Original Research Article

Analyzing the cause and effects in Intra-operative rupture (IOR) in intracranial aneurysms

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Abstract

Introduction: When Aneurysm surgery procedure is being learned, performance tends to improve with experience; however, in medicine there are no accurate measurements to monitor the said improvement. Experience of the surgeon plays an important role in dealing with aneurysm surgery while dissecting the aneurysm, clipping and controlling the bleeding if the aneurysm ruptures. Intra Operative Rupture (IOR) has been reported in a wide range of percentages during microsurgery, ranging from 3.5% to 50%. We would like to analyse the causes for IOR of intracranial aneurysms and strategies to control it. **Aims:** The aim of this study was to evaluate the incidence and reasons behind IOR and also to analyze the strategies of controlling hemorrhage. **Material and Methods:** A retrospective study was designed to analyze factors associated with IOR of intracranial aneurysms Over the Two-year period from 1 January 2014 to December 2016 at Nizam's Institute of Medical Sciences at the Neurosurgery Division, a total of 92 patients were operated for 100 brain aneurysms. The 92 patients who met the criteria were selected for inclusion in the study. Data collected from case records and operation notes. **Results**: 92 patients with 100 aneurysms were treated in this series. There were a total of 13 IORs which represented an IOR rate of 14.1% per patient and 13% per aneurysm. M=8, F= 5, Mean age 46.1 yrs, (27 - 65 yrs), No of patients with Grading of SAH according to Fisher was Gr.I-0,II-2,III-7,IV-4.Timing of rupture was during micro dissection 46%(6), during clipping 54%(7). Severity of IOR Bleeding were minor-4, moderate-7,Major-2. Outcomes in IOR pts were-Completely recovered-7, Hemiparesis occurred in-3,Decompressive craniectomy required in-2,No of pts died-1. **Conclusions:** High Fisher grade of ruptured aneurysms are associated with more chances of IOR. Avoiding undue retraction and sharp dissection around the aneurysm holds the key in preventing IORs.There is always a LEARNING CURVE in cerebrovascular surgery.

Keywords: Cerebral aneurysm, Intraoperative Rupture, Clipping of aneurysm

Introduction

In microsurgery for intracranial aneurysms, intraoperative rupture (IOR) is an unavoidable complication. The incidence, predisposing variables, and impact on result have all been reported in different ways in the past. IOR has been reported in a wide range of percentages during microsurgery, ranging from 7% to 40%. The reported related mortality in cases of IOR was likewise variable, ranging from 0% to 33%. The ambiguous definition of IOR could be one of the key reasons for such a wide range of findings [1,2]. Although uncontrolled and unwanted bleeding can occur at any stage of surgery, several characteristics are linked to an increased risk of intraoperative rupture.

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The risk of IOR of cerebral aneurysms increases with big aneurysms, basilar artery aneurysms, and anterior communicating artery aneurysms, according to the literature, however the association between localization and the occurrence of IOR is not well established.Surgical experience, which is frequently evaluated by annual case volume, has been linked to a better prognosis in a variety of surgical specialties. Surgical experience has been shown to have a good influence on coronary artery bypass surgery, aortic valve replacement, and cancer resection, among other procedures[2]. Surgical expertise was also found to be particularly helpful in specific procedures in neurosurgery, such as removal of brain neoplasms, carotid endarterectomy, and microvascular decompression. However, in microsurgery for cerebral aneurysms, the impact of surgical experience on IOR and outcome was only mentioned in passing. Furthermore, the results are incongruent. We aim to study to evaluate the incidence and reasons behind IOR and also to analyze the strategies of controlling hemorrhage.

Materials and methods

A retrospective study was designed to analyse factors associated with IOR of intracranial aneurysms over the Two-year period from 1 January 2014 to December 2016 at Nizam's Institute of Medical Sciences at the Neurosurgery Division, a total of 92 patients were operated for 100 brain aneurysms. The 92 patients who met the criteria were selected for inclusion in the study (aneurysm surgery after subarachnoid haemorrhage, highly experienced surgeon). A questionnaire was designed for the purpose of data statistical processing. The data was collected with regard to age, sex, presence of symptoms, Timing and reasons for IOR of Intracranial aneurysms and strategy of controlling hemorrhage was analyzed in terms of locations of aneurysms, timing of rupture and severity of IOR.

The relevant parameters obtained from the questionnaire were then entered in a computerized database, and processed using the Windows XP Pro operating system, Microsoft Office 2003/2007 Pro software package and SPSS for Windows v.13. Thomas and Jennifer classification was used for assessing severity of bleeding.

