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Effect of surgery for recurrent glioblastoma multiforme among Indians

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Abstract:
High-grade glioma continues to be one of the prevalent diseases linked to an unfavorable outcome. Therefore, it is of interest to investigate the prognostic value of reoperation in patients with recurrent glioblastoma. The sample size was divided into two subcategories solely in order to assess the effectiveness of a second surgery at glioblastoma advancement: (a) study participants who undergone re-resection usually accompanied by systematic therapy and (b) participants who received extra chemotherapy. The median overall survival (OS) was 26 months among the individuals who underwent re-surgery as opposed to 18 months in the nonsurgical category. Progression-free survival (PFS) varied considerably between re-surgery (thirteen months) vs. non-surgical (ten months) groups. Comparing the group receiving re-surgery (ten months) and the group receiving only systemic therapy (nine months), the median post-progression survival (PPS), did not change substantially. Our second procedure complication rate was under acceptable ranges and consistent with earlier reports**.** Despite good clinical outcomes in patients who underwent reoperation, we were unable to show survival advantages.

Keywords: Surgery, recurrent glioblastoma multiforme

Background:
The most frequent malignant brain tumour in adults is glioblastoma (GBM), which has a poor prognosis and increased possibility of recurrence **[1]**.The best therapeutic results have been achieved with aggressive multimodal therapy, including maximally radical and secure tumour excision, accompanied with stupponco-therapy programme **[2-4]**. The life expectancy of GBM patients has been significantly increased as a result of the use of pre-operative and intra-operative imaging procedures **[5]**. These techniques maximise tumour cyto-reduction and reduce surgical morbidity. Although patient survival rates increased gradually in the beginning of introduction and application of temozolomide, they have plateaued during the past 5–10 years **[6-7]**.

Despite recent advances in the rate of overall survival (OS) and progression-free survival (PFS), owing to implementation of the Stupp regimen, high-grade glioma continues to be one of the more prevalent diseases having unfavorable outcome. When possible, complete surgical dissection is used as the accepted standard of management **[7-8].** This is followed by radiation and temozolomide (TMZ) as concurrent and complementary regimens [**9].** Tumour recurrence is regrettably common in these patients, despite better treatment results. At this stage, alternatives therapy includes chemotherapy, resection, and radiotherapy, given either individually or in combination of two or more therapy **[10]**. There is no agreement on the best course of treatment for recurrent GBM due to the shortage of successful alternative onco-therapy or clear guidelines for surgical removal of re-growing tumour.

In local regional therapy, a re-operation and irradiation therapy is frequently used **[11-12]**. Patients usually receive therapy according to clinical situation, because there is no standard second-line chemotherapy medication. Bevacizumab has shown to have a high rate of response when used in clinical practise for recurrent glioblastoma **[7-8]**. However, modifications in vascular permeability might be the cause of this transient effect. Lomustine and fotemustine, two nitrosurea-based treatment approaches, offer negligible additional survival effects either independently or when used together **[9]**. In clinical studies, newer approaches including immunotherapy, targeted drugs, or innovative radiation techniques have produced encouraging results; yet, further confirmation is required **[10]**. However, a small percentage of patients can benefit from a re-operation due to their poor clinical prognosis or involvement of important brain regions. Due to the retrospective approach used in a large number of studies, the variability of the clinical situation, which always indicates significant selection bias, and the absence of potential gathering of data, current information on the significance of a second procedure in recurrent glioblastoma remains deficient in a considerable amount of clinical testimony **[11-12]**. Therefore, it is of interest to investigate the prognostic value of reoperation in patients with recurrent glioblastoma.

Methods:
Patient selection:
In accordance with the 2016 WHO guidelines **[13]**, we conducted a retrospective analysis of patients who had new histological findings of glioblastoma at our hospital during May 2008 and June 2023. The observation period was till July 15, 2023. Groups of patients having resection and biopsy were separated based on the size of the primary operation. Deep-seated or multicentric placement, involvement of vital regions of brain, and diseases that would limit a debulking surgery was the key indicators of biopsies. Patients in our target cohort had their tumour surgically removed and then received additional complimentary treatments when the disease

progressed and required management. Patients who had been solely diagnosed by biopsy, who did not receive treatment according to the Stupp regulations following the initial surgery, or who were not being diligently treated following disease progression were omitted from the research group.

