEURYSMAL INTRACRANIAL HAEMORHAGE AT CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

By

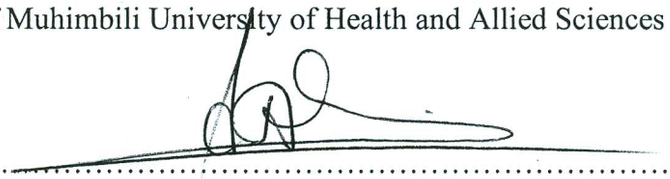
KILOLOMA,Wanin Othman.
(MD, MMed. Surg)

A dissertation Submitted for in partial fulfillment of the requirement for the Degree of Masters of Science (Neurosurgery) of the Muhimbili University of Health and Allied Sciences.

Muhimbili University of Health and Allied Sciences. (MUHAS)
OCTOBER, 2010.

CERTIFICATION

The Undersigned certifies that he has read and hereby recommends for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled: "**Management of spontaneous aneurysmal intracranial haemorrhage at Charlotte Maxeke Johannesburg Academic Hospital**" submitted in partial fulfillment of the requirements for the degree of Master of Science in Neurosurgery of Muhimbili University of Health and Allied Sciences (MUHAS).



.....

Dr Abednego D. A. Kinasha, MBChB, MMed (Surg), MSc (Neurosurg), FCS (ecsa), FRCSI
Senior Lecturer
Muhimbili University of Health and Allied Sciences. (MUHAS).

SUPERVISOR.

Date 22.10.2010

DECLARATION AND COPYRIGHT

I, **Dr Wanin Othman Kiloloma,** declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature.....Date 22.10.2010

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ACKNOWLEDGEMENTS.

Saying it was a long academic walk is a statement of the obvious but perhaps if it was not so long I would have convinced myself (erroneously though) that I could make it on my own. The culmination of decades spent struggling to learn an unforgiving craft—illuminates both the mysteries of the mind and the realities of the neurosurgery; where the social dimension turns out to be as essential as the scientific. The presence and valuable assistance of several people made the metamorphosis from naive intern towards neurosurgery less painful.

This dissertation stands as a tribute to the remarkable vision, diligence and intelligence of Prof. L.M.museru, Executive Director, M.O.I, it is the concrete legacy of his character and persona. It serves as an example for all of us who would call ourselves doctors and represents the epitome of the term "contribution to the field"- a notion and a goal that is the elusive "Holy grail" for many of us, for his fatherly concern, trouble and struggle he went through for my permission, welfare and constant visit to South Africa amidst chaos of xenophobic violence. Thank you for picking me up when I was down and for not giving up on me when I literally crawled at almost zero pace.

I am grateful to my Supervisor Dr. Abednego D. Kinasha, the Medical Director of Muhimbili Orthopaedic Institute, for his patience in guiding me through my practical neurosurgical training at MOI and solving most of the administration issues, for the trouble he went through from preliminary and final work up of this dissertation. He has been a tireless advocate to residents and reminds us daily for his actions and words, to be advocated for the patients and families in our care.

I wish also to acknowledge the fruitful constant assistance of Prof J.F.Kahamba, Head Neurosurgical unit MOI, for his encouragement advice and dedicated neurosurgical teaching.

My study in South Africa and Tanzania was made possible by a financial aid from Ministry of health and social welfare – United republic of Tanzania, on which I express my sincere gratitude.

I am humbled and grateful to Prof. Rasik Gopal, Head, Department of Neurosurgery, Johannesburg and Chriss Hani Baragwanath Hospital (University of Witwatersrand, South Africa), for allowing me to study in his department, for his fatherly, neurosurgical and life in Johannesburg guidance, for his generosity and support to facilitate my attendance in neurosurgical registrar course in Capetown. His dedication to consistency and thoroughness in neurosurgical care deserves my admiration.

Dr John Ouma, Principle specialist, a true Neurosurgeon, I thank him for his dedicated teaching, supervision of this dissertation and trouble he went through for review, correction and attendance to various ethical clearance meeting at Wits and Johannesburg Hospital. I was

privileged to work with him, learn and share the mysteries of the mind in neurosurgical operating room. I had to leave Johannesburg prematurely and I really miss the vast plethora of your knowledge and wisdom.

To Staff of CMJHB hospital, Consultants Dr Mayoyo, Dr Dinesh Naidoo, Dr Kennedy, Dr Ofori Kwame, Dr Bopalamo, my fellow (executive) registrars and our secretary Junia Mthombeni thank you very much for keep on smiling amidst tremendous workload.

Dr Thobejane Eddy, thank you for your travel assistance to Baragwanath hospital and generous support for paying my entrance to Soweto Derby and all social events we had, it's a memorable event, you know I will always miss you. I wish also to acknowledge extra ordinary support I received from the staff of neurosurgical ICU (ward 565) Sr Magada, Sr Pinkie, and all others. *Kilo* (as you used to call me) will always appreciate your assistance.

I wish to convey special thanks to trauma casualty (Area 163), neurosurgical and emergency theater staff for their support.

Also the entire staff of MOI, Dr Mcharo, Dr Mboya,Dr sharif, Dr Nungu and other colleague thank you for being there, when I needed you most. Mrs. Alison Mclean, the principle administrator at WITS medical school, deserves my admiration for a quick response in coordinating administrative issue, Mrs R. Mpembeni for statistical assistance and constant advice.

Finally, I thank God (perhaps this is where I should have begun) for provision and protection throughout my entire study period.

DEDICATION

- To the memory of my ***parents,*** to the continued gift of my ***teachers***, to the present of my darling wife ***Latifa*** and to the future of my children ***Tariq, Talha and Tamir.***

- ***And to all the innocent bodies, living and dead,*** through whom a knife and bullet has passed; fired from a rifle in the hands of a perpetrators....unexpected thunderstorm...the XENOPHOBIC (rather Negrophobic) attack of May 2008....staying few yards from HILBROW, Johannesburg, an epicentre of crime...unable to offer a helping hand...I was also a VICTIM...murmuring to my ancestors...to My GOD ....and keep recalling an isiZULU word for elbow *indololwane* ...Yes, a slogan for my survival ....

ABSTRACT

Title : Management of spontaneous aneurysmal intracranial haemorrhage at Charlotte Maxeke Johannesburg academic Hospital.

Study design: This is a descriptive retrospective study of the clinical characteristics, Neurological imaging findings, surgical intervention and three months outcome of treatment amongst 102 patients with ruptured aneurysmal intracranial haemorhage. The patients were treated at the department of neurological surgery Charlotte Maxeke Johannesburg academic hospital (incorporating department of Neurosurgery of the university of the Witwatersrand,South Africa). The medical records of all patients admitted from June 2007 to May 2009 with spontaneous aneurysmal intracranial haemorrhage were included in the study. The surgical outcome were evaluated by using the Modified Ranking scale, the relationship of Hunt and Hess score, Fisher grading on outcome were also examined.

Results: Amongst 102 enrolled cases, the age of the patient ranged between 25 and 78 years with a mean of 45 years, the peak aneurysmal frequency was in the age of 41- 50 years (4th decade of life), with the Male: Female ratio of 1:1.2, majority of aneurysms were located on anterior circulation (94.6%) over (5.4%) on posterior circulation. The anterior communicating artery was highly affected with aneurysmal frequency of 43.8%, 36.2% were on middle cerebral artery and 11.4% on posterior communicating artery. The rate of multiple aneurysms amongst recruited patients was 2.9%.

The commonest presenting symptom was headache (97%) followed by nausea and vomiting (63%). Most patients were admitted with Hunt and Hess grade (iii) 71.6%, while 21.6% had grade (ii).

On Neuro imaging modality on CT scan indicated that60.8% were admitted with Fisher grade 3, 35.3% had Fisher grade 4 and none of the patient had Fisher grade 1.

Angiographic findings and adequacy preoperatively revealed that 47.1% had DSA, 30.4%, CTA and 22.5% had MRA.

All patients underwent surgical clipping of aneurysm, and timing of surgery was as follows, 54% were operated on 12 day and above, 38% had surgery within 72 days from onset of symptoms and 8% were operated on 4^{th} to 11^{th} day.

Overall surgical outcome was good, mortality was 2.9%. The Modified Ranking score at three months post operatively was 90.2% had favourable outcome, while 9.8% had unfavourabble outcome. The patients who presented with poor clinical grade (Hunt and Hess, Fishers' grade) were associated with poor Modified Ranking score.

Recomendations

- The standards on management of ruptured aneurymal intracranial haemorrhage e.g. Hunt and Hess score, Fisher grading, Timing of surgery and et cetera should be adhered in order to minimize surgical morbidity and mortality.
- The long term follow up to assess surgical outcome (morbidity and mortality) should be considered.

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LIST OF ABBREVIATIONS (ACRONYMS)

1. **ACA** – Anterior Cerebral Artery
2. **ACT** – Activated Coagulation Time
3. **ADPKD** – Autosomal Dominant Polycystic Kidney Disease
4. **AVM** – Arterial Venous Malformation
5. **B.C** – Before Christ
6. **BPNSAH** – Benign Perimesencephalic Polycystic Kidney Disease
7. **C 2** – Cervical vertebra 2
8. **CTA** – Computerized Tomographic Angiography
9. **CT SCAN** – Computerized Tomographic Scan
10. **CCA** – Common Carotid Artery
11. **CMJHB** – Charlotte Maxeke Johanesburg Academic Hospital
12. **CNS** – Central Nervous System
13. **CSF** – Cerebral Spinal Fluid
14. **DSA** – Digital Subtraction Angiography
15. **EC-IC** – Extracranial – Intracranial
16. **FDA** – Food and Drug Authority
17. **FMD** – Fibro Muscular Dysplasia
18. **GCS** – Glasgow Coma Scale
19. **GDC** - Guglielmi Detachable Coils
20. **H&H** – Hunt and Hess
21. **ICA** –Internal Carotid Artery
22. **ICGA** – Infrared Indocyanide Green Video Angiography
23. **ICH** – Intracerebral Haemorrhage
24. **ICP** – Intracranial Pressure
25. **ISAT** – International Subarachnoid Aneurysm Trial
26. **ISUIA** - International Study of Unruptured Intracranial Aneurysms
27. **Lt** - Left

28. **MCA** – Middle Cerebral Artery
29. **MRA** – Magnetic Resonance Angiography
30. **MRI** – Magnetic Resonance Imaging
31. **MRV** – Magnetic Resonance Venography
32. **PC** – Phase Contrast
33. **Rt** - Right
34. **SAH** – Subarachnoid Haemorrhage
35. **SD** – Standard Deviation
36. **SPSS** - Statistical Package for the Social Sciences
37. **STA** – Superficial Temporal Artery
38. **TCD** – Transcranial Doppler
39. **TOF** – Time of Flight
40. **PICA** – Posterior Inferior Cerebellar Artery
41. **VA** – Vertebral Artery
42. **WFNS** – World Federation of Neurological Surgery

1.0 CHAPTER ONE.

INTRODUCTION, LITERATURE REVIEW, STATEMENT OF THE PROBLEM AND OBJECTIVES.

