Early Versus Late Clipping of Anterior Communicating Artery Aneurysm Regarding Karnofsky Score

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Abstract

Background: The anterior communicating artery (AComA) is the most common site for cerebral aneurysms, with a higher prevalence in men than in women. The age distribution of AComA aneurysms is similar to that of aneurysms in general. **Aims:** The study aims to evaluate the impact of early clipping compared to late clipping on the enhancement of Karnofsky Performance Score in patients diagnosed with anterior communicating artery aneurysms. This research is conducted due to the lack of literature addressing the optimal timing of the clipping procedure concerning pre-operative Hunt and Hess grades. **Materials and Methods:** This is a prospective clinical study performed in Neurosurgery Teaching Hospital, Baghdad, Iraq, to assess the effect of early clippings versus late clippings in 48 patients with A-com aneurysm on their KPS, between January 2018 to January 2021, followed up for 3 months. All patients were assessed preoperatively according to their age, Hunt and Hess grading score, and The Karnofsky Performance Status (KPS) on presentation. CT scan and CT angiography were used as the gold standard. Patients were admitted to the ICU for monitoring. We approach the aneurysm through pterional craniotomy, clip application, and papaverine is applied to all the exposed and manipulated vessels. Postoperatively, patients are monitored in the ICU according to their GCS, neurological examination, KPS, vital signs, and electrolyte level. All patients were sent for follow-up native brain CT scans. Informed consent was adopted from all patients and the study was approved by the ethical committee. **Results:** This study was done on 48 patients with A-com aneurysm. 58.3% of them were male with the mean age was (42.38 ± 10.688) years. The mean KPS pre-operatively was (59.4± 10.086), reaching (70.63 ± 9.087) on discharge, and (81.67 ± 8.078) on follow-up. 20 of those patients were Hunt and Hess grade 1, 16 were grade 3. There was a highly significant effect of Hunt and Hess grade and clipping timing on the KPS with a p-value less than 0.001. **Conclusion:** Patients with good pre-operative grades (H&H grades 1&2) demonstrated higher Karnofsky Performance Status (KPS) scores at discharge and during follow-up compared to those with poor pre-operative grades (H&H grades 3, 4, and 5).

Keywords: Karnofsky, Acom Aneurysm, Subarachnoid Hemorrhage.

Introduction

Key clinical studies have highlighted the anterior communicating artery (AComA) region as the primary location for intracranial aneurysms. In the original Cooperative Study of Intracranial Aneurysms and Subarachnoid Haemorrhage (1958 to 1965), 30.3% of 2349 aneurysms were in the ACoA region. The combined incidence of A1 segment–AComA–distal ACA aneurysms in this study was 34.6%. This incidence has remained steady over time. In the International Cooperative Study on the Timing of Aneurysm Surgery (1980 to 1983), AComA-ACA aneurysms accounted for 39% of cases.[1]

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In recent studies, aneurysms of the anterior communicating artery (AcoA) account for 23–40% of all intracranial aneurysms and unruptured aneurysms account for 12–15%, making them the most common type in patients under 30 years old.[2,3] Aneurysms on the anterior communicating artery usually develop on the side with the larger A1 segment when the proximal anterior cerebral

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arteries are unequal, and in the midportion when they are equal. Anomalies in the artery's development, such as incomplete coalescence, can lead to multiple channels or fenestrations, affecting aneurysm location.[4]

The anterior communicating artery (AComA) shows a higher prevalence in men than in women.[5] The age distribution of AComA aneurysms is similar to that of aneurysms in general. Patients with AComA aneurysms may experience a variety of focal deficits related to the position of the aneurysm. The blood flow distribution of the anterior cerebral artery (ACA) forms a butterfly pattern on the brain's inferior mesial and dorsal surfaces.[6,7] The main complication related to these aneurysms is the rupture leading to subarachnoid hemorrhage.[8] Symptoms of subarachnoid hemorrhage (SAH) include headache, dizziness, diplopia, photophobia, and neck stiffness.[4] Hydrocephalus, a complication of ruptured aneurysms, is more common in patients with anterior communicating artery aneurysms than in those with aneurysms at other locations. Other potential complications include intracerebral hemorrhage (ICH), subdural hematoma (SDH), intraventricular hemorrhage (IVH), cerebral ischemia, and infarction. Electrolyte disturbances, particularly hyponatremia, may also occur. Neurologic findings can range from visual symptoms due to optic nerve compression to hypothalamic/endocrinological symptoms and psycho-organic syndrome resulting from various ischemic or pressure-related mechanisms. Paraparesis or hemiparesis and extrapyramidal symptoms may also manifest due to specific artery distributions.[9] The study aims to evaluate the impact of early clipping compared to late clipping on the enhancement of Karnofsky Performance Score in patients diagnosed with anterior communicating artery aneurysms. This research is conducted due to the lack of literature addressing the optimal timing of the clipping procedure concerning pre-operative Hunt and Hess grades.