Our research sample was divided into two subcategories solely in order to assess the effectiveness of a second surgery at glioblastoma-recurrence: (a) study participants who undergone re-resection usually accompanied by systematic therapy and (b) participants who received extra chemotherapy only. Our interdisciplinary tumour committee discussed all individuals with recurrent illness. Although there isn't a clear protocol in place at our institution, individuals with a favorable clinical condition with tumour that develop close to the previous cavity and don't involve eloquent cortical regions, basal ganglia, diencephalic structures, or brainstem structures are generally considered for re-intervention having PFS usually greater than 9 months.

Clinical variables:
Age, gender, multiple medical conditions, clinical symptoms, tumour position, and approximated volume in cubic centimeters according to the abc/2 method were assessed in medical records. If there was any remnant contrast-enhanced picture in a preliminary postoperative MRI imaging, the degree of excision (EOR) was classified as whole (GTR) or limited (STR). Surgical assistants were used either for standard neuro-navigation or for "advanced" techniques like 5-ALA fluorescence assistance or intraoperative MRI. After the initial surgical procedure, during the initial progression, after the second operation, and at the secondary progression, patients' clinical state was determined using the Eastern Cooperative Oncology Group (ECOG) assessment. Patients were split into groups with symptoms (ECOG 2-3-4) and those without symptoms or with minor symptoms (ECOG 0-1). The success of the full first-line of treatment was evaluated. The Landriel-Ibaez classification **[14]** was used to classify all observed problems. Finally, we segmented our sample based on the year in which patient received their diagnosis. Date, clinical traits, and therapeutic selection at progression were recorded. Age and PFS (a pair of continuous variables) were also recorded with the median of the investigated group serving as the cutoff level.

Outcomes:
According to study participants who remained alive at the research's conclusion or who did not return to follow-up, OS was characterised as the period that elapsed from the patient's first medical diagnosis till death from any reason whatsoever. According to the RANO criteria, PFS was outlined as the period of time from diagnosis to an observable tumour recurrence in neuroimaging **[15]**. Follow-up pictures at eight to twelve weeks were used to monitor MRIs with an elevated likelihood of pseudo-progression **[16]**. Additionally, post-progression survival (PPS), which is measured as the interval between a tumour recurrence and death from any factor, was taken into account.

Statistical analysis:
The analyses were conducted using SPSS 22.0 (IBM, Armonk, NY), a statistical programme. Continuous data are provided as medians along with ranges, whereas categorical parameters are shown as rates and proportions. The Mann-Whitney U comparison test and two separate tests were used to compare groups. Survival curves generated by Kaplan-Meier were used to demonstrate the results of a log-rank test-based survival evaluation. In order to account for confounding factors in survival, the hazard ratios (HR) and 95 percent confidence intervals (CI) were obtained using multivariate as well as univariate proportional hazards regression models **[17]**. A p value of 0.05 or less was regarded as significant.

Results:
In 428 cases (61.2%) out of the 700 participants with freshly diagnosed glioblastoma, complete resection was attempted. We did not include 272 patients whose diagnoses came from stereotactic or open biopsies. 96 patients were eliminated from the survival study as they did not receive any more oncological care in our hospital following surgical resection for a variety of various clinical reasons. The rate of reoperation in our study was 16.5%. Each patient had 60 Gy of radiation therapy, and they all completed variable cycles of temozolomide adjuvant. At progression, 66 instances (group I) chose a combination of an additional surgical procedure accompanied with chemotherapy regimens, 168 patients (group II) received chemotherapy, and the remainder of the 98 cases (group III) receiving BSC underwent exclusion.

Table 1 provides a summary of the key traits of the 234 patients (groups I+II) who made up the study population. The cohort's average age was 59 years old. Regarding EOR, Stupp regimen completion, medical condition at disease recurrence kind, and radiological trajectory of advancement, there were notable differences across groups. After the initial surgery, we were unable to identify any variations in gender, years of age, tumour magnitude or position, health-related comorbidities, or problems. The molecular indicators did not reveal any differences. The uniformity of the chosen cohort is shown by these findings.