"For the patient, an operation is a single defining moment. For the neurosurgeon, each moment in the operating room represents the culmination of decades spent struggling to learn an unforgiving craft. When these two join there is drama, often too much of it."

Frank Vertosick
Author of the book **'When the Air Hits Your Brain'**

1.1 Introduction

The word aneurysm comes from the Latin word *aneurysma,* which means dilatation. Aneurysm is an abnormal local dilatation in the wall of a blood vessel, usually an artery, due to a defect, disease, or injury.

Aneurysms can be true or false. A false aneurysm is a cavity lined by blood clot. The 3 major types of true intracranial aneurysms are saccular, fusiform, and dissecting [1]

Patients who present with an intraparenchymal hematoma associated with a ruptured aneurysm usually require urgent clot evacuation and clipping of aneurysm. The impact of the presence of hematoma on outcome has been poorly characterized [2]. Although rupture of cerebral aneurysms usually results in subarachnoid haemorrhage (SAH), and a degree of intraparenchymal bleeding is often seen. A cooperative study reported by Locksley[3] showed that 90% of patients with SAH who died within 72 hours also had intracerebral haematoma. Only 4 to 17% patients with aneurysmal SAH, however, have clinically significant hematomas.[4]

It is well known that the presence of a subarachnoid haemorrhage and intracerebral haematoma(ICH) after aneurysm rupture negatively influences the patient's clinical course and outcome.[5,6,] The overall mortality rate for patients with subarachnoid haemorhage with intracerebral haematoma ranges from 36 to 58%.[7,8,9]

The risk of rupture among intracranial aneurysms that have not bled is unknown and, for many years, was believed to be 1-2% per year. Prior to the advent of endovascular coiling, most aneurysms were surgically treated via craniotomy and clipping to prevent a future disastrous hemorrhage. A study (International Study of Unruptured Intracranial Aneurysms [ISUIA]) published in 1998 (retrospective component) and 2003 (prospective component) that involved 2621 and 1692 subjects, respectively, with intracranial aneurysms without intervention to

determine the true natural history risk, has amplified our current understanding of the natural history risk of aneurysms.[10]

Surprisingly, the study found that, for certain aneurysms, particularly those smaller than 7 mm and those located in the anterior circulation in patients who had not had a hemorrhage from another aneurysm, the risk of subsequent rupture was extremely small (0.05% per year in the retrospective and a 5-year cumulative risk of rupture of 0% in the prospective arm). Aneurysms at other locations (such as the basilar tip and the posterior communicating artery), aneurysms larger than 10 mm, and aneurysms that are found in patients who had bled from a previous aneurysm were found to have higher risks (about 0.5% per year). Despite these results, other recent reports continue to estimate the rupture risk for unruptured aneurysms at 1% per year.[11]

1.2 Literature Review.

Historical background.

Fernel in 1591 described an aneurysm as the 'dilatation of an artery full of spirituous blood'. Considerable attention has been given throughout ancient and modern history to the cause and treatment of aneurysms. One of the earliest texts known, by the Ebers Papyrus [11] contains a description of traumatic peripheral arterial aneurysms. Galen defined an aneurysm as a localized pulsatile swelling that disappeared on pressure and wrote, "If an aneurysm be wounded, the blood is spouted out with so much violence that it can scarcely be arrested" [11].

The first elective operation for treatment of an aneurysm was reported by the most famous surgeon in Greek antiquity, Antyllus, in the second century (AD). His recommendation for aneurysm repair was named as Antyllus method [11]. "An operation for aneurysm whereby he applied two ligatures to the artery, cut between them and evacuating its contents" remained the basis of direct arterial operations for centuries. He was also first to recognize two forms of aneurysms – the developmental caused by dilatation and the traumatic following wounding of an artery.

In the seventh century, details of operative repair of an arterial aneurysm were rewritten by Aetius of Amida in his book De Vosorum Dilatatione ("On the Dilation of the Vessels"). Aetius also recognized the difference between true degenerative aneurysms and traumatic false aneurysms [12].

The common causes of intracranial aneurysm include haemodynamically induced or degenerative vascular injury, atherosclerosis (typically leading to fusiform aneurysms), underlying vasculopathy (e.g., fibromuscular dysplasia), and high-flow states, as in arteriovenous malformation (AVM) and fistula.

Most aneurysms do not cause symptoms until when they rupture, in which case they are associated with significant morbidity and mortality

- Subarachnoid hemorrhage

The most common presentation of intracranial aneurysm is subarachnoid hemorrhage (SAH). In North America, 80-90% of non traumatic SAHs are caused by the rupture of an intracranial aneurysm. Another 5% are associated with bleeding from an AVM or tumor, and the remaining 5-15% are idiopathic. Trauma is the most common cause of SAH, and a good history is often helpful in this regard. Increase in the number of patients taking antiplatelet or anticoagulant agents means that even a minor trauma could result in SAH. [14]

On presentation, patients typically report experiencing the worst headache of their lives. The association of meningeal signs should increase suspicion of subarachnoid haemorrhage (SAH), subhyaloid hemorrhages, often bilateral, located between the retina and vitreous membrane, may be observed in up to 25% of patients.[14]

Other symptoms: symptoms of aneurysm other than those associated with SAH are relatively uncommon. Some intracranial aneurysms produce cranial neuropathies. A common example is the third nerve palsy that is secondary to posterior communicating artery aneurysm. Other, less common symptoms include visual loss caused by an ophthalmic artery aneurysm that compresses the optic nerve, seizures, headaches, and transient ischemic attacks or cerebral infarction secondary to emboli (usually associated with large or giant partially thrombosed MCA aneurysms). The so-called giant aneurysms (diameter >2.5 cm) are more often symptomatic because of their mass effect.[14,15]

Vasospasm is the leading cause of disability and death from aneurysm rupture[18,19,20], of patients with SAH, 10% die before reaching medical attention and another 50% die within one month. Fifty percent of survivors have neurological deficits. Ruptured aneurysms are most likely to rebleed within the first day (2-4%), and this risk remains very high for the first 2 weeks (about 25%) if left untreated. Early referral to a hospital that has clinicians experienced

in treating intracranial aneurysms, early treatment (open surgery and clipping or endovascular coiling), and aggressive treatment of vasospasm are 3 factors that have been correlated with improved outcomes. Outcomes associated with unruptured aneurysms are based primarily on whether they are treated and the results of that treatment.[20]

Natural history

The risks of SAH from an unruptured aneurysm were reported and had been accepted for the past three decades as approximately 2% per year. With the publication of the first part of the ISUIA in 1998, the natural history figures included an exceedingly low rupture rate (0.05–1% per year). With very low rates of hemorrhage, the decision about which patients would benefit became more challenging. New data from the second part (prospective arm) of the ISUIA showed rupture rates in the range of 0.5–3.0% per annum, and stratified the risk according to the lesions' location and size. One clearly appreciates that the natural history of unruptured aneurysms has been a moving target, and that more information is required to understand fully the behavior of these lesions. [10, 96]

Untreated ruptured aneurysms have a very high risk of rebleeding after the initial hemorrhage. The risk is estimated at 20-50% in the first 2 weeks, and such rebleeding carries a mortality rate of nearly 85%. Aneurysms that have not ruptured but have manifested with other symptoms such as a new onset third nerve palsy (considered a true emergency that requires urgent treatment of the aneurysm), brain stem compression due to a giant aneurysm, or visual loss (caused by an ophthalmic artery aneurysm), for example, should be treated because the risk of rupture is believed to be significantly higher (6% per year) than that of incidentally discovered lesions.

Cigarette smoking, female sex, and younger age have recently been shown to correlate with aneurysm growth and rupture [10, 96].

Treatment

Although cases have been reported to resolve spontaneously, direct treatment is usually recommended. Such aneurysms can usually be approached either surgically (clipping) or

endovascularly (coiling), depending on the location. For aneurysms located proximally near the skull base, balloon-test occlusion and parent vessel sacrifice may be an option. For distal aneurysms, coiling or clipping with vascular bypass (if important branch vessels are incorporated into the aneurysm neck) may both be considered.

Treatment decisions for ruptured aneurysms differ significantly from those for unruptured aneurysms. Ruptured aneurysms should be treated urgently (within 72 hours of hemorrhage) to prevent rebleeding and to permit aggressive management of vasospasm. Unruptured aneurysms are generally treated electively. The following are 3 options for treating intracranial aneurysms:

- Observation
- Craniotomy and clipping
- Endovascular coiling

In the earlier days of aneurysm treatment, surgery was delayed until the second or third week after the hemorrhage to avoid difficulty related to brain swelling during surgery. Although this lowered surgical morbidity and mortality rates, management results were not always good because of a high incidence of rebleeding and difficulty in managing vasospasm. Although how to treat patients with a very poor grade (grade 5) is controversial, current recommendations are that select patients in this group undergo aneurysm treatment; coiling has become a good alternative for this subset of patients.

Early management for Ruptured Aneurysms.

Administration of calcium channel blockers (nimodipine for 21 days) to all patients; this has been shown to improve outcomes after subarachnoid hemorrhage. Early impressions that nimodipine prevents vasospasm have not been confirmed, but outcomes appear to be better when patients have been treated with this medication.[16] Anticonvulsant use is generally given phenytoin (epanuntin) or Epilim, particularly for patients undergoing craniotomy or those with focal cerebral hematomas in addition to the SAH.[16]

Blood in the subarachnoid space obliterates the arachnoidal villi, causing acute hydrocephalus. Blood within the ventricles can block the foramen of Monroe, also leading to hydrocephalus. When hydrocephalus leads to neurologic worsening because of the raised intracranial pressure (ICP), a ventriculostomy catheter should be emergently placed for cerebrospinal fluid (CSF) diversion. Not only can this be lifesaving, but a patient's neurologic examination can improve dramatically after the hydrocephalus has been treated.[16]

Surgical clipping.

The goal of surgical treatment is usually to place a clip across the neck of the aneurysm to exclude the aneurysm from the circulation without occluding normal vessels. When the aneurysm cannot be clipped because of the nature of the aneurysm or poor medical condition of the patient, the following alternatives may be considered:

- Wrapping: Although this should never be the goal of surgery, situations may arise in which little else is possible (e.g., fusiform basilar trunk aneurysms). Plastic resins may be slightly better than muscle or gauze for this purpose. Wrapping can be performed with cotton or muslin, with muscle, or with plastic or other polymer. Some studies demonstrate benefit with plastic or other polymer, but others show no difference from natural course. In one study with long-term follow-up, the protection from rebleeding during the first month was unchanged, but, thereafter, the risk was slightly lower than for the natural history.
- Trapping: Effective treatment requires both distal and proximal arterial interruption with direct surgery (ligation or occlusion with a clip). Treatment may also incorporate extracranial-intracranial (EC-IC) bypass to maintain flow distal to the trapped segment.
- Proximal (Hunterian) ligation: Proximal ligation has been used with some success for giant aneurysms, particularly of the vertebrobasilar circulation. Advanced endovascular techniques, however, now offer better alternatives for such lesions.