Thomos and jennifer classification

Minor	small and easily controlled by 3-French micro sucker.
Moderate	required temporary occlusion of the proximal arterial segment or tamponade of the aneurysm to stop the bleeding
Major	significant hemorrhage that was difficult to control.

Results

Total 92 patients with 100 aneurysms were treated in this series.

Table 1: Distribution of patients in study

Age distribution	No of patients	Percentages
21-30	7	7
31-40	14	14
41-50	25	25
51-60	34	34
61-70	11	11
>70	1	1
Gender		
Male	35	35
Female	57	57
Total	92	92

There were a total of 13 IORs which represented an IOR rate of 14.1% per patient and 13% per aneurysm. M=8, F= 5, Mean age 46.1 yrs, (27 - 65 yrs). (Table -1).

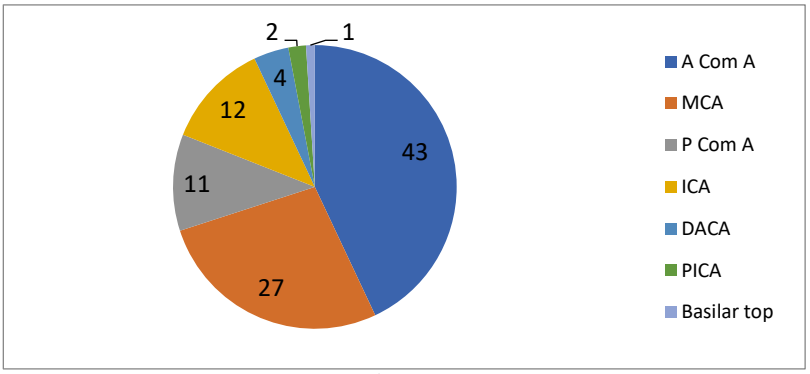

Fig 1: Type of aneurysm in study

Type of aneurysm in the study are A com Aeurysm-43, MCA Aneurysm-27, PCom Aneurysm-11, ICA Aneurysm-12, DACA-4, PICA-2, Basilar top-1.(Figure-1).

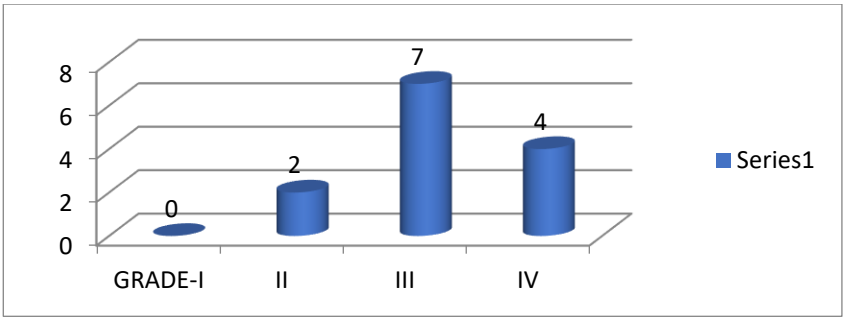

Fig 2: Fisher Grading in present study

No of patients with Grading of SAH according to Fisher was Gr. I-0, Gr. II-2(15.38%), Gr. III-7(53.84%), Gr. IV-4(30.76%). (Figure-2).

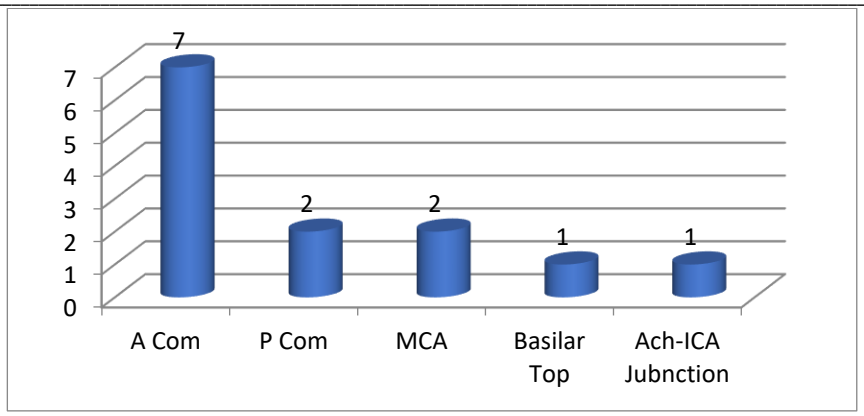

Fig 3: Rupture Rates in present study

IOR rates were A com-7(53.84%),P Com-2 cases(15.38%),MCA-2 cases (15.38%), Basilar top-1case (7.69%),Ach-ICA Junction -1case(7.69%). (Figure-3).