The median OS was 26 months among the individuals who underwent re-surgery as opposed to 18 months in the nonsurgical category (, p = 0.004). PFS varied considerably between re-surgery group (thirteen months) vs. non-surgical group (ten months) (p = 0.002). Comparing the group receiving re-surgery (ten months) and the group receiving only systemic therapy (nine months), the median post-progression survival (PPS) did not change substantially (p = 0.143).The effect of important factors affecting prognosis were found using a univariate proportional hazard assessment.
The findings showed that OS was significantly correlated with patients having a minimum of six phases of temozolomide (p =0.001), having a PFS equivalent to or greater than 10 months (p= 0.001), poor score on the ECOG scale at advancement (p = 0.002), and being a member of the re-surgery category (p = 0.006). When PPS is taken into account as the final result, our findings show that patients who were in good medical condition at advancement (p = 0.002) and individuals that were identified and managed recently

(2012-2019, p = 0.021) are linked to prolonged PPS. Treatment modality (p = 0.16) and longer PFS (p = 0.836) had been no longer linked to improved survival (Table 2,3).

At progression, after considering the most important variables, there were no OS differences between the treatment modalities. The sole factor statistically linked to better OS in our cohort appears to be an extended progression-free interval. A favorable clinical circumstance at progression or having undergone surgery in the most current phase of the research (2012–2019) appears to favor PPS in this situation.

We come to the conclusion that an extended progression-free duration as well as low ratings (0 or 1) according to the ECOG index at advancement keep influencing OS independently of one another, but if we take into account the date of resection, it appears that a second operation may have a detrimental effect on survival. Table 6 provides a summary of all outcomes.

Table 1: Clinical properties of the compared groups (*n* = 234 patients)

Variableof significance	Cases of Reintervention (*n* = 66)	Cases of Chemotherapy (*n* = 168)	*p value*
Age (years) details			0.085
Mean values	53.92	58.81	
Median values	56.11	59.11	
Range values	8–71	32–77	
Sex details			0.364
Male gender	34	102	
Female gender	32	33	
Comorbidities			0.351
Presence of comorbidity	14	50	
Absent of comorbidity	52	108	
Resection at first surgery details			0.036
GTR details	58		
STR details	08		
ECOG 1 status			0.295
Asymptomatic/mild conditions	30	70	
Symptomatic conditions	3	14	
Chemotherapy (TMZ)			0.001
Complete Stupp followed	28	40	
Incomplete Stupp followed	5	44	
Progression			0.020
Only radiological assessment	24	31	
Clinical assessment	9	53	
ECOG 2			0.001
Asymptomatic/mild conditions	27	45	
Symptomatic conditions	6	39	

Table 2: Analysis of different variables and their correlation with OS in study participants

Variable of significance	Amount. of events/ Amount of patients (*n* = 234)	Values of HR (CI 95%)	*p* value
Age (years)			0.351
< 58 years	106/112	0.94 (0.79 –2.25)	
≥ 58 years	116/122	1	
Comorbidities			0.595
Absent comorbidity	160/170	0.80 (0.61–2.57)	
Present comorbidity	62/64	1	
Volume			0.270
< 24 cm^3	112/116	0.94 (0.71–2.30)	
≥ 24 cm^3	110/118	1	
Surgical assistants role			0.961
Advanced assistants	88/98	0.94 (0.68–2.63)	0.782
Navigation assistants	82/84	0.84 (0.68–2.66)	0.961
No assistants	52/52	1	
Complications observed			0.741
No complications	164/174	0.83 (0.71 –1.53)	
Any complications	58/60	1	
Resection at first surgery carried out			0.179
GTR mode	166/174	0.81 (0.58–2.25)	
STR mode	56/60	1	
ECOG 1 status			0.096
Asymptomatic/mild condition	188/200	0.82 (0.49–2.19)	
Symptomatic condition	34/34	1	
First surgery date data			0.148
Recent (2012–2019) cases	154/166	0.86 (0.51–2.22)	
Old (2005–2011) cases	136/136	1	
Chemotherapy status			< 0.001
Complete Stupp followed	126/136	0.61 (0.43–0.82)	
Incomplete Stupp followed	96/98	1	
ECOG 2 status			0.002

Asymptomatic/mild condition	134/144	0.76 (0.48–0.91)	
Symptomatic condition	88/90	1	< 0.001
PFS			
≥ 10 months	108/118	0.52 (0.3–0.69)	
< 10 months	114/116	1	
Treatment groups			0.006
Reintervention carried out	58/66	0.76 (0.45–0.94)	
Chemotherapy carried out	164/168	1	

