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# Clinical Characteristics and Outcome of Ruptured Intracranial Aneurysms from East India: A Six-yearSingle Center Study.

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**ABSTRACT**

**Background:** The availability of information on intracranial aneurysms from different parts of the world has led to a better understanding of ethno-geographic variations of the disease. This uninhibitedly impacted positively on the evolution of management over the years.

**Methods:**This was a retrospective study of patients managed in a neurosurgical institution in East India. A search for patients managed for aneurysmal sub-arachnoid hemorrhage (aSAH) was made from the Operation theatre logbooks and patient details obtained from Integrated Hospital database system from June 2010 to November 2016. With the aid of a questionnaire, biodata, clinical profile, radiologic findings and management modalities were extracted. Data

analysis was carried out using SPSS for Windows, version 21 (SPSS, Inc., Chicago, Illinois, USA).

**Results:** A total of 107 patients with 126 aneurysms were Identified. Age of patients ranged from 14-76 years, with a mean age of 50.3 ±13. Peak incidence was at 6th decade. Mean age difference between genders was not significant (p-value, 0.631). There was a slight female preponderance with a Female to Male ratio of 1.4:1. Ictus to presentation interval varied between 1-69 days (Mean 9.1±11.6). Only 25.3% presented within the 1st 24 hours post ictus. The most common presenting features were severe throbbing headache (91.6%) and altered consciousness (50.5%). The predominant diagnostic modalities were Cranial CT and CT angiography. The Number of aneurysms ranged from 1 to 4, with a mean number of 1.18 aneurysms per patient (SD±0.5). Ninety-three (86.9%) occurred as single aneurysm while 14 (13.1%) were part of multiple aneurysms. Anterior communicating (ACOM) artery was the most common location of ruptured aneurysm (32.7%). The aneurysm largest mean diameter was 6.9mm (SD± 4.2). Sixty percent of the aneurysms were <7mm, and 88.6% were <10mm in diameter.

Clipping was the main treatment modality (83.2%) compared to Coiling (10.3%). Good outcome, defined as Glasgow Outcome Score (GOS) of 4& 5, was achieved in 77 patients (72%) while 30 patients (28%) had a poor outcome. A significant association was noticed between WFNS (World Federation of Neurological Societies) grade on admission and outcome at discharge. (p = 0.027).

**Conclusion:** The demographic profiles of ruptured intra-cranial aneurysms are largely consistent with findings in literature with acceptable outcomes. Mean size of aneurysms was< 7mm.

**Key Words:** *Ruptured, Intra-cranial aneurysms, Characteristics, outcome*

## INTRODUCTION

Intra-cranial aneurysms and their most dreaded complication, rupture, remain an important pathology that confronts the modern-day Neurosurgeon. Approximately 3-5% of new strokes are due to aneurysm rupture related subarachnoid hemorrhage.[1] Globally, the incidence has been stable but exhibits regional variation and is highest among Finnish population.[1,2]Several factors

have been studied and related to risk of rupture of intra-cranial aneurysms including size and location of the aneurysms, smoking, hypertension, excessive alcohol consumption, non-white ethnicity and female gender among others.[3]Clinical trials such as the (International Subarachnoid Aneurysm Trial) ISAT,(International Study of Unruptured Intracranial Aneurysm) ISUIA, and the (Barrow Ruptured Aneurysm Trial) BRAT among others have immensely contributed in re-defining clinical practice in intracranial aneurysms. However, these studies were mainly based on practice in more developed countries.[4–6] Unlike advanced countries, lack of national registry in developing countries like India have been identified as one of the reasons for lack of sufficient data and hence the need to develop one.[7]

This study aims to define the clinical characteristics and outcome of ruptured intracranial aneurysms as seen in a city in eastern India.



## METHODS

A retrospective analysis of consecutive cases of aneurysmal subarachnoid hemorrhage (aSAH) managed at the Neurosurgery department of an institute in Kolkata, West Bengal, India was conducted between June 2010 and November 2016. Operation theatre logbooks, and integrated computerized hospital database systems were searched. With the aid of a questionnaire, bio-data, clinical profiles e.g.; gender, time of the ictus, date of admission, consciousness levels, seizure history, headache history, social habits and co-morbidities. Radiologic modalities of diagnosis e.g. computed tomography scan (CT scan), CT angiography, DSA (Digital Subtraction Angiography), and in some cases magnetic resonance imaging(MRI)/MR angiography, radiologic findings; ruptured or unruptured, single or multiple, size of aneurysm and management modalities; clipping, coiling and wrapping were extracted. Data analysis was carried out using SPSS for Windows, version 21.