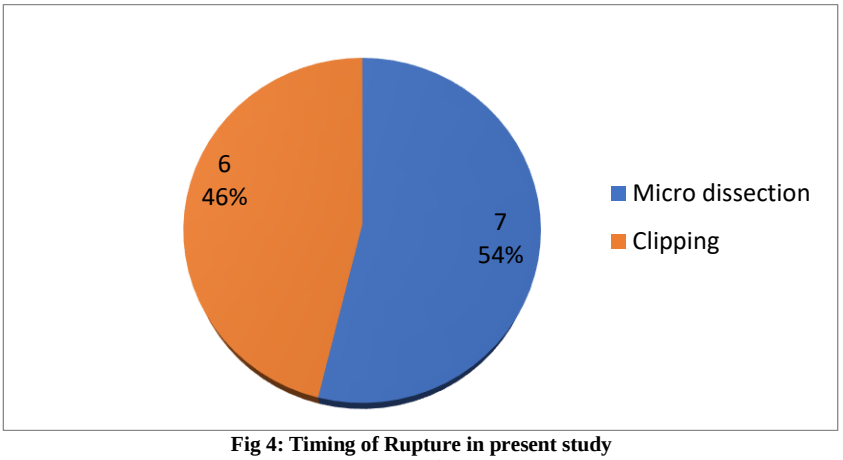

Fig 4: Timing of Rupture in present study

Timing of rupture was during micro dissection 46% during clipping 54%.(figure-4)

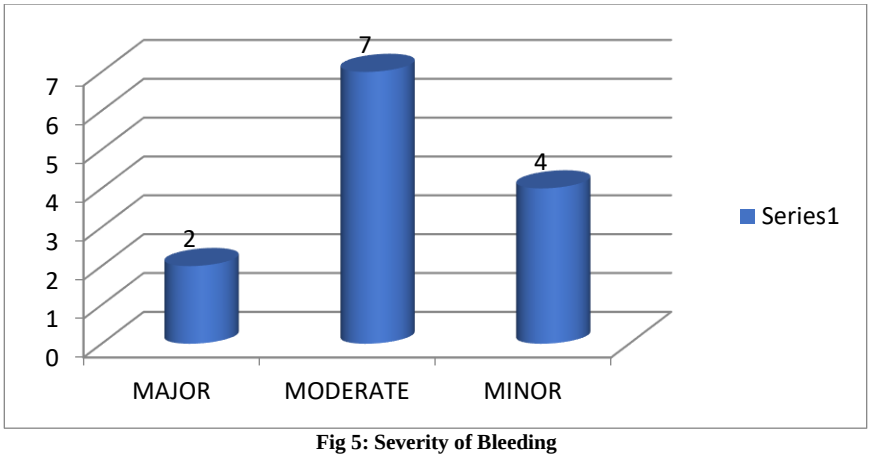

Fig 5: Severity of Bleeding

Severity of IOR Bleeding were minor 4 cases(30.7%), moderate-7 cases(53.84%),Major-2 cases(15.38%).(Figure-5)

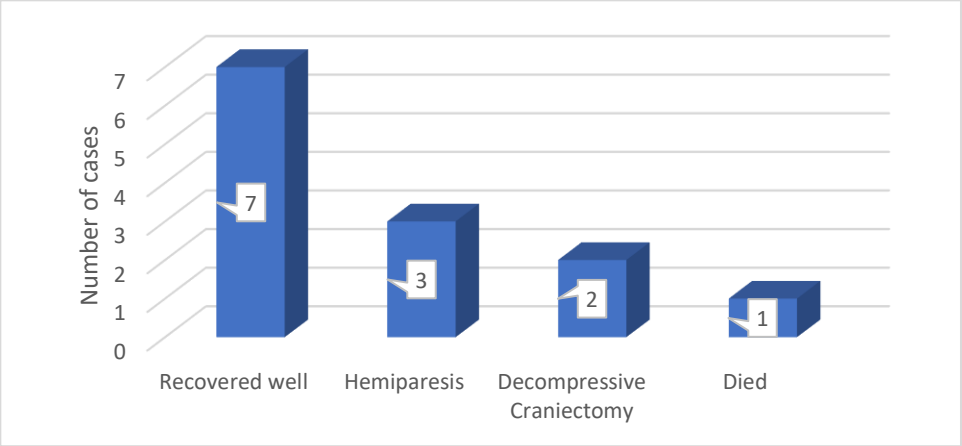

Fig 6: outcome in present study

Outcomes in IOR as 7(53.84%) cases recovered , 3 (23.07%)cases hemiparesis-, 2(15.38%) cases decompressive craniectomy and 1 (7.69 %)patients died.(Figur-6)