Materials and Methods

This is a prospective clinical study performed in Neurosurgery Teaching Hospital, Baghdad, Iraq, to assess the effect of early clippings versus late clippings in 48 patients with A-com aneurysm on their KPS, between January 2018 to January 2021, followed up for 3 months.

Pre-operative Assessment

All patients were assessed preoperatively according to their age, Hunt and Hess grading score, and The Karnofsky Performance Status (KPS) on presentation.

CT scan was the initial radiological test done for all patients that presented with clinical suspicion of SAH (Figure 1), while CT angiography was the standard test for the diagnosis of Acom aneurysm. (Figure 2) CT Angiography was necessary to visualize aneurysms and define treatment strategies, it detects the location, size, and configuration of the aneurysm, the relation of the aneurysm to the adjacent vessels, the direction of the dome, and the dominant A1.

Patients were admitted to the ICU for monitoring (GCS, new deficit, and controlling blood pressure) before surgery. All patients received prophylactic anti-epileptic drugs, calcium channel blockers, anti-hypertensive agents to achieve acceptable blood pressure levels, fluid resuscitation, and painkillers. Blood tests included complete blood count (CBC), renal function test(RFT), liver function test(LFT), electrolytes, bleeding profile, viral screen, and blood preparation.

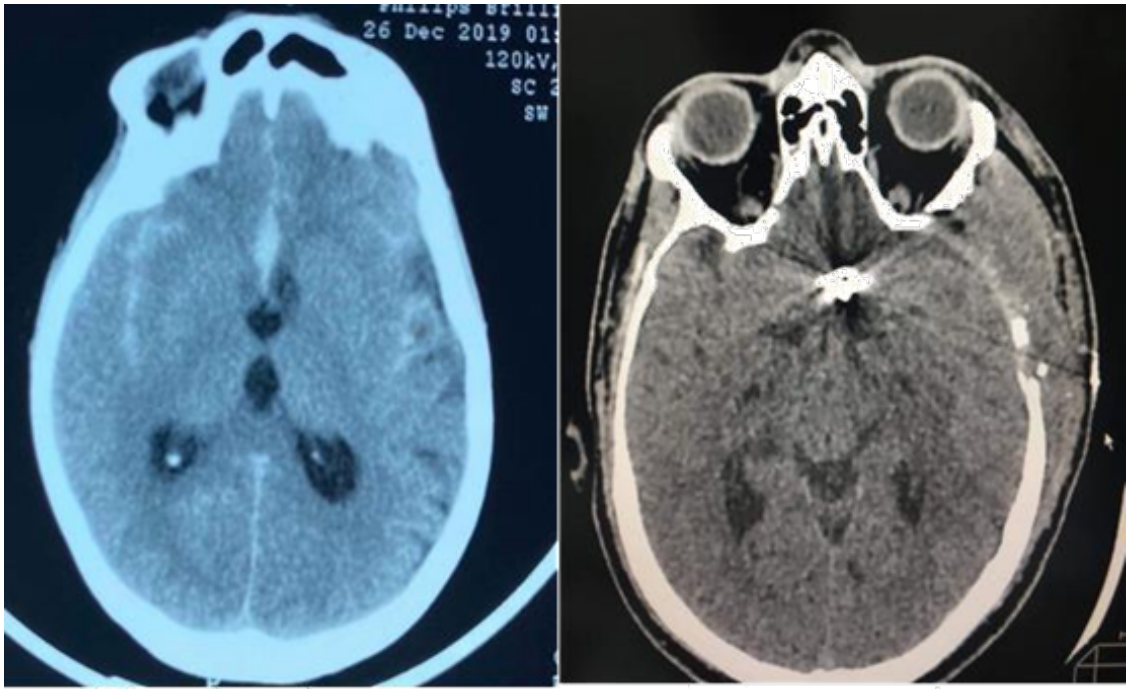

Figure 1: Non Contrast Axial Brain CT Scan with Diffuse SAH and Clip Application.