After performing a craniotomy, microsurgical techniques with the operative microscope to dissect the aneurysm neck free from the feeding vessels is applied without rupturing the aneurysm. Final treatment involves the placement of a surgical aneurysm clip around the neck

of the aneurysm, thereby obliterating the flow into the aneurysm. The goal at surgery is to obliterate the aneurysm from the normal circulation without compromising any of the adjacent vessels or small perforating branches of these vessels. The clips are manufactured in various types, shapes, sizes, and lengths and are currently manufactured to be MRI compatible.[17]

Intraoperative angiography is now frequently used as an adjunct to clipping and permits confirmation of aneurysm occlusion and patency of nearby vessels. The frequency of its use varies widely; however, many vascular neurosurgeons choose to use this technique selectively for difficult aneurysms. Technique called near-infrared indocyanine green videoangiography (ICGA) has become popular as a novel less invasive way to assess aneurysm and blood-vessel patency during aneurysm surgery.[17] After intravenous injection of the indocyanine green dye, an operating microscope equipped with appropriate software can within minutes detect blood flow within the vasculature using near infrared technology. The technique is less invasive than intraoperative angiography, but one disadvantage is that only vessels that can be seen by the operating microscope can be evaluated.[19,20]

The operative morbidity and mortality associated with clipping depends on whether the aneurysm has ruptured; ruptured aneurysms are more treacherous to operate on and morbidity is higher. The risk of surgery for unruptured aneurysms is estimated to be 4-10.9% morbidity and 1-3% mortality.[19, 20] Many factors affect the morbidity rates, with larger aneurysms in certain locations and in older, less medically healthy patients faring less well. Surgeon experience likely plays a role, with high-volume surgeons working in high-volume institutions likely having lower morbidity; the definition of high-volume, however, is a matter of controversy.[20]

Postoperative care

Most agree that an angiogram is necessary after surgery to confirm good clip placement with total obliteration of the aneurysm and patency of the surrounding vessels. In cases in which this is accomplished, the rebleeding rate is negligibly low.[22]

Whether a patient who undergoes intraoperative angiography should undergo post surgery angiography with the better equipment available in a dedicated angiography suite is also

controversial, and practices vary. However the short experience at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) postoperative angiography was seldom done during the study period due to various reasons that includes the use of stainless steel surgical clips which are contraindicated for MRA and glares on CTA.

After successful obliteration of a ruptured aneurysm, the patient remains at significant risk for vasospasm, hydrocephalus, and medical complications (including hyponatremia, venous thromboembolism, infections, and cardiac stun[97]) and remains in an intensive care setting for at least 7-10 days.[22] Operative complications represent only a small portion of the morbidity and mortality rates associated with a ruptured intracranial aneurysm. The major causes of morbidity and mortality include misdiagnosis, rebleeding, hydrocephalus, and vasospasm.

Vasospasm is defined as angiographic narrowing that can lead to delayed ischemia. Clinically, vasospasm is diagnosed as deterioration in mental status or focal neurologic deficits, most commonly hemiparesis or dysphasia. Transcranial Doppler (TCD) is frequently used as a noninvasive diagnostic tool and is sensitive to changes in the vessel caliber of the larger vessels of the circle of Willis. A trained technician should perform TCDs daily or every other day during the vasospasm period (day 3-12 post-SAH, with some flexibility based on the extent of the hemorrhage). If the patient's condition deteriorates, excluding all other causes of neurologic deterioration is important. If in doubt, cerebral angiography is indicated to confirm the diagnosis. Vasospasm must be aggressively managed once it is detected because it can lead to permanent disability and death.

Triple "H" therapy (hypertension, haemodilution, and hypervolemia) remains the most important aspect of the medical management of vasospasm, but, in refractory cases in which medical management fails, use of endovascular methods. Transluminal balloon angioplasty is the primary method of choice, but intra-arterial papaverine may be used for vasospasm in the distal vasculature, where balloons may not be able to access. Additionally, intra-arterial papaverine may be used to temporarily open vessels to permit passage of a balloon, which can then be used to treat the vasospasm. Papaverine has been shown to be short-lived and associated with more adverse side effects than angioplasty.[21]

Persistent hydrocephalus develops in approximately 20% of cases. In such instances, a shunting procedure, usually a ventriculoperitoneal shunt is required.[21]

Choice of surgical technique.

Obliteration of an aneurysm (ruptured or unruptured) with coiling or clipping is a matter of much controversy. Currently, data suggest that, whereas coiling is somewhat safer than clipping for both ruptured and unruptured aneurysms, at least in the acute perioperative period, clipping is slightly more durable.[29,30] However the current state at Johannesburg academic hospital all cases admitted with intracranial aneurysm and once the surgical option has been opted then clipping remain the main stay of treatment due to lack of coiling facilities nearly for the past five years.

Risks of clipping and coiling

Exact risks for clipping or coiling an aneurysm are not known and depend on patient and aneurysm specific factors. Surgeon and institutional volume likely also plays a role, which has not yet been quantified.[18,19,20] Historical data published by experienced vascular surgeons suggest that the morbidity and mortality rates associated with clipping of an unruptured aneurysm are ranging from 4-10.9% and 1-3%, respectively.[21,22,13]

The International Study of Unruptured Intracranial Aneurysms (ISUIA) also examined the risks associated with clipping an unruptured aneurysm and found that those risks (15.7% morbidity at 1 year) were higher than previously believed. Estimated risks associated with coiling based on several large studies is on the order of 3.7-5.3% morbidity and 1.1-1.5% mortality.[24,25,29] One of the major drawbacks associated with coiling is that, over time, the coils can compact, leading to reopening or recanalization of the aneurysm. A reopened aneurysm has a certain risk of hemorrhage, the magnitude of which is not known. Fortunately, re-coiling is a fairly safe technique. Additionally, newer technologic advances such as newer biologically

active coils and stents designed to prevent recanalization have been developed, and the early results are encouraging.

Increased safety of coiling over clipping was better demonstrated in the well-publicized International Subarachnoid Aneurysm Trial (ISAT) conducted in England.[29, 30]. In that study, 2143 patients who presented with subarachnoid hemorrhage and were deemed to have an aneurysm that was felt to be treatable with either coiling or clipping were prospectively randomized to one of the 2 treatments.

The study was stopped prematurely after a planned interim analysis found a 23.7% rate of dependency or death in the coiling cohort versus a 30.6% rate in the clipping cohort. This controversial study has significantly affected the treatment of ruptured aneurysms.

The main criticism of the study was that the great majority of the aneurysms were felt to be better treated by one modality over the other and were therefore not randomized. Only 22.4% of all aneurysms screened were randomized. Of those, the overwhelming majority were small and located in the anterior circulation. Therefore, although the study is important, generalizing the results to all ruptured aneurysms is not appropriate. Continued follow-up from the ISAT study has recently been published and found that the original results were confirmed with a higher rate of seizures in the clipping group and a slightly higher rate of rebleeding in the coiling group.[29, 30] Even more recently the ISAT investigators reported on a reanalysis of the data in which they stratified the benefit of coiling over clipping in patients with SAH. Because of the small chance of aneurysm recurrence (recanalization) after coiling that is higher than with clipping, the investigators found that the results of the study may not necessarily apply to patients under 40 years of age.[29, 30]

Ultimately, the decision to clip or coil should be made on an individual basis and may often involve difficult to quantify variables such as patient interest in one technique over the other or the experience or availability of physician operators.

Early versus late surgery.

Controversy exists between early surgery (generally, but not precisely defined as within 48-96 hours post-subarachnoid hemorrhage and late surgery (usually >10-14 days post-SAH).

Early surgery is advocated for the following reasons:

- If successful, surgery virtually eliminates the risk of rebleeding, which occurs most frequently in the period immediately following SAH.
- Early surgery facilitates treatment of vasospasm, which peaks in incidence between days 6 and 8 after SAH (rarely observed before day 3) by allowing induction of arterial hypertension and volume expansion without danger of aneurysmal re-rupture.
- Surgery allows lavage (including use of thrombolytic agents to remove potentially spasmogenic agents from contact with vessels; the benefits of this are controversial.
- Although the operative mortality rate may be higher, the overall patient mortality rate is lower.

Arguments against early surgery and in favor of late surgery include the following:

- Inflammation and brain edema are most severe immediately following SAH. Such inflammation further complicates brain retraction because an inflamed brain is usually softer, more friable, and more likely to be lacerated by a brain retractor.
- The presence of solid clot further complicates surgery.
- The risk of intraoperative rupture is higher with early surgery.
- The incidence of vasospasm due to mechanotrauma to vessels may be increased following early surgery.[29,30]

Although no randomized trials have compared early surgery and late surgery, the trend in the United States has been strongly toward early surgery. The advent of endovascular coiling as a less invasive modality of treatment that does not require brain manipulation is expected to continue the ability to treat patients in the early period.

In the Cooperative Study of Intracranial Aneurysms and Subarachnoid Hemorrhage, which involved 6038 ruptured aneurysms, the critical size of rupture was, interestingly, found to be 7-10 mm. Other recent studies of large personal or institutional series have recorded higher rates

of rupture for unruptured aneurysms.[29, 30] A decision of whether to treat an unruptured intracranial aneurysm can require great wisdom with scientific base. Physicians should review all the relevant data from trials and natural history studies. They must also become acquainted with their patients and their particular conditions, coexisting disorders, and desires. Some patients welcome statistical data and choose therapies logically based on such data. Others eschew science and rely on alternative therapies. Decisions take time, patience, experience, and repeated visits with patients. [29, 30]

1.3 STATEMENT OF THE PROBLEM.

There are currently numerous reports in the literature on the epidemiology and management outcome of spontaneous aneurysmal intracranial haemorrhage worldwide. However, there is no research projecting the magnitude of the problem and challenges facing the management of this condition at Charlotte Maxeke Johannesburg academic hospital (CMJAH). This study was therefore set up to determine the demographic distribution, type and distribution of ruptured intracranial aneurysms, clinical presentation, Choice and adequacy of neurological imaging, Neurosurgical intervention modalities, and surgical outcome (morbidity and mortality) in the local circumstances.

It is hoped that the study will allow a comparison to be made between our results and those of international benchmarks and help stimulate and improve management strategies that will prolong life and improve the quality of life of the affected patients where this are found wanting.

Hypothesis of the study

- The management outcome of spontaneous aneurysmal intracranial haemorrhage at CMJAH, conforms to internationally accepted standards.

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1.5 Objectives:

Broad Objective:

To determine the management outcome amongst patients with spontaneous aneurysmal intracranial haemorrhage in patients admitted at CMJAH.

Specific Objectives:

1. To study the demographic distribution of spontaneous aneurysmal intracranial haemorrhage in terms of age, sex, race and location of aneurysm CMJAH hospital.
2. To study the impact of Fisher and initial Hunt and Hess grade on outcome at CMJAH hospital
3. To determine the complications and outcome of management of spontaneous aneurysm intracranial haemorrhage at CMJAH hospital.