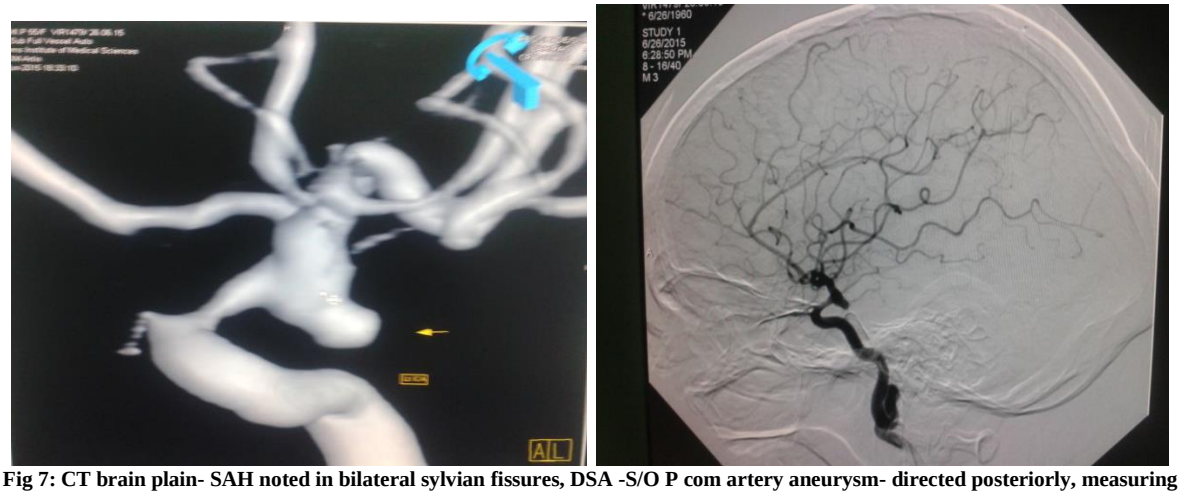

Fig 7: CT brain plain- SAH noted in bilateral sylvian fissures, DSA -S/O P com artery aneurysm- directed posteriorly, measuring 6.6x3.1x4.4 neck measuring 1.9mm. Treatment- Left pterional craniotomy plus clipping of aneurysm plus wrapping, Aneurysm ruptured during dissection. Temporary clip at proximal ICA for 3 minutes and patient recovered well.