## RESULTS

A total of 107 patients with 126 aneurysms drawn from Kolkata and several neighboring cities were identified. All 107 patients had a ruptured aneurysm giving a total of 107 ruptured aneurysms with co-existing additional 19 unruptured aneurysms. Admissions were highest in the month of October (Figure 1).

**Demographics**

Age of patients ranged from 14-76 years, with a mean age of 50.3 ±13. Most cases (76.6%) occurred from 5th decade of life and above, with peak incidence at the 6th decade (29.9%). (Table 1)

There was a slight female preponderance with 62 (57.9%) females and 45 (42.1%) males resulting in a Female-Male ratio of 1.4:1. Among female patients, occurrence peaked earlier and extends over two decades (40-59 years) of life (see Table 1).The mean age for males was 49.58±12.4. The mean age for females was 50.8±13.5. No significant difference in mean age between the genders (t- test p-value 0.631).

**Clinical Features**

Ictus-to-presentation interval varied between 1-69 days (Mean 9.1±11.6). Only 25.3% presented within the 1$^{st}$ 24 hours post ictus, 41.8% presented within 72 hours, and 39.6% presented after 7 days.

Throbbing headache was the most common symptom reported in 98 (91.6%) patients followed by altered consciousness in 54 (50.5%) patients. (*Table 2.0*). Seizure was a presenting feature in 5.6% of patients. Pre-ictus systemic hypertension was present in 33 patients (30.8%). Only 7 (6.5%) had history suggestive of a sentinel bleed, 5 patients (4.7%) were known to have cardiac diseases, and 4 others (3.7%) have diabetes mellitus.

The neurological grades of patients at admission based on the WFNS grade of SAH was grade I (44.9%), grade II (24.3%), grade III (16.8%), grade IV (10.3%), and grade V (3.7%).

**Diagnosis and Aneurysm Characteristics**



All patients had a cranial CT scan as the initial evaluation modality. To identify site of bleeding, CT angiography after initial CT scan was done in 59.8% of patients.

Additional DSA was required for diagnosis after initial CT+CTA in seven (6.5%) patients. In 24 patients (22.4%), a combination of CT and DSA was used for diagnosis. Other investigation modalities such as MRI and MRA were utilized in diagnosis in 12 patients. (Figure 2)

Sub-arachnoid hemorrhage (SAH) was detected by CT scan in 106 patients (99.1%). Only one negative brain CT scan but diagnosis of SAH was confirmed with lumbar puncture.

ICH (Intracerebral Hemorrhage) and IVH (IntraventricularHemorrhage) were found in 24 patients each (22.4%), while 11.2% of patients had hydrocephalus on CT scan. (Figure 3) Anterior circulation aneurysms constituted 92.5% while posterior circulation aneurysms accounted for 7.5%. The anterior-posterior circulation ratio was 12.3 to 1.

The anterior communicating artery (A-COM) was the most common overall site of rupture (32.7%). It is the most common site among males (43.5%) but the second most common in females. (Table 3). The middle cerebral artery is the most common site of aneurysmal rupture in females (34.4%).The ratio of anterior circulation among gender is 1.4:1 in favor of the female gender, and 1.7:1 for posterior circulation in favor of males.

Of the 107 ruptured aneurysms, 93 (86.9%) occurred as single aneurysm while 14 (13.1%) were part of multiple aneurysms. Ten patients (9.3%) had 2 aneurysms, three (2.8%) had 3 aneurysms, and 1 (0.9%) had 4 aneurysms.

The maximum diameter of aneurysms encountered varied between 2.2-25.0mm with a mean of 6.9±4.2. Sixty percent of the aneurysms were <7mm. (Figure 4), and 88.6% were <10mm in diameter.



**Treatment and Outcome**

Eighty-nine patients (83.2%) were treated with clipping while 11 (10.3%) were coiled. Other treatment modalities including clip-wrap, wrapping, and clip-excision were used in the treatment of the remaining 7 (6.5%) patients.