2.0 CHAPTER TWO.

METHODOLOGY

"If a physician makes a wound and cures a free man he shall receive ten pieces of silver, but only five if the patient is son of a plebeian... ... However it is decreed that if a physician treats a patient with a metal knife for a severe wound and has caused the man to die – his hands shall be cut off."

Code of Hammurabi.

2.1 METHODOLOGY

2.1.1 Type of study

A descriptive retrospective study, where hospital records of consecutive patients with spontaneous aneurysmal intracranial haemorrhage admitted over a two years period (June 2007 to May 2009) was retrospectively reviewed.

2.1.2 Study Area

The study was conducted at the neurosurgical wards (both adult and paediatric) at CMJAH-a tertiary consultant and teaching hospital.

2.1.3. Study population

The target population was all patients treated for spontaneous aneurysmal intracranial haemorrhage from June 2007 to May 2009.

3(i) Inclusion criteria

- All patients who were admitted with a diagnosis of spontaneous aneurysmal intracranial haemorrhage.

3(ii) Exclusion criteria

- Patients admitted with unruptured intacranial aneurysm/s.
- Patients with posttraumatic intracranial aneurysm/s

2.1.4 . Study design and sample size

Study design –

This is a descriptive retrospective study where patient's medical records were reviewed.

Sample size

Based in all consecutive cases of SAH patients admitted at the CMJAH from June 2007 to May 2009.

2.1.5 Parameters for observation

Patient characteristic such as age, sex, type and location of aneurysm was recorded. Patient clinical characteristics on arrival as well as imaging results were also recorded. Management methods and immediate postoperative complications and mortality were also recorded. Hunt and Hess clinical grading was done on arrival, initial SAH on computerized scanning was graded using the Fisher grading scale. Surgical outcome was measured using Modified Rankin scale[98, 99,100].

End point of the study

Patients' follow-up information for up to 3 months including outpatient visits was recorded.

2.1.6. Data collection

A data collection sheet was designed to capture the information that the specific objectives of the study required. (Appendix IV)

2.1.7. Data processing and analysis

All data were gathered in a data collection sheet (Appendix 4), the research questions were coded and data entered into the computer for analysis. Data cleaning and analysis was done using SPSS™ (statistical package for the social sciences) version 17.0.1 - December 2008. For univariate analysis, frequency distribution was run for categorical (dichotomous) variables while continues variables were summarised using means and standard deviations (SD). The Wald Chi-square test was used to test the association between the variables and outcome. All the analyses were two-tailed and significant level was set at 0.05%. The statistical significance level of P – value less than 5% ($P<0.05$) was used for comparison.

2.1.8. Ethical considerations

The proposal was submitted to the ethical committee of the hospital and University of the Witwatersrand for clearance. The consideration to protect the rights of human subjects and scientific enquiry was taken into consideration.

Issues of ethical consideration were:

2.1.5 Parameters for observation

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Issues of ethical consideration were:

(a) Confidentiality in handling patients' data.

(b) An identity number rather than the patient's name was used for each record to protect patients' identity

As this study is retrospective by record review without direct contact with patients, the data will remain anonymous.

Permission from The Hospital Research and Publication Committee for use of Charlotte Maxeke Johannesburg Academic Hospital records was sought and letters of such ethical approval are shown in appendix IV

3.0 CHAPTER THREE

RESULTS AND DISCUSSION

"Concern for man and his fate must always form the chief interest of all technical endeavors……never forget this in the midst of your diagrams and equations."

Albert Einstein

3.1. RESULTS

3.1.1. Demographic characteristics

3.1.1.1. Age, Sex and Race distribution.

During the two year of study conducted at neurological unit Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), a total of 102 cases were available for the study. The male to female ratio was 1:1.2. The ages of the patients ranged between 25 and 78 years with a mean of 45 years. The peak aneurysmal frequency was between the ages of 42.3 and 46.3 years overall. There was apparent age related incidence in male and females between 41 – 50 years. (Table 1).

Gender distribution shows 45(44.1%) were males and 57(55.9%) were females, Eighty two (80.4%) of the patients were blacks, amongst those thirty four (33.3%) were black males and forty eight (47%) were female patients. There were 13 coloured patients (12.7%), of whom 6(5.8%) were male and 7(6.9%) were female. The male and female sexual difference was similar ($P > 0.05$). Seven (6.9%) were white patients, with 5(4.9%) male and 2(1.96%) female white patients. The black race patients with aneurysmal intracranial haemorrhage was significantly commoner than other races (coloured and white)[P value < 0.05] Table 1.

3.1.1.2. Aneurysmal Location.

Ninety nine (94.3%) of the aneurysms were located in the anterior circulation, six (5.7%) were in the posterior circulation of the circle of Willis. The location of aneurysm in the anterior circulation was significantly commoner than the posterior circulation [$P < 0.05$] (Table 3). Amongst aneurysms located in the anterior circulation sixty (60.6%) and 39(39.4%) were on the right and left side respectively. (Table 2) Forty six (43.8%) of the aneurysms were located on the anterior communicating artery (ACA), 38 (36.2%) on the middle cerebral artery (MCA), 12(11.4%) on the posterior communicating artery (Post comm.) and 3(2.86%) on the pericallosal or Callosomarginal artery.

Three aneurysms (2.9%) involved the posterior inferior cerebellar artery (PICA), 2 (1.9%) located on superior cerebellar artery (SCA) and 1(0.95%) was a basilar tip aneurysm. (Table 2).

Three patients (2.9%) with aneurysms located on the MCA had multiple aneurysms (two aneurysms each). One of them had clinical features of acquired immunodeficiency disease but refused to consent to HIV testing. The second patient was a known patient with HIV/AIDS on treatment for five months. The CD 4 count was 250. She had a saccular and a fusiform aneurysm which were clipped and wrapped respectively. The third patient had polycystic kidney disease with a positive family history. (Table 3).

3.1.2. Clinical Findings

3.1.2.1. Hunt and Hess grade (H and H).

- On admission

Seventy three (71.6%) of patients were admitted with Hunt and Hess grade 3, 22(21.6%) with grade 2, Five (4.9%) had grade 4 and 2 patients (1.9%) had grade 5.

- On the day of surgery

Fifty seven (55.9%) had Hunt and Hess grade 2, 35(34.3%) were grade 1, and 10 (9.8%) grade 3. No grade 4 or 5 patients came to surgery. (Figure 1)

3.1.2.2 Symptoms and Signs

The commonest presenting symptoms and signs were headache (97%), nausea and vomiting (63%), disorientation (55%), gait disturbance (49%), speech abnormality (45%), seizure (41.1%) and hemiplegia (39.2%) (Fig)

Other symptoms and signs caused by aneurysmal intracranial haemorrhage were oculomotor nerve palsy (11.8%) and exophthalmos (8.8%). Correlation of the clinical finding to the location of the aneurysm revealed that oculomotor nerve palsy, exophthalmos, and seizures were features peculiar to anterior circulation aneurysms while occurrence of headache, nausea and vomiting and gait disturbances were common in both groups.

The posterior circulation aneurysm presented with non specific symptoms like headache, nausea and vomiting. (Table 6)

3.1.3 Neurological imaging findings.

3.1.3.1 Computer tomography

All patients underwent computer tomography (CT) examination upon arrival. Sixty two patients (60.8%) presented with CT findings of localized clot or vertical layer equal to or greater than 1 mm (Fisher 3) and 36 patients (35.3%) had intracerebral or intraventricular clot with diffuse or no subarachnoid haemorrhage (Fisher 4). Only 4 (3.9%) had diffuse or vertical layer equal to or less than 1 mm (Fisher 2). None of the patient had Fisher grade 1 CT findings. (Figure 2, Plate 1)

3.1.3.2 Angiography

All patients underwent cerebral angiography in addition to CT scanning. Angiography was done to determine the anatomical location of the aneurysm and the relation to neighbouring structures. Forty eight patients (47.1%) underwent Digital Subtraction Angiography (DSA), 31 (30.4%) computer tomographic angiography (CTA) and 23 (22.5%) had magnetic resonance angiography (MRA). In thirty one patients (30.1%) repeat angiography was required to demonstrate the aneurysm. (Figure 3, Plate 2)

3.1.4 Neurosurgical intervention and outcome.

3.1.4.1 Surgical treatment and timing of surgery.

All patients underwent surgical clipping of aneurysms, and only two patients amongst those with multiple aneurysm had additional wrapping for their fusiform aneurysms. No patient underwent coiling of aneurysm at CMJHB hospital due to lack of facilities during the study period (Figure 5).

Fifty five patients (54%) were operated upon on day12 or later after onset of symptoms. Thirty nine patients (38%) were operated upon during the first three days of SAH, and 8 patients (8%) were operated on the fourth to twelfth day. The majority of patients were therefore operated upon before the 3rd day and after day12 following SAH. (Figure 4 and 5)

3.1.4.2 Surgical Outcome.

Modified Rankin score was used to evaluate the outcome of aneurysmal treatment. The overall outcome of surgical clipping of aneurysm was very good. The overall mortality was 3 (2.9%),

and all this patients were operated on 4th to 12th day from admission. Three months post surgery, patients with a favorable Modified Rankin score(0 – 3) were 90.8% [These are patients who are able to carry on normal activity and to work; no special care needed]. Ten (9.2%) had a score (4 – 6) 70%) [That means unable to work; able to live at home and care for most personal needs with varying amount of assistance needed] .

3.1.4.3 Fisher Grading and outcome

Amongst 10 patients (9.8%) with Fisher Grade 1 and 2, all patients had favourable Modified Rankin Score (0 -3), and for those who had Fisher Grade 3 and 4 upon admission 82 (80.4%) had favorable Modified Rankin Score (0 -3) while 10 patients (9.8%) had unfavorable prognosis.(Table 5)

Table 1.Age, Sex and racial distribution

Age groups	Males			Females			Total
	Black	Coloured	White	Black	Coloured	white	
21-30	4	1	0	4	0	0	9
31-40	6	2	1	7	2	0	18
41-50	10	2	2	27	2	1	44
51-60	6	1	1	4	2	0	14
61-70	7	0	0	3	1	1	12
71-80	1	0	1	3	0	0	5
Total	34	6	5	48	7	2	
	45			**57**			**102**

Table 2.Distribution of aneurysmal location on patients with intracranial haemorrhage

Anterior circulation	Location	Right	Left	Total	
	ACA	29	17	46	99
	MCA	22	16	38	
	Postcom	7	5	12	
	Pericallosal/callosalmaginal	2	1	3	
Posterior Circulation	PICA	2	1	3	06
	SCA	1	1	2	
	Basilar Tip	1	0	1	
Total		64	41	105	

Key:

ACA – Anterior Communicating Artery

MCA – Middle Cerebral Artery

Postcom.- Posterior Communicating Artery

PICA- Posterior Inferior Cerebellar Artery

SCA – Superior Cerebellar Artery

Table 3: Distribution of location of aneurysm Versus Sex

	Anterior circulation	**Posterior circulation**	**Total**
Male	**41**	**4**	**45**
Female	**55**	**2**	**57**
Total	**96**	**06**	**102**

NB: For the patients with multiple aneurysms, only the ruptured aneurysm was included in the study.