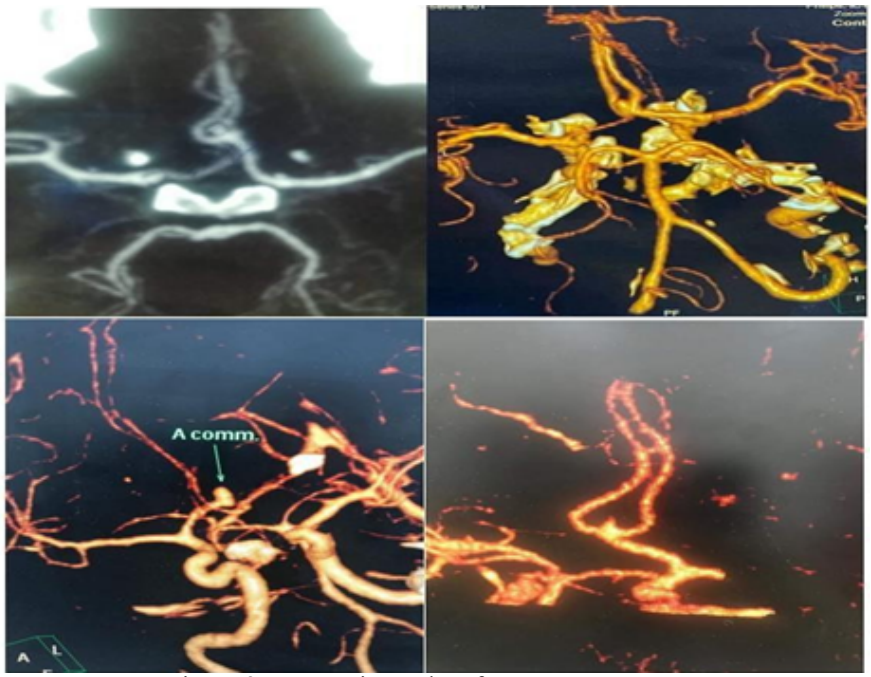

Figure 2: CT Angiography of Acom Aneurysms.

Operative Procedure and Post-operative Follow-up

We approach the aneurysm (according to the side of the dominant A1 segment and direction of the dome) through pterional craniotomy, clip application, and papaverine is applied to all the exposed and manipulated vessels (Figure 3).

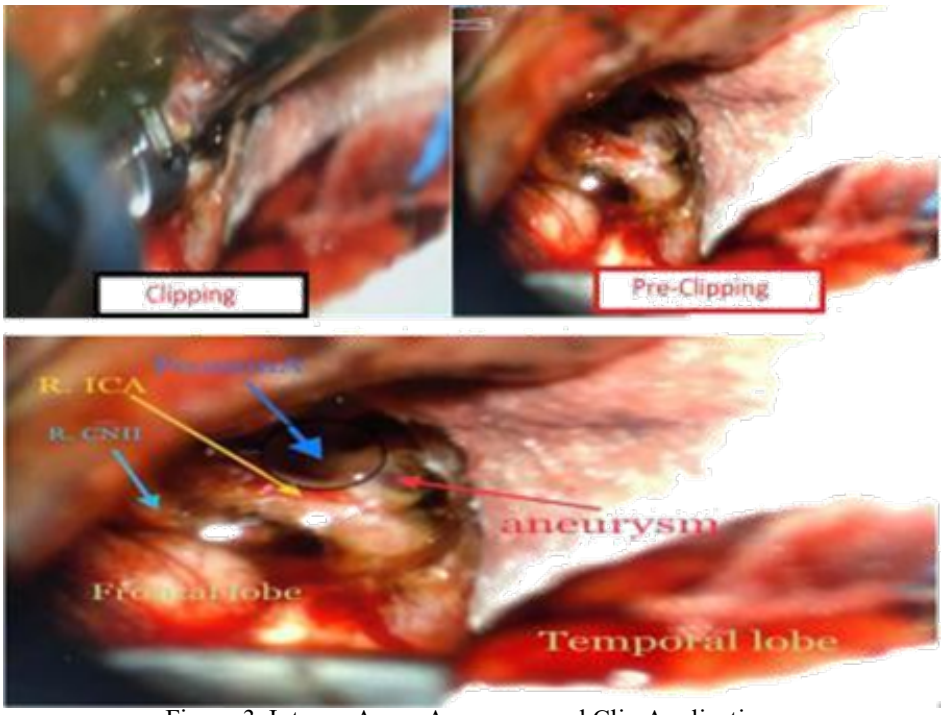

Figure 3: Intraop Acom Aneurysm and Clip Application.

Postoperatively patients are monitored in the ICU according to their GCS, neurological examination, vital signs, and electrolyte level. All patients were sent for follow-up native brain CT scans. Postoperative Patients monitoring continued in the ward till discharge home after wound stitches removal. Brain native CT scan was done after 3 months for all the patients during follow-up. Patients were also assessed using The Karnofsky Performance Status (KPS) (Figure 4).