The duration spent on admission ranged between 3-96 days with a mean in-hospital stay of 17.8 days (SD±14.4). A hundred (93.5%) of the patients survived and were discharged from the hospital. In-hospital mortality was recorded in 7 patients (6.5%). The Glasgow outcome score (GOS) of patients at discharge was GOS 1 (6.5%), GOS 2 (3.7%), GOS 3 (17.8%), GOS 4 (29.0%), and GOS 5 (43.0%)

Good outcome, defined as GOS of 4& 5, was achieved in 77 patients (72%) while 30 patients (28%) had a poor outcome defined as GOS 1-3 at discharge or referral to a secondary facility. A significant association was noticed between WFNS grade on admission and outcome at discharge. ($p = 0.027$). (Table 4)

## DISCUSSION

Ruptured aneurysms were conspicuously more common in October from this series which coincides with the end of the rainy season and beginning of the winter. There have been conflicting reports in the literature on the effect of seasonal variation on risk of rupture. In their study based on 920 cases, Kamatsu et.al opined that the occurrence of ruptured intra-cranial aneurysm was apt to be frequent in winter and infrequent in summer, but concluded that it could not be considered a great cause of rupturing of aneurysms.[8]

From this study, ruptured intracranial aneurysms (RIA) are rare below the age of 20 but the incidence increases with age and peaks inthe 6th decade of life (51-60years) irrespective of sex. However, it appears to peak a decade earlier in females compared to males. (Table 1). RIA is 1.4 times more common among females compared to males. There was no difference in mean age between males and females in this study. These findings agree with results of meta-analysis by Linn et al, and a population–based study by Dolati et al who reported female preponderance in ruptured intracranial aneurysms.[2,9] Similarly, both Dolati et al from the United states and Froelich et al from Australia found no difference in mean age between sex among their cohorts.[2,10]

Unlike ISUIA report of 23.7% headache, a high occurrence rate of headache in ruptured aneurysms was observed among our patients and it was the most common complaints (91.6%). This corroborates with another study from Lucknow, India where headache was seen in 98.2% of patients.[11]Carpenter et al did a systemic review and concluded that symptoms, including headache, have low specificity in diagnosing SAH but suggested that the presence of signs of meningeal irritation could increase sensitivity.[12] From our study, sudden onset throbbing

headache, altered consciousness, vomiting, and signs of meningeal irritation are leading features of ruptured intracranial aneurysm. (Table 2). Pre-ictus systemic hypertension was present in 30.8% of patients. Systemic hypertension has been identified as a risk factor for aneurysm rupture in PHASES study.[13]In Delhi, Northern India, 34% patients of surgical clipping group had hypertension at the time of presentation in preoperative period.[14]

The diagnosis of SAH was made mainly using non-contrast cranial CT scan in our patients. It demonstrated very high sensitivity with 99.1% SAH detection rate. In a meta-analysis by Duboshet al the authors established the high sensitivity and specificity of early brain CT scan in detecting aneurysmal SAH.[15] Most of our patients harbored a single ruptured aneurysm (86.9%). The incidence of multiple aneurysms among our patients was 13.1%. This corroborates with the incidence in Kenyan population where Nabaweesi-Batuka and Co-workers found multiple intracranial aneurysms in 14.05% of patients.[16]The ARETA ( Analysis of Recanalization after Endovascular Treatment of intracranial Aneurysm) study group from France reported a rate of 62.9% for single and 24.7% for multiple aneurysms.[17] Thevariability in aneurysm characteristics among different population group and geographic locations is a known phenomenon described by various researchers.[1,2,18]

The mean diameter of the aneurysms among our patients was 6.9mm, while 60% of the aneurysms were <7mm. With 92.5% of the aneurysms located on the anterior circulation, the dimensions of the ruptured aneurysms from this study appears to be inconsistent with projected rupture risk for aneurysms as reported in ISUIA study.[6] More recent studies have shown significant rupture rates among aneurysms <7mm with mean maximum diameters ranging from 6.4-6.6mm in various populations.[9,10] This brings to bare the need to individualize and do a proper risk analysis for aneurysm particularly when detected in an unruptured state irrespective of size.