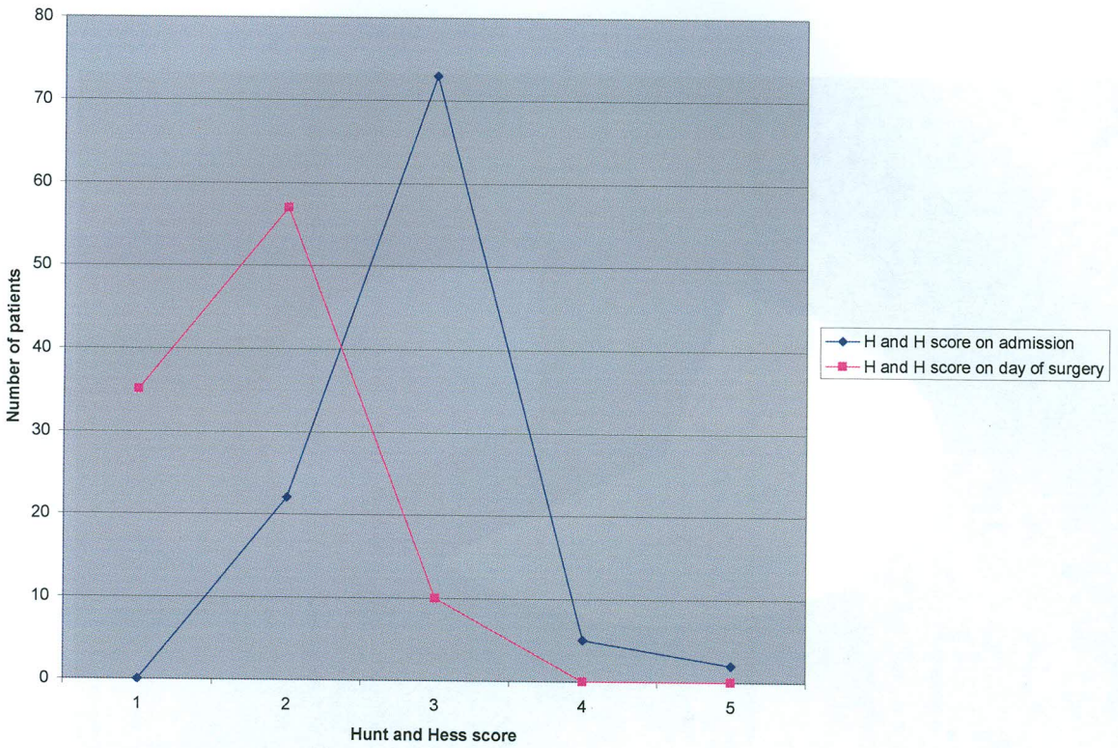
Table (4). Distribution of aneurysmal location versus age groups

Age groups	Anterior circulation	Posterior circulation	Total
21 – 30	9	0	9
31 – 40	16	2	18
41 – 50	44	0	44
51 – 60	11	3	14
61 – 70	11	1	12
71 – 80	5	0	5
Total	99	06	102

NB:

- For the patients with multiple aneurysms only a ruptured aneurysm was included in the study
- Three patients in anterior circulation group each had 2 aneurysms; all were located on Middle Cerebral Artery.

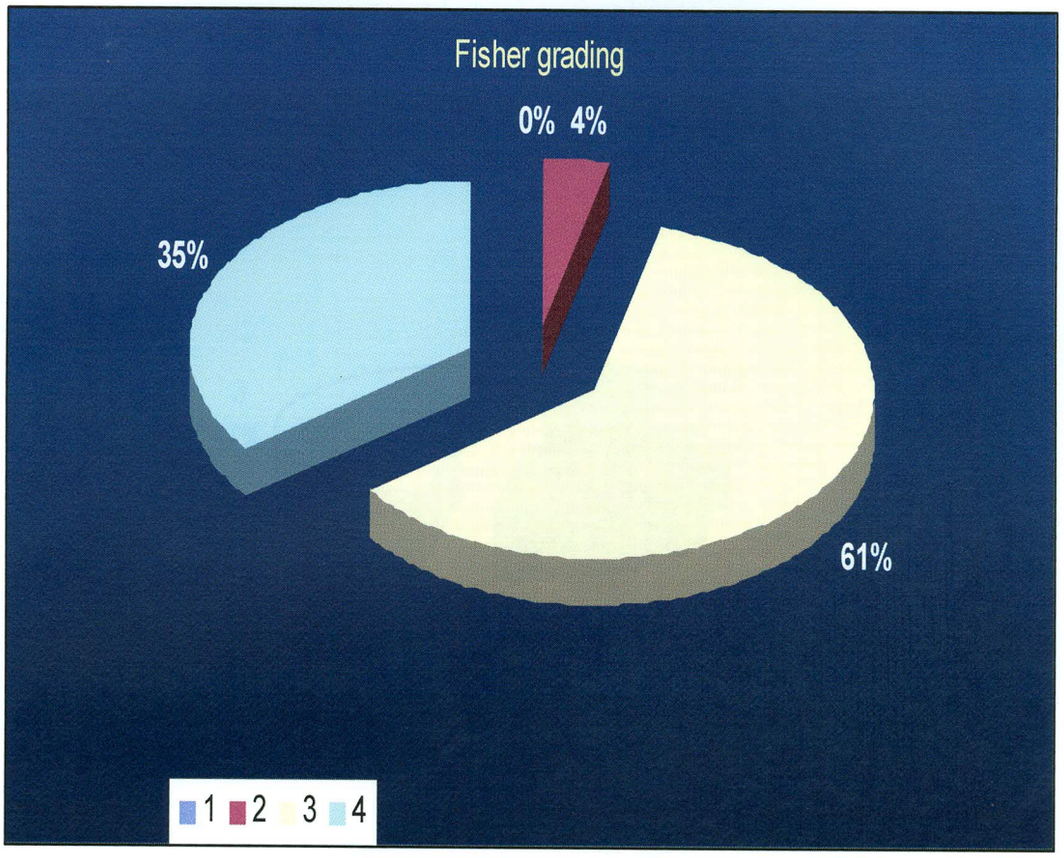
Figure 1. Distribution of Hunt and Hess score on admission and Day of surgery.



Key:

H and H – Hunt and Hess Score

Figure 2. Fisher Grading on computerized tomographic scanning on admission.



Key:

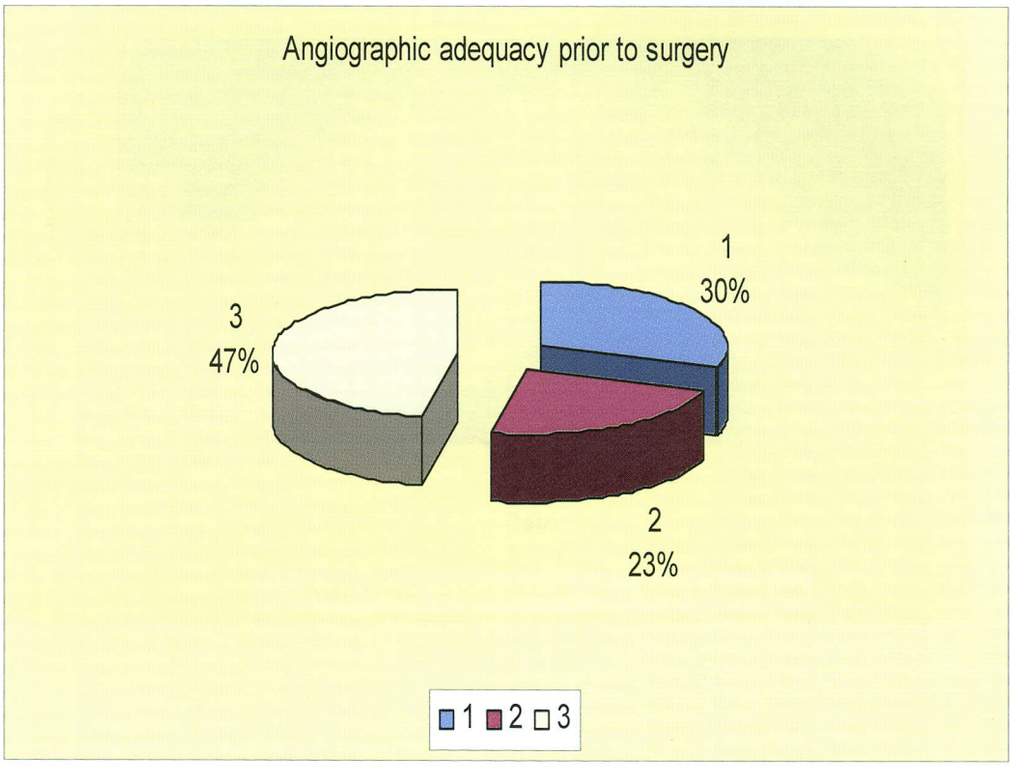
Fisher grade 1: - O%

Fisher grade 2: - 4%

Fisher grade 3: - 61%

Fisher grade 4: -35%

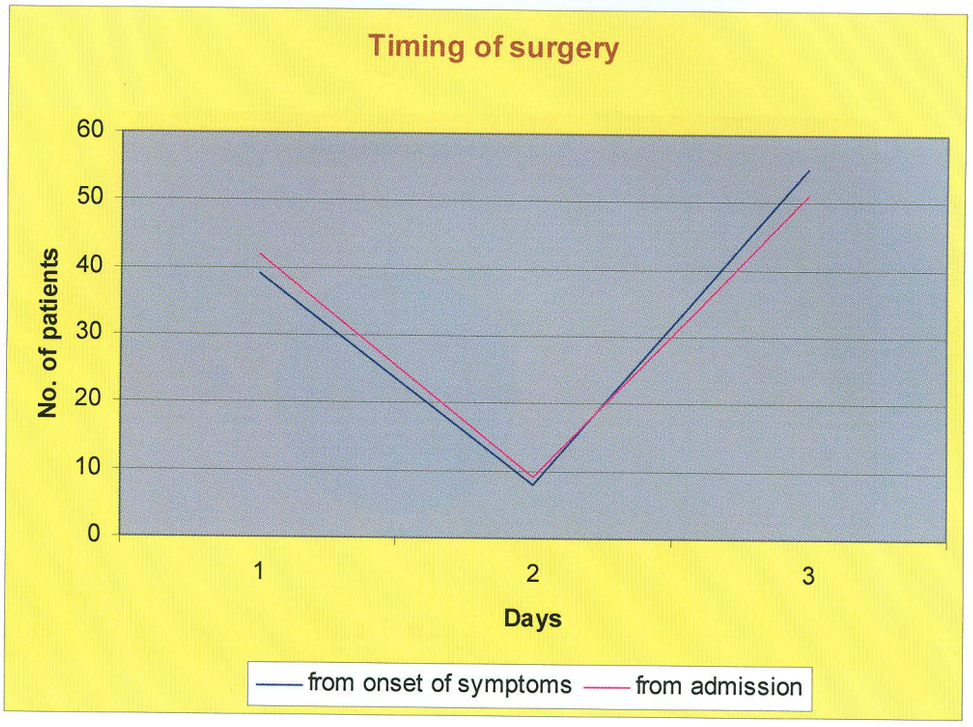
Figure 3. Distribution of angiographic adequacy prior to surgery



Key:

1. CTA - (Computerized tomographic angiography)
2. M.R.A- (Magnetic resonance imaging)
3. D.S.A - (Digital subtraction angiography).