Figure 4: Patient with Acom Aneurysm During Post-operative Period and on Follow Up in the Neurosurgery Teaching Hospital (with Permission).

The Hunt and Hess Scale

The Hunt and Hess scale categorizes the clinical severity of subarachnoid hemorrhage resulting from intracerebral aneurysm rupture, serving as a predictor of survival:
Grade 1: Asymptomatic or minimal headache with slight neck stiffness; 70% survival.
Grade 2: Moderate to severe headache with neck stiffness; no neurological deficit except cranial nerve palsy; 60% survival.
Grade 3: Drowsy with minimal neurological deficit; 50% survival.
Grade 4: Stuporous with moderate to severe hemiparesis, possibly early decerebrate rigidity, and vegetative disturbances; 20% survival.
Grade 5: Deep coma with decerebrate rigidity, moribund; 10% survival.[10,11]

The Karnofsky Performance Status (KPS)

The Karnofsky Performance Status (KPS) is a subjective measure used by healthcare providers to assess functional impairment in patients. It categorizes patients into ten levels, ranging from 0 (indicating deceased) to 100 (representing normal activity with no evidence of disease), with assessments typically taking 1-2 minutes to complete.

Table 1: Shows the Karnofsky Performance Status [12-14].

Percent	Performance Status
100	Normal; no complaints, no evidence of disease
90	Able to carry on normal activity; minor signs or symptoms
80	Normal activity with effort; some signs or symptoms
70	Cares for self but unable to carry on normal activity
60	Requires occasional assistance but can care for most needs
50	Requires considerable assistance and frequent medical care
40	Disabled; requires special care and assistance
30	Severely disabled; hospital admission indicated
20	Very sick; hospital admission is necessary
10	Moribund; fatal processes progressing rapidly
0	Deceased

Statistical Analysis

Data was entered and analysed using SPSS V.25 with a 95 confidence level. Descriptive statistics was used in the form of mean, standard deviation, and proportions. Repeated measures ANOVA was used to show the effect of preoperative grade, age, and clipping time on the KPS score (per, post-operative, and during the follow-up period).

Ethical Approval

Informed consent was adopted from all patients and the study was approved by the ethical committee.

Results

This study was done on 48 patients with A-com aneurysm, (2.1%) were in age groups 10-19 years, (4.2 %) were in age groups 20-29 years,(37.5 %) were in age groups 30-39 years, (39.5 %) were in age groups 40-49 years, (6.3 %) were in age groups 50-59 years and (10.4 %) were in age groups 60-69 years, the mean age was (42.38 ± 10.688)years;(58.3 %) were males, while (41.7 %) were females, male to female ratio was (7:5). (Table 2)

Table 2: Age and Gender Groups of Patients with A-com Aneurysm.

Variable	No.	%
Age groups Mean ± SD (42.38 ± 10.688) years		
0-9	0	-
10-19	1	2.1
20-29	2	4.2
30-39	18	37.5
40-49	19	39.5
50-59	3	6.3
60-69	5	10.4
Total	48	100.0
Gender groups (M:F ratio 7:5)		
Male	28	58.3
Female	20	41.7
Total	48	100.0

Regarding to the preop grade and time of surgery, (41.7 %) were grade one;(6.25 %) operated on 4-7 days, and (35.5%) operated on >15 days of rupture. (25 %) were grade 2; (10.4 %) operated on 4-7 days, (8.35 %) operated on 8-14 days and (6.25 %) operated on >15 days. (33.3 %) were grade three; (12.52 %) operated on 0-3 days, (14.53 %) on 4-7 days, and (6.25 %) operated on 8-14 days. (Table 3)

Table 3: Preop Grade and Surgical Timing in Patients with A-com Aneurysm.

	Preop Grade		
Time of Surgery (Days from Last Bleeding)	Grade 1	Grade 2	Grade 3
0-3	**0**	**0**	6
4-7	**3**	**5**	7
8-14	**0**	**4**	3
>15	**17**	**3**	0
Total	**20**	**12**	16
%	41.7	25	33.3

The mean KPS preop was (59.4± 10.086); 41.7 % was KPS 80, 10.4 % was KPS 70, 14,6 % was KPS 60, 33.3 % was KPS 30. The mean KPS on discharge was (70.63 ± 9.087); 2.1 % was KPS 90, 41.6 % was KPS 80, 29.2 % was KPS 70 and 27.1 % was KPS 60, While the mean KPS on follow-up was (81.67 ± 8.078); 2.1 % was KPS 100, 37.5 % was KPS 90, 45.8 % was KPS 80, 14.6 % was KPS 70. (Table 4)

Table 4: KPS Preop, on Discharge, and Follow-up of Patients with A-com Aneurysm.