The most common site of aneurysmal rupture was the anterior communicating artery (A-COM) seen in 32.7% of our patients. Of interest however the fact that while A-COM was also the most common site of rupture in males; the MCA (middle cerebral artery) was the most common site of rupture among females. (Table 3). Studies from Australia and Kenya have also reported the A-COM as the most common site of rupture.[10,16]A-COM location of aneurysms have been shown to have a significant association with rupture.[19] Anterior circulation aneurysms constituted 92.5%

while posterior circulation aneurysms accounted for 7.5%. The anterior-posterior circulation ratio was 12.3 to 1. The ratio of anterior circulation among gender is 1.4:1 in favor of the female gender, and 1.7:1 for posterior circulation in favor of males. The BRAT study reported anterior circulation aneurysms in 83% and posterior circulation in 17.5% while the ISAT had 97.3% anterior circulation aneurysms.[5]

The ratio of anterior-posterior circulation in patients with single ruptured aneurysm as seen by McDowell et al was 4.4:1.[20]The ratio of anterior circulation among gender is 1.4:1 in favor of the female gender, and 1.7:1 for posterior circulation in favor of males.Less proportion of patients (69.2%) presented with good WFNS grade (1 & 2) compared to 88% in ISAT study.[21]

Surgical clipping was the mainstay of treatment employed alone in 83.2% of patients. In some difficult cases, clipping was combined with other maneuvers such as wrapping, coiling, and excision and these constituted 6.5% of the treatment measures. Coiling alone was done in 10.3% of patients. We tend to coil posterior circulation aneurysms in our practice. Apart from aneurysm location, affordability of treatment modality by patients also favors clipping. In a National survey regarding practice patterns in cerebral aneurysms in India, Ambekar et al found that surgical clipping was the preferred treatment for anterior circulation aneurysms and endovascular treatment for aneurysms along the posterior circulation.[22]The Barrow Ruptured Aneurysm Trial also suggested that outcomes for posterior circulation aneurysms continued to favor coiling.[5] Coiling is fast becoming popular even in India.[23] The challenge of cost and affordability have, however, been identified in other parts of the world. Amine at al from Morocco concluded that cost of endovascular treatment of intracranial aneurysms remains high and represents a major handicap for the development of this technique in countries with low coverage by a health insurance.[24]

Good outcome, defined as GOS of 4& 5, was achieved in 77 patients (72%) while 30 patients (28%) had a poor outcome defined as GOS 1-3 at discharge or referral to a secondary facility. There was an in-hospital mortality rate of 6.5%.A study from Kerala, India found a good GOSin 63% and mortality of 26% at 3 months.[18] The higher mortality could be due to the higher number of co-morbidities among their patients mainly hypertension (56%) and diabetes mellitus (33%). We also observed that patients who had good WFNS score on admission (Grades 1&2) had a better postoperative outcome. (P-value, 0.027). This is consistent with reports in the

neurosurgical literatures on aneurysms.[25] It is expected that the outcome continues to improve with time after hospital discharge.Consequently, a follow up study to assess the long-term outcome of patients will give a better picture of management outcome.

## CONCLUSION

This study has brought to light the clinico-demographic profiles and outcome of ruptured intracranial aneurysms in our locality. The demographic profiles were to a large extent consistent with existing knowledge but most ruptured aneurysms were of small size. This information could be invaluable in developing a local management protocol that suits the needs of the people but is limited by being a single center experience. A multicenter prospective study is advocated.

**Declaration**: *The authors have no conflict of interest to declare.*



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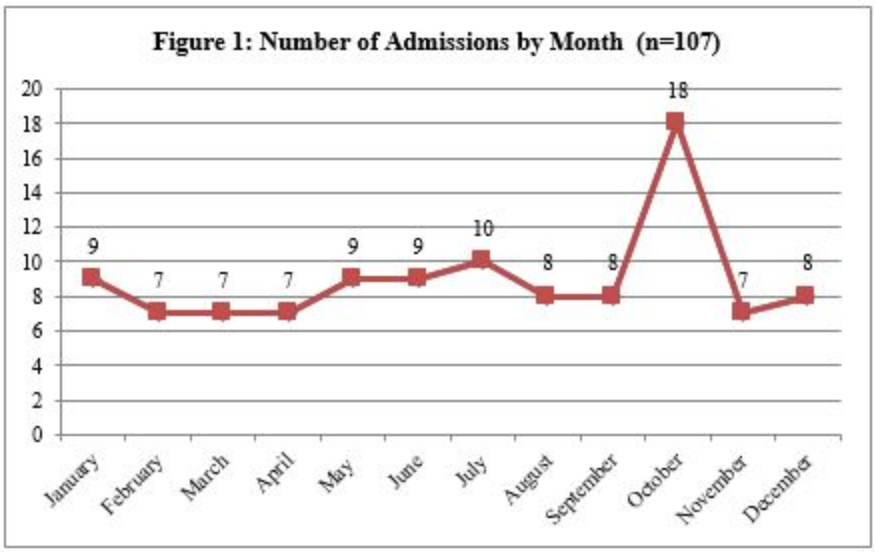
Figure 1: Number of Admissions by Month (n=107)
20
18
16
14
12
10
8
6
4
2
0
9
7
7
7
9
9
10
8
8
18
7
8
January
February
March
April
May
June
July
August
September
October
November
December