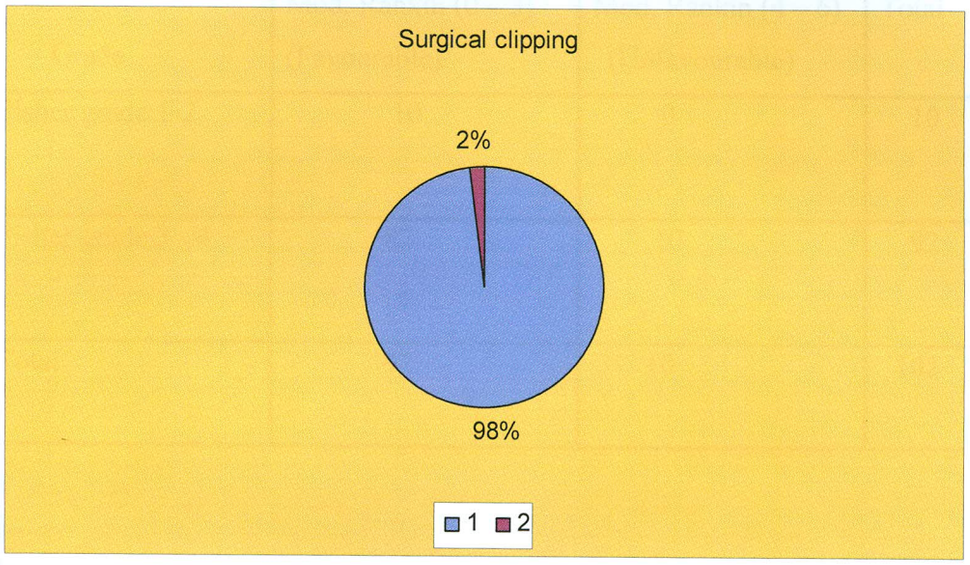
Figure 4. Timing of surgery.



Key:-

1. 0 – 3 days
2. 4 – 12 days
3. >12 days

Figure 5: Surgical treatment (N=105)



Key:

1. Surgical clipping of aneurysm
2. Wrapping of aneurysm

Table 6: Symptoms and signs in patients with ruptured intracranial aneurysm by location of aneurysm.

Sno.	Symptoms and signs	Anterior circulation	Posterior circulation	Total
1.	Headache	85	5	90
2.	Nausea and vomiting	60	4	64
3.	Oculomotor palsy	12	0	12
4.	Exopthalmos	9	0	9
5.	Seizure	42	0	42
6.	Disorientation	53	3	56
7.	Speech abnormality	46	0	46
8.	Gait disturbances	48	2	50
9.	Hemiplegia	40	0	40

Table 7: Timing of surgery (from onset of symptoms) versus Mortality.

Days	No of patients	Mortality
0 – 3 days	39 (38%)	0
4 – 12 days	8 (8%)	3 (2.9%)
>12 days	55 (51%)	0

NB:

Mortality rate 2.9%

Plate 1. Computed tomograms below show blood in cisterns, sulci, and visible giant aneurysm of the anterior communicating artery (left) and basilar artery (right).

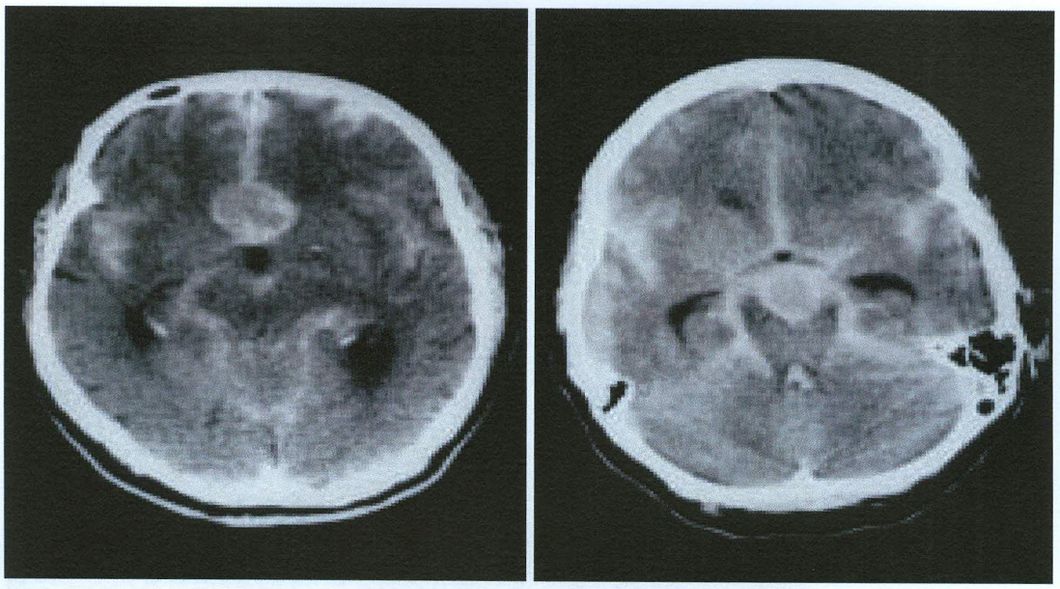


Plate 2. The CT angiography demonstrating middle cerebral artery aneurysm in relation to a bony structures.

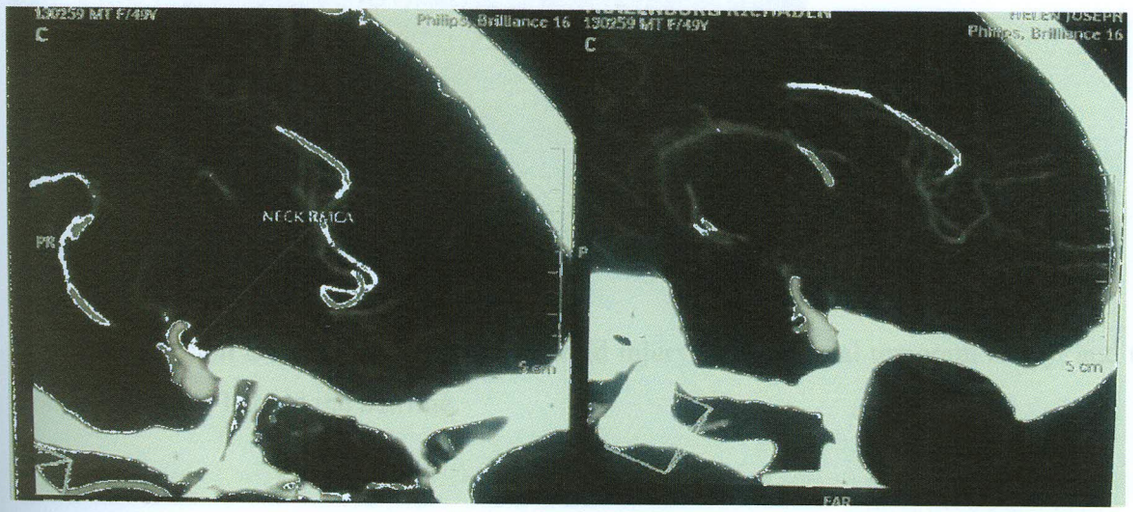
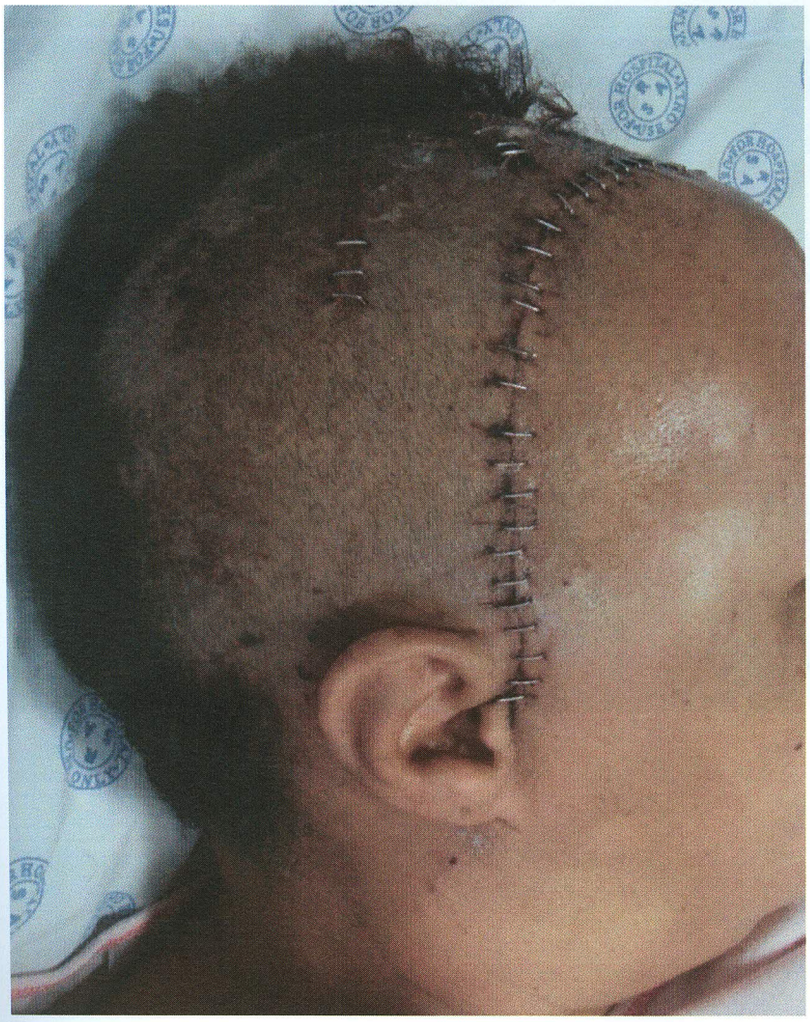


Plate 3. Post craniotomy wound, 3rd day post aneurism clipping.



Note: The incision is close to the tragus to avoid injury to superficial temporal artery, and the wound is entirely behind the hairline.

Plate4. Titanium clips in various shapes, size and length used for surgical clipping of aneurysms



3.2. Discussion.

3.2.1. Demographic characteristics

3.2.1.1. The Age, sex and Race incidences.

The age, range, and the Male: Female ratio in this study is comparable to those reported by other researches [13, 14, 18], where female age incidence is found to be slightly higher than male incidence. Male and female preponderance seems to commence at the 4th decade while the extreme end of age groups is associated with decreased incidence for both sexes.