Variable	No.	%
KPS (Pre-op) | Mean ± SD (59.4± 10.086)		
80	20	41.7
70	5	10.4
60	7	14.6
30	16	33.3
Total	48	100
KPS (on discharge)|Mean ± SD (70.63 ± 9.087)		
90	1	2.1
80	20	41.6
70	14	29.2
60	13	27.1
Total	48	100
KPS (on follow up) |Mean ± SD (81.67 ± 8.078)		
100	1	2.1
90	18	37.5
80	22	45.8
70	7	14.6
Total	48	100

Table 5: Correlation between the Pre-operative Grade, Surgery Time and Age Groups with the KPS in Patients with A-com Aneurysm.

Variable	No.	Mean KPS (Preop)	Mean KPS (on Discharge)	Mean KPS (on Follow Up)	*P Value
Preop Grade					
1	20	80	78.5	87.5	**< 0.01 Highly significant**
2	12	65	68.3	81.7	
3	16	30	66.3	76.9	
Surgery Time (Days from Last Bleed)					
0-3	6	30	73.3	80	**< 0.01 Highly significant**
4-7	15	58	.366	78.7	
8-14	7	47.5	63.3	75.6	
>15	20	72.5	78.5	87	
Age (Years)					
0-9	0	0	0	0	
10-19	1	80	80	90	
20-29	2	80	80	90	**0.495 Not significant**
30-39	18	58.3	67.8	80.6	
40-49	19	58.3	73.5	83.5	
50-59	3	72.5	76.7	86.7	
60-69	5	47.5	71.3	77.5	

* Correlation is significant at the 0.01 level (2-tailed).

Discussion

Regarding the age groups, there was no significant association between the age groups and improvement in the KPS (P=0.495). The most common age group in this study was the fourth decade of life in 39.5 % of patients, followed by third decades in 37.5 % of patients with a mean age was (42.38 ± 10.688) years. A study done by Krzyżewski *et al.*[14] also found that the most common age groups were the fourth decade of life with a mean age (47.62 ± 18.20. years).

In our study, most of the patients with AcomA were males in 58.3 %, this finding is similar to a study done by Xia *et al.*[15], which also found that 53.7% were male patients. Another study done by Park *et al.*[16], in his study observed that the male patients were more than the female patients. The pre-operative grade was based on the Hunt and Hess classification. In this study, the pre-operative grade correlated with improvement in the KPS; In good risk groups (grades 1 and 2), there was a highly significant improvement in the KPS compared with poor risk groups (grades 3, 4, and 5) with P<0.01. A study done by Bohnstedt *et al.*[17], that found a good H&H grade at presentation correlated to a good outcome at both discharge and the latest follow-up, they also observed that the majority of the patients had an H&H grade of 1. In another study done by Andaluz and Zuccarello[18] the majority of cases were H&H grade 1 and 2 and associated with good clinical outcomes at discharge and during the follow-up.

Preoperative KPS scores indicated moderate to severe functional impairment, with KPS 80 being the most common (41.7%). At discharge, mean KPS improved to 70.63, with KPS 80 remaining prevalent (41.6%). Follow-up KPS showed further improvement (mean 81.67), with KPS 80 (45.8%) and KPS 90 (37.5%) being the most common scores.

The most common timing for surgery among patients with AcomA was observed to be after 14 days, accounting for 41.6% of cases, followed by the 4-7-day range, which accounted for 31.2% of cases. Notably, early-time surgery within the first 3 days showed a highly significant improvement in the (KPS) score.

Regarding the correlation between surgical timing and improvement in patients' KPS, surgeries conducted within the first 3 days and those performed after 14 days post-rupture of AcomA demonstrated a significant enhancement in KPS compared to surgeries performed between days 4 and 14. It is important to note that there are no previous studies available for comparison regarding the effect of surgical timing of AComA on KPS, underscoring a gap in existing research on this topic.

The main limitations associated with this study are the small sample size and the limited follow-up duration. Another important limitation is that all these patents were of the same center.

In conclusion, patients with good pre-operative grades (H&H grades 1&2) demonstrated higher Karnofsky Performance Status (KPS) scores at discharge and during follow-up compared to those with poor pre-operative grades (H&H grades 3, 4, and 5). Additionally, early-stage surgery (<3 days) and late-stage surgery (>15 days) were associated with significant improvements in KPS compared to intermediate-stage surgery (4-14 days).

Conflict of Interest

The authors declare no conflict of interest.

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