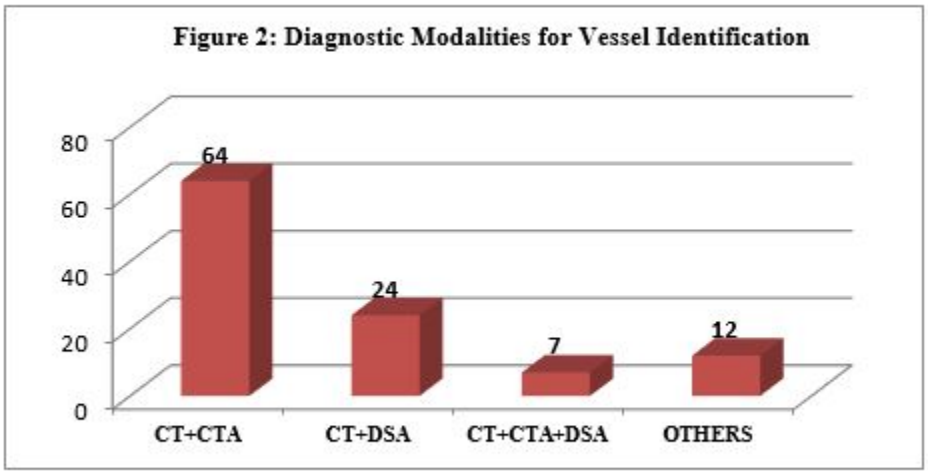
Figure 2: Diagnostic Modalities for Vessel Identification
80
60
40
20
0
64
24
7
12
CT+CTA
CT+DSA
CT+CTA+DSA
OTHERS

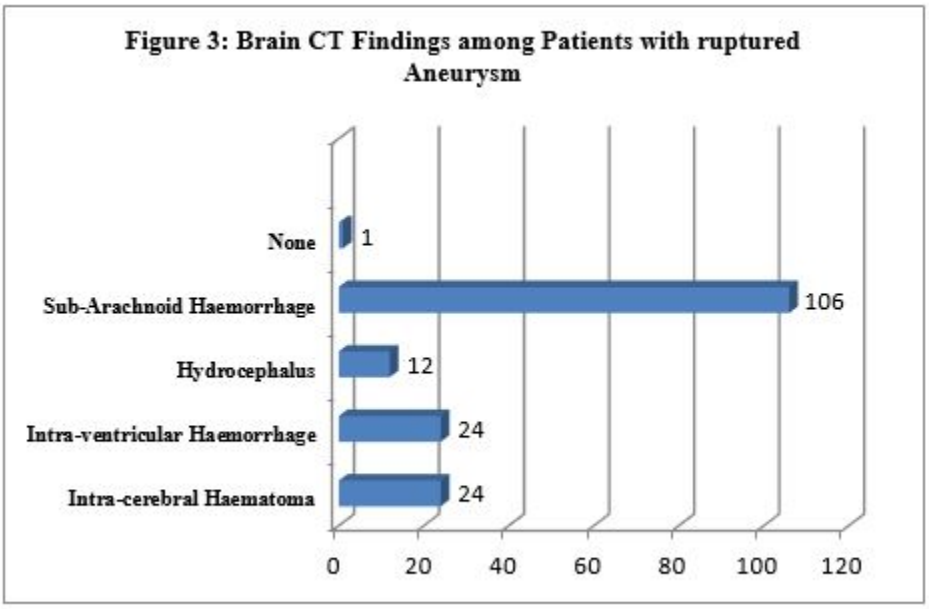
Figure 3: Brain CT Findings among Patients with ruptured Aneurysm
None
Sub-Arachnoid Haemorrhage
Hydrocephalus
Intra-ventricular Haemorrhage
Intra-cerebral Haematoma
1
106
12
24
24
0
20
40
60
80
100
120