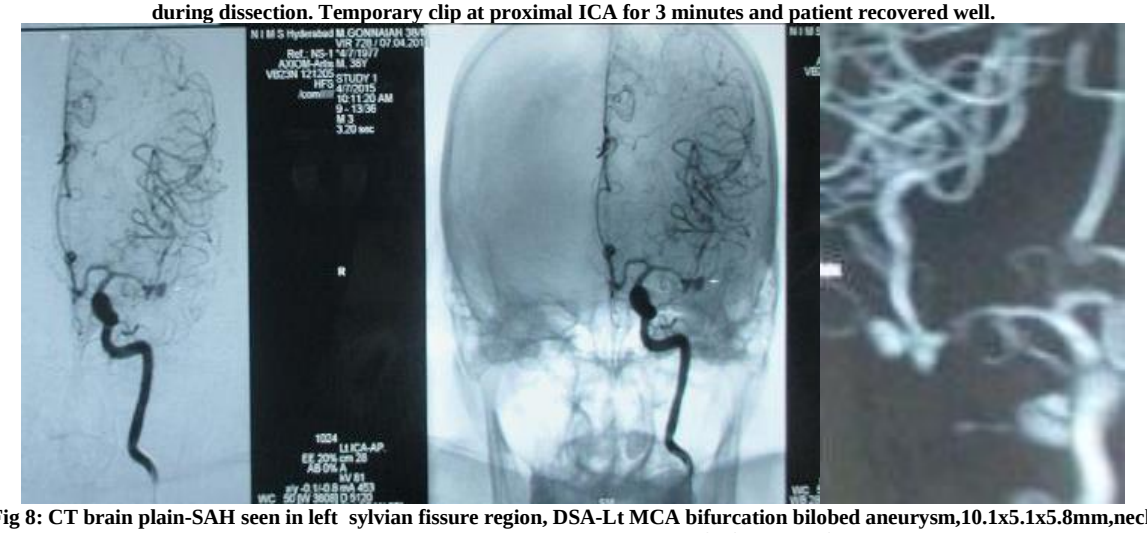

Fig 8: CT brain plain-SAH seen in left sylvian fissure region, DSA-Lt MCA bifurcation bilobed aneurysm,10.1x5.1x5.8mm,neck 3.76mm. Treatment:- Lt pterional craniotomy plus clipping of left MCA bifurcation aneurysm

Discussion

Intraoperative rupture of an intracranial aneurysm during microsurgical procedure still varies between 3.2 and 50%[1]. IOR of BAs (Blister like Aneurysms) occurs in approximately 40-60% of patients and morbidity associated with this hemorrhage has been extremely high[1,4]. The severity of IOR was categorized according to the description by Thomas and Jennifer as minor bleed, moderate bleed, and major bleed. Minor bleeds from the intraoperative rupture aneurysm were small and easily controlled by 3-French micro sucker. Moderate bleeding usually required temporary occlusion of the proximal arterial segment or tamponade of the aneurysm to stop the bleeding. Major IOR resulted in significant hemorrhage that was difficult to control. Few of the cases treated in the study figures are included at figure-7 and 8 who are treated.

S.F Chen et al[5] studied 211 patients with 228 aneurysms were treated ,there were a total of six IORs which represented an IOR rate of 2.84% per patient and 2.63% per aneurysm. The highest ruptures rates occurred in patients with internal carotid artery aneurysms (25%). Surgeries in the group with ruptured aneurysms had a much higher rate of IOR compared with surgeries in the group with unruptured aneurysms.

A S Kheĭreddin et al[6] showed incidence of IOR was 11.7% of the operated aneurysms and 13.7% of the patients. In our series we had 13% of IOR per aneurysm and 14.1% per patient.

We had higher rate of IOR in A Com Aneurysm surgery i.e.53.84% as compared to other series which has reported 40-60% of ruptures in Blister like aneurysms[4],reason for this variation could be ,because, we had operated more on A Com aneurysms.

Factors associated with IOR of Aneurysm are size, location, rupture status, elevated preoperative systolic blood pressure, Fisher grade, brain swelling and intracerebral hemorrhage seem to correlate with an increased incidence of IOR. In our series we had higher IOR rate in A Com aneurysm, smaller in size aneurysms, higher fisher grade and also if associated with cerebral edema. We found that cerebral oedema was associated with difficulty in brain retraction and microdissection around aneurysm, this was the time where most of our aneurysms ruptured.

Van Lindert EJ et al. reported the IOR rate was three times higher for surgeons who perform occasional aneurysm surgery compared to the single surgeon who performed more than 10 cases a year[7]. In our series more than two surgeons with varied surgical experience were involved in aneurysm microsurgery. Maneuvers to control IOR include Focal tamponade with a neurosurgical paddle, Temporary proximal and distal vascular control, Double suction technique, Induced hypotension and adenosine[8,9]. In the setting of minor bleeds, gentle tamponade, coagulation of the aneurysmal rent or suction with 3-French micro sucker may control the bleeding. Moderate bleeding usually requires temporary occlusion of the proximal vessel or using double suction technique for addressing the rupture point. *Hypotension* induced by propofol, thiopentone or adenosine can decrease the bleeding significantly and facilitate dissection of the aneurysm in moderate and major bleeding. Gianotta reported that additional use of hypotension to control IOR decreases favorable outcome significantly from 87% down to 38%. The use of temporary clips may be more effective and safer than induced hypotension[10,11].However, in addition to the above said techniques or medications to control bleeding when IOR of aneurysm occurs, the experience of the surgeon plays a major role in handling IOR. Hence there is always a learning curve in cerebrovascular micro neurosurgery.

Conclusion

High Fisher grade of ruptured aneurysms are associated with more chances of IOR. Avoiding undue retraction and sharp dissection around the aneurysm holds the key in preventing IORs.There is always a LEARNING CURVE in cerebrovascular surgery: Start it early under supervision!!

Limitations

Minor leaks may still be under reported, Surgical technique cannot be standardized, Experience of the surgeon varied in the series. Prospective study will give better insigh

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