However, various clinical studies, demonstrate predominance of aneurysms in female population, and is even stronger when there is multiplicity of aneurysms. The study by Brisman et al [17] demonstrates the Female to Male ratio of 5:1 and the ratio rises to 11: 1 in patients with multiple aneurysms. In Comparison to this study, the rate of multiple aneurysms encountered was 2.9% with a male to female ratio of 1: 1.2. Wiebers et al on autopsy studies showed that the prevalence in the adult population is between 1 and 5 percent[13]. Aneurysmal spontaneous subarachnoid hemorrhage is a major clinical problem in the United States, with an annual incidence of approximately 1 per 10,000 people[48]. This rate suggests that each year approximately 27,000 Americans have ruptured intracranial aneurysms, which are fatal in 14,000. The incidence of aneurysmal subarachnoid hemorrhage is higher than that of many other major neurologic disorders, including primary brain tumors and multiple sclerosis.

A retrospective study of the Ethnic distribution of intracranial aneurysms by S.C. Ohaegbulam et al, looked at 244 cases of intracranial aneurysm seen at the Henry Ford Hospital (HFH). The study was done from 1979 to 1985 where 171 whites and 73 blacks were enrolled in the study. The results showed a higher white to black case ratio (2.3 :1) than the white to black hospital population ratio (1.14 :1). If only bleeding aneurysms were considered, there were 81 whites and 52 blacks, with a white to black case ratio of 1.6 :1, thus giving only a borderline racial difference.[55] In the current study in Johannesburg, health seeking bahaviour in public hospital amongst various races is unequal. More blacks are attended in public hospital than are coloureds and whites.

Ruptured aneurysms typically become symptomatic in people aged 40 – 60 years with the peak incidence of subarachnoid haemorrhage (S.A.H) occurring in patients aged 55 – 60

years[17] , where only 2% of intracranial aneurysm are encountered in children, In a study by Yasui et al,[44] 234 patients with and without SAH were evaluated during a period of 6.25 years. Thirty-four patients (14.5%) bled, with an average annual rupture rate of 2.3%. In a separate study, these authors evaluated aneurysm size in 25 patients with or without prior SAH and rupture of a previously unruptured aneurysm.[45] Twenty-two of the newly ruptured aneurysms were <9 mm in diameter at initial diagnosis and 16 were <5 mm in diameter.
The Finnish series have given alarming results where the age standardized incidence of subarachnoid hemorrhage was 33/100,000 per year among Finnish men and 25/100,000 per year among Finnish women. Subarachnoid hemorrhage represented 11% of all strokes detected during 1983-1985 in the community-based stroke register in three areas of Finland [45].

This finding suggests that the incidence and mortality of subarachnoid hemorrhage in Finland are among the highest worldwide, although differences in criteria, study methodology and classification procedures jeopardise the logical comparability of studies from different countries.[45]

3.2.1.2 Location of aneurysm

The majority of intracranial aneurysms (80 to 85 percent) are located in the anterior circulation, most commonly at the junction of the internal carotid artery and the posterior communicating artery, the anterior communicating-artery complex, or the trifurcation of the middle cerebral artery[41,42]. Aneurysms of the posterior circulation are most frequently located at the bifurcation of the basilar artery or the junction of a vertebral artery and the ipsilateral posterior inferior cerebellar artery.[41,42] Multiple intracranial aneurysms, usually two or three in number, are found in 20 to 30 percent of patients.[41,42,43] In rare cases, as many as 13 intracranial aneurysms have been detected in a patient.[41,44] The findings in the current series of ruptured intracranial aneurysms are similar to the study quoted above whereby the majority of the aneurysms (94.3%) were located in the anterior circulation and only 5.7% were in the posterior circulation.

An estimated 5 to 40 percent of patients with autosomal dominant polycystic kidney disease have intracranial aneurysms,[14,15] and 10 to 30 percent of these patients have multiple

aneurysms.[14] Screening with intracranial magnetic resonance angiography is indicated for people who have two immediate relatives with intracranial aneurysms and for all patients with autosomal dominant polycystic kidney disease.[14,15,45] Rescreening of patients with autosomal dominant polycystic kidney disease is recommended, although the frequency of the procedure depends on whether other affected family members are known to have intracranial aneurysms.[45]

3.2.2 Clinical findings

3.2.2.1 Hunt and Hess grade.

The clinical grading scales such as the Hunt and Hess Scale is used to describe the neurologic condition on admission and are considered good predictors of ultimate outcome.[46,47]. Bracard et al [(101)] presented the results of a retrospective study on endovascular treatment of patients with Hunt and Hess grade IV and V aneurysms during a 6-year period. Their conclusion is that early endovascular treatment of high-grade subarachnoid hemorrhage (SAH) is a viable alternative to surgery and that "clinical outcomes have proved to be at least as good as those obtained by surgery, with a higher number of patients enjoying very satisfactory recovery." This last conclusion seems to be true only for patients with grade IV aneurysms, however, because the mortality of patients with grade V aneurysms is 63% (15 of 24 patients treated) and a favorable outcome was obtained in only 29% of cases (7 of 24 patients). These results are comparable with those of other reported surgical series [(103).] Also they presented the results of a prospective study of the endovascular treatment of 11 patients with SAH and (World Federation of Neurological Surgeons) WFNS grade V admitted during a 12-month period [(102).] Although the WFNS scale and the Hunt and Hess scale are not identical, there is a very good correlation on advanced grade with poor outcome, the patient distribution was comparable. All WFNS grade V patients were included in our study unless brain stem reflexes were absent or an aneurysmal intracerebral hemorrhage mandated surgical evacuation. Inclusion criteria were a Glasgow Coma Score between 3 and 6 after resuscitation, without improvement after ventriculostomy in the case of hydrocephalus. The treatment protocol consisted of early endovascular occlusion of the aneurysm followed by aggressive treatment of intracranial

hypertension and prevention of vasospasm by routine hypertensive hypervolemic hemodilution therapy. Ten patients were treated within 24 hours, most of them receiving treatment within 8 hours after the SAH. Fifty five percent (55%) of the patients had favorable outcome; the mortality rate was 18%.[102] In comparison with published surgical and other endovascular series, our results are favorable with mortality rate of 2.9%.

The difference in outcome between Bracard et al's study [(101)] and Loon study [(102)] for grade V patients is mainly due to aggressive early preventive treatment of vasospasm for latter study. Vasospasm as a cause of delayed ischemic deficit is more frequent in poor-grade (WFNS grade 4 and 5) patients and is the most important cause of morbidity and mortality. Optimal treatment in the initial phase after the SAH may be crucial to preserve the viability of the already compromised brain. This optimal treatment includes early occlusion of the aneurysm to prevent rebleeding and to allow appropriate prevention of vasospasm by optimizing cerebral perfusion. This is confirmed in a surgical series of poor-grade patients as well.[103] However, surgery in poor-grade patients is often difficult and has the risk of inflicting further damage to the already edematous and ischemic brain by retraction and manipulation of cerebral vessels. Therefore, the combination of early endovascular treatment causing minimal additional damage and aggressive intensive care for optimal cerebral perfusion may lead to the best results for these patients. Thus, even patients in very poor clinical (Hunt and Hess grade 5) condition after SAH have a fair chance of experiencing favorable outcomes (Modified Rankin score 0 - 3). Because no admission finding is a sufficient absolute predictor of favorable or poor outcomes in patients with aneurysmal SAH, they suggest that all patients be treated unless brain stem reflexes are absent. In the current study patients with higher Hunt and Hess score (grade $ - 5) had unfavourable outcome (Modified Rankin Scale 4 – 5) in comparison to those with low Hunt and Hess (Grade 1,2 and 3).

3.2.2.2 Symptoms and signs.

The presenting symptoms and signs of ruptured intracranial aneurysm is most common during times of exertion or stress, however aneurysms can rupture at any time [36]. The typical presentation is that of a uniquely severe headache of acute onset. The headache is often accompanied by nausea or vomiting, and the patient may or may not lose consciousness. One

third to one half of patients with subarachnoid hemorrhage have a history of an unusual and acute headache preceding the hemorrhage by several days or weeks.[37,38] Such a prodromal headache is most likely due to minor leaking of blood into the wall of the aneurysm or into the subarachnoid space and is therefore commonly referred to as a "warning leak.[37,38] The prodromal headaches are often not recognized as such by physicians, and many cases of frank aneurysmal subarachnoid hemorrhage are initially misdiagnosed as migraine headache, sinusitis, influenza, or malingering.[39] Aneurysmal rupture may cause not only subarachnoid hemorrhage but also intraventricular, intracerebral, or subdural hemorrhage. Patients describe a "thunderclap headache" (a severe intense sudden onset headache). The patient reports the worst headache of his or her life, more precisely, a split second, extremely intense, and overwhelming headache that does not subside. Many patients report feeling as if "the top of my head is blown off" or as though "someone hit me in the head with a hammer," but these key elements in the medical history may be difficult to elicit in confused patients. Rarely, there are other non aneurysmal causes of thunderclap headache present. These disorders include pituitary apoplexy, arterial dissection, cerebral venous thrombosis, hypertensive encephalopathy, or may be idiopathic [40]. When the patient is seen hours after onset of symptoms, neurologic examination may reveal nuchal rigidity, cranial neuropathy (third or sixth cranial nerve most commonly), or other localized neurologic deficit (aphasia, hemiparesis); however, major neurologic signs generally are absent. Seizures may occur in a small percentage of surviving patients, and epilepsy may develop in less than 10%, particularly in those who had a subdural hematoma or cerebral infarction during their hospital course[41].

The findings on current study has shown similar pattern of presentation, where 97% of patients presented with head ache, nausea and vomiting (63%), disorientation (55%), gait disturbance (49%), speech abnormality (45%), seizure (41.1%) and hemiplegia (39.2%) while oculomotor nerve palsy (11.8%) and exopthalmos(8.8%) were not uncommon.