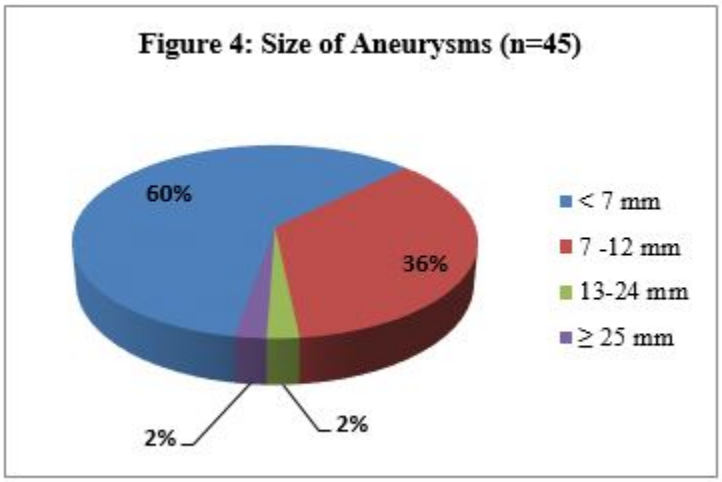

*Table 1: Distribution of Age by Gender*

| Age Group | GENDER | | TOTAL |
|---|---|---|---|
| | Male (%) | Females (%) | |
| **10-19** | 0 (00.0) | 1 (1.6) | 1 (0.9) |
| **20-29** | 6 (13.3) | 5 (8.1) | 11 (10.3) |
| **30-39** | 5 (11.1) | 8 (12.9) | 14 (12.1) |
| **40-49** | 11 (24.4) | 17 (27.4) | 28 (26.2) |
| **50-59** | 15 (33.3) | 17 (27.4) | 32 (29.9) |
| **60-69** | 5 (11.1) | 9 (14.5) | 14 (13.1) |
| **70-80** | 3 (6.7) | 5 (8.1) | 8 (7.5) |
| **TOTAL** | 45 (100.0) | 62 (100.0) | 107 (100.0) |

*Table 2: Clinical Features at Presentation*

| Clinical Feature | Frequency | % Frequency |
|---|---|---|
| Throbbing Headache | 98 | 91.6 |
| Altered Consciousness | 54 | 50.0 |
| Vomiting | 30 | 28.0 |
| Meningism* | 27 | 25.2 |
| Motor weakness | 26 | 24.3 |
| Dysphasia | 17 | 15.9 |
| Anisocoria | 7 | 6.5 |
| Seizures | 6 | 5.6 |

*Signs of meningeal irritation

**Table 3: Sites of aneurysm rupture by gender**

| VESSEL | GENDER | | TOTAL (%) |
|---|---|---|---|
| | Male (%) | Female (%) | |
| **Anterior Circulation** | **41 (89.1)** | **58 (95.1)** | **99 (92.5)** |
| **Anterior cerebral artery** | 4 (8.7) | 5 (8.2) | 9 (8.4) |
| **Anterior communicating artery** | 20 (43.5) | 15 (24.6) | 35 (32.7) |
| **Middle cerebral artery** | 11 (23.9) | 21 (34.4) | 32 (29.9) |
| **Posterior communicating artery** | 4 (8.7) | 9 (14.8) | 13 (11.2) |
| **ICA**** **-related branches** | 4 (8.7) | 9 (14.8) | 13 (11.2) |
| **Posterior Circulation** | **5 (10.9)** | **3 (4.9)** | **8 (7.5)** |
| **Posterior cerebral artery** | 0 (0.0) | 1 (1.6) | 1 (0.9) |
| **Basilar artery** | 2 (4.3) | 0 (0.0) | 2 (1.9) |
| **Vertebral artery** | 1 (2.2) | 0 (0.0) | 2 (1.9) |
| **TOTAL** | **46 (43.0)** | **61 (57.0)** | **107 (100.0)** |

** *Internal carotid artery*

Table 4: Factors affecting Outcome at discharge among Patients

| | Good outcome* | Poor outcome** | Total | Significant |
|---|---|---|---|---|
| WFNS Grade at Admission | | | | |
| 1 -2 | 58(54.2%) | 16(15.0%) | 74(69.2%) | $X^2$=4.895, |
| 3-5 | 19(17.8%) | 14(13.0%) | 33(30.8%) | p-value 0.027 |
| Total | 77(72%) | 30(28%) | 107(100%) | |
| Sex of Patients | | | | |
| Female | 42(44.6%) | 20(17.4%) | 62(57.9%) | $X^2$=1.3016, |
| Male | 35(32.4%) | 10(12.6%) | 45(42.1%) | p-value0.254 |
| Total | 77(72%) | 30(28%) | 107(100%) | |

**GOS 4&5, ** GOS 1 - 3*