3.2.3 Neurological imaging

3.2.3.1 Computerised tomography

Computed tomography (CT) of the head without the administration of contrast material is the initial diagnostic test of choice for suspected subarachnoid hemorrhage. The Fisher grade uses a four-point scale to describe the amount of blood on non–contrast-enhanced CT of the head and has been shown to correlate with the development of vasospasm.[50]

The CT scans are very sensitive in detecting acute hemorrhage, and they can demonstrate the presence of a subarachnoid hemorrhage in 90 to 95 percent of patients who undergo scanning within 24 hours after the hemorrhage.[42,51] Blood is cleared rapidly from the subarachnoid space, however, and the sensitivity of CT scanning decreases to 80 percent at three days, 70 percent at five days, 50 percent at one week, and 30 percent at two weeks mainly because resolution of blood with time decreases CT scan density.[42,51] CT scans are also very useful in detecting any associated intracerebral hemorrhage or hydrocephalus, and the distribution of blood may offer important clues to the location of the ruptured aneurysm . On CT, an aneurysm is rarely seen but when present indicates large size (>10 mm) Examination of CSF is necessary when CT is normal and has been reviewed for subtle areas of subarachnoid blood (posterior horns, sylvian fissure, and sulci). Prompt ascertainment of a diagnosis of SAH is warranted because a ruptured aneurysm has the highest rate of rerupture within the initial 48 hours. However, no evidence suggests that lumbar puncture increases the risk of aneurysmal re-hemorrhage. Testing CSF for the presence of xanthochromia, the yellow tinge in CSF caused by the breakdown products of hemoglobin, is the gold standard for diagnosis of SAH, with a sensitivity greater than 99%. Xanthochromia is present as early as 6 hours after SAH and along with bilirubin remains detectable until about 2 to 3 weeks after SAH.[53,54]
Hemorrhage located predominantly within the interhemispheric fissure is common in anterior communicating artery aneurysms, and sylvian fissure blood is often observed in MCA lesions. Intraventricular blood can be helpful in localizing ruptured aneurysms. Fourth ventricle hemorrhage is common in posterior fossa aneurysms, particularly those that arise at the posterior inferior cerebellar artery (PICA) takeoff, and intraventricular blood typically occurs with anterior communicating artery or basilar tip lesions[55]

MRI is not sensitive in detecting acute hemorrhage, and its role in the early evaluation of subarachnoid hemorrhage is limited. However, MRI may be very useful in demonstrating subacute or chronic subarachnoid hemorrhage long after the findings on the CT scan have become normal.[52]

3.2.3.2 Angiography.

All patients were subjected to selective angiography study of the ruptured intracranial aneurysms. The aim of angiography was to reveal and study the size, location and morphology of the intracranial aneurysms. The three methods of choice to identify or rule out an intracranial aneurysm and to delineate the size and morphologic features of an intracranial aneurysm are CT angiography (CTA) after a venous injection, magnetic resonance angiography (MRA), and 4 vessel angiography by direct intraarterial catheterization (catheter angiography), the last is still considered the benchmark. Several studies have evaluated the accuracy of detecting intracranial aneurysms by comparing CTA, MRA, and the synergistic combination of CTA and MRA with catheter angiography, intraoperative findings, or both.[56,57,58,59,60,61]

CTA provides software-generated images from thin-section contrast-enhanced CT to show cerebral vessels in three-dimensional views. The reconstructed pictures, which are obtained in matter of minutes, can be rotated and allow the vasculature to be visualized relative to the brain and the bones of the skull base, facilitating surgical planning. Studies evaluating CTA in the management of intracranial aneurysms have reported sensitivities ranging from 0.77 to 0.97 and specificities ranging from 0.87 to 1.00.[56,57,59,62,63] Sensitivity drops precipitously for the detection of smaller aneurysms; sensitivity for aneurysms smaller than 3 mm is estimated to be 0.40 to 0.91.[56,56,65] Caution must be exercised when CTA is used in patients with impaired renal function, since a large bolus of contrast material is administered.

The high sensitivity of MRA in the detection of cerebral aneurysms has already been reported.[66,67,68,69,70,71,72,73,74] MRA is ideal for screening cerebral aneurysms because the procedure is noninvasive and the patient is not exposed to radiation. The majority of previous studies used 3D-TOF MRA.[66–70] Ikawa et al[74] reported that 3D-TOF MRA had a sensitivity higher than that of phase-contrast MRA (92.6% versus 70.4%, respectively). In a recent prospective study involving 23 aneurysms, however, contrast-enhanced MRA showed a sensitivity higher than that for 3D-TOF MRA (100% versus 96%, respectively).[75] In the latter study, only one aneurysm was not detected by 3D-TOF MRA, which was of poor quality because of patient movement creating artifacts.

tremendously since then, particularly over the past two decades, with the introduction of microsurgical techniques, the operating microscope, bipolar coagulation, and a variety of self-closing aneurysm clips.[82,83]

In this study all patients (102) underwent craniotomy and surgical clipping of the aneurysm. No patient had endovascular coiling of aneurysm, mainly due to lack of competent technical expertise during the study period.

An area of continuing controversy in the management of ruptured intracranial aneurysms is the timing of surgery. Early surgery (i.e., within 48 to 72 hours after the hemorrhage) is beneficial because patients with subarachnoid hemorrhage are at very high risk for a recurrent hemorrhage shortly after the initial one. The rate of recurrent hemorrhage is at least 4 percent within the first 24 hours[84] (and may be as high as 10 or 20 percent[85,86]) and between 1 and 2 percent per day for the first 2 weeks.[84] Early surgery also allows aggressive treatment of the secondary intracranial arterial narrowing due to vasospasm, which is an important cause of delayed cerebral ischemia after subarachnoid hemorrhage.[87] The cause of vasospasm is not known, but its incidence is clearly related to the amount of subarachnoid blood seen on the CT scan.[87] Vasospasm occurs between 3 and 15 days after the subarachnoid hemorrhage, and the optimal treatment — hypervolemia, hypertension, intraarterial papaverine infusion, or endovascular balloon angioplasty — is dangerous in the presence of an untreated ruptured aneurysm.[87] Because of brain edema and the presence of a tenacious clot around the aneurysm, however, early surgery may be technically more challenging than surgery performed 10 to 14 days after the hemorrhage.

The timing of surgery in this study, 54% had surgical intervention within first 72 hours, 38% after 12th day of onset of symptoms and only 8 % had surgery within 3rd to 12th day (vasospasmodic period).

In one large, single-center series and two meta-analyses, the morbidity and mortality rates associated with clipping an unruptured aneurysm ranged from 4.0 to 10.9 percent and 1.0 to 3.0 percent, respectively.[23,24,25] Although successful clipping is generally associated with definitive protection against rupture, long-term studies have documented a certain small risk of technical

failure, incomplete occlusion (5.2 percent), recurrence (1.5 percent), and hemorrhage (0.26 percent).[88]

The International Study of Unruptured Intracranial Aneurysms assessed the risk of morbidity associated with the clipping of unruptured aneurysms. The risk associated with surgical repair was reported to be 15.7 percent after one year, higher than previously reported. Additional single-center reports, however, have since demonstrated a lower risk of surgical morbidity, in the range of 3 to 7 percent.[89] In any event, the results of the International Study of Unruptured Intracranial Aneurysms have had an important effect on the management of unruptured aneurysms,[89,90] resulting in more aneurysms now being treated with observation alone. Guidelines for the management of unruptured intracranial aneurysms have been issued by the Stroke Council of the American Heart Association in 2000.[62]

3.2.4.2 Outcome.

Functional outcome with the use of Modified Rankin Scale at three months was used in the assessment of ruptured aneurysm outcome,[10] although the time at assessment after therapy has not been standardized.

The majority of studies of outcome after surgery for aneurysmal intracerebral haemorrhage involve case series of one or more neurosurgeons in which their results are evaluated. The range of mortality and morbidity rates reported in the largest series is wide, varying from 0% to 7% for death and 4% to 15.3% for complications.[10, 19,25,91,92,93,94] Two meta-analyses were recently reported.[24,25] The first of these involved 733 patients[24] and reported a 1% mortality rate and a 4% morbidity rate. The second, which encompassed 2460 patients and reported a mortality rate of 2.6% and a permanent morbidity rate of 10.9%, [25] also found declining morbidity and mortality rates for anteriorly located aneurysms in recent years. There has been virtually no uniformity regarding the definition of good versus poor outcomes, or even mortality rates; some have been defined at 30 days, 3 to 6 months, or 1 year after surgery. None of the studies contained a sufficient number of patients to warrant conclusive judgment regarding the predictors of outcome, in this study the follow up and Modified Rankin Scale evaluation was done at 90 days (3 months).

The surgical mortality in this study is 2.9% and is comparable to that of other series [10, 19, 25, 91, 92, 93]. The overall outcome was influenced by the aggressiveness of preoperative measures to counteract vasospasm and timing of surgery. Most patients in the current study had favourable Modified Rankin Score.

4.0 CHAPTER FOUR

Conclusion and recommendations

"The mathematical science particularly exhibit order, symmetry and limitations and these are the greatest forms of the beautiful"
Aristotle (384 – 322)

4.1 CONCLUSION.

Aneurysmal SAH is a devastating condition for which prevention has been advocated as the most effective strategy aimed at lowering mortality rates.[95] However, all current treatments carry risks, and recommendations for treatment versus observation are often difficult and controversial. Treatment complications generally occur at or around the time of the procedure but could potentially improve during the patient's remaining lifetime. In contrast, the risk of rupture of an untreated aneurysm is cumulative but may provide a period of unimpaired life. Nonlethal complications in both settings can potentially improve over time.[95]

The highest incidence of aneurysmal rupture occur around 4th decade of life with a slight female preponderance. Most aneurysms occurs significantly on the anterior circulation (94.3%), and among the vessels on anterior circulation anterior communicating artery is the most commonly affected (43.8%). Posterior circulation aneurysm the number of cases was too small for statistical significance. The frequency of aneurysmal multiplicity in this study was 2.9%.

The majority of patients admitted with a moderate Hunt and Hess score. Those with a score of 3 were 71.6%.and only 1.9% had Hunt and Hess score of 4.

The main chief complaint on admission was headache (97%), nausea/vomiting (63%) and disorientation (55%). Oculomotor nerve palsy, exopthalmos and seizures were feature peculiar to anterior circulation aneurysms. Predominantly patients presented with higher grade Fisher score where 60.8% of patients presented with Fisher grade 3 and 35.3% grade 4, on computerized tomographic survey.

Angiographic adequacy prior to surgery were mainly achieved by DSA – Digital Subtraction Angiography (47.1%), while 30,4% achieved by CTA and 22.5 % by MRA, however the patients were subjected to CTA or MRA and those who failed to achieve the desired goal then they were subjected to DSA.

Surgical intervention for the ruptured aneurysm was the main stay of therapy, whereby craniotomy and clipping of aneurysm was done. Most patients were operated after 12th day

from onset of symptoms (54%) and 38% had early clipping within 72 hours, a pattern similar to other studies.[84,85,86,87]

The overall outcome at three moths post surgery was favourably good, 90.2% and 9.8% had unfavourable outcome on the Modified Rankin Scale

All patients with lower Fisher grade score (1 and 2) had favourable surgical outcome. Those with higher Fisher grade (3-4), 80.4% had favourable and 9.8% unfavourable outcome. All patients with higher Fisher grade on Computerized Tomographic scan, was associated with a poor outcome. This concurs with a well known phenomenon of advanced Fisher grade being associated with worse prognosis.[50]

4.2 RECOMMENDATIONS.

- The standards on management of ruptured aneurysmal intracranial haemorrhage such as Hunt and Hess score, Fisher grading and timing of surgery should be adhered in order to minimize surgical morbidity and mortality.
- The long term follow up to assess surgical outcome (morbidity and mortality) should be considered.
- There is a need to establish a neurosurgical intervention services for aneurysms in Tanzania, this is being taken by the author as a challenge for future endevours.

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