Table 3: Analysis of different variables and their correlation with post-progression survival (PPS) in study participants

Variable of significance	Number. of events/No of patients (*n* = 334)	Values of HR (CI 95%)	*p* value
Age (years)			0.235
< 58 years	106/112	0.91 (0.84–2.18)	
≥ 58 years	116/122	1	
First surgery date			0.021
Recent (2012–2019) cases	154/166	0.72 (0.51–0.83)	
Old (2005–2011) cases	68/68	1	
Resection at first surgery data			0.492
GTR cases	166/174	0.91 (0.66– 2.43)	
STR cases	56/60	1	
Chemotherapy			0.791
Complete Stupp achieved	126/136	0.89 (0.75– 2.49)	
Incomplete Stuppacheived	94/98	1	
ECOG 1 data			0.219
Asymptomatic/mild conditions	188/200	0.82(0.64–2.3)	
Symptomatic conditions	34/34	1	
ECOG 2 data			0.002
Asymptomatic/mild conditions	134/144	0.63 (0.57–0.94)	
Symptomatic conditions	88/90	1	
PFS (months)			0.836
≥ 10 months	108/118	0.88 (0.87–2.51)	
< 10 months	114/116	1	
Treatment groups			0.166
Reintervention carried out	58/66	0.84 (0.58–2.24)	
Chemotherapy carried out	164/168	1	

Table 4: Analysis of different variables and their correlation with OS and PPS in study participants

Variable of significance	Number of events/Number of study participants (*n* = 334)	Values of HR (CI 95%)	*p* value
Reintervention as a time directedvariable			0.028
Re-intervention carried out	58/66	1.01 (0.21–1.91)	
No reintervention	164/168	1	
Chemotherapy details			0.798
Complete Stupp followed	126/136	0.86 (0.68 –2.87)	
Incomplete Stupp followed	94/98	1	
ECOG 1 status			0.296
Asymptomatic/mild condition	188/200	0.81 (0.51–2.32)	
Symptomatic condition	34/34	1	
ECOG 2 status			0.022
Asymptomatic/mild conditions	134/144	0.79 (0.59–0.88)	
Symptomatic condition	88/90	1	
PFS			0.023
≥ 10 months	108/118	0.54 (0.34–0.95)	
< 10 months	114/115	1	

Discussion:

Treatment for recurrent glioblastoma is still a difficult therapeutic choice **[16-18]**.Various efforts have been undertaken to determine whether to continue surgical therapy as the condition advances. There have been introduction of different scoring systems that take into account the clinical status of the patient, the size of the tumour, and the presence of eloquent cortex as well as ependymal tissue **[19-21]**. The description of specific indicators is lacking in literature, which reveal characteristics linked to improved prognosis and usually connect second operations with an increased likelihood of survival in chosen candidates **[22-24]**.Due to their poor clinical prognosis or involvement of significant brain regions, only a small percentage of patients can benefit from a second surgery. Current knowledge on the significance of a second procedure in recurrent glioblastoma is still lacking in a significant amount of clinical testimony, primarily due to the retrospective approach used in a large number of studies, the variability of the clinical situation, which always indicates significant selection bias, and the absence of potential data gathering **[21-22]**. This study's goal is to examine the prognostic significance of reoperation in individuals with recurrent glioblastoma. In present research, 428 cases (61.2%) out of the 700 participants with a newly diagnosed glioblastoma diagnosis, complete resection was attempted. We did not include 272 patients whose diagnoses came from stereotactic or open biopsies. 96 patients were eliminated from the survival study and did not receive any more oncological care in our hospital following surgical

resection for a variety of various clinical reasons. The rate of repeat surgery is 16.5%. Each patient had 60 Gy of radiation therapy, and they all finished varying numbers of temozolomide adjuvant rounds. At progression, 66 instances (group i) chose an amalgam of an additional procedure accompanied by various chemotherapy regimens, 168 patients (group ii) received chemotherapy, and the remainder of the 98 cases (group ii) receiving BSC underwent exclusion.

In 428 cases (61.2%) out of the 700 participants with freshly diagnosed glioblastoma, complete resection was attempted. We did not include 272 patients whose diagnoses came from stereotactic or open biopsies. 96 patients were eliminated from the survival study as they did not receive any more oncological care in our hospital following surgical resection for a variety of various clinical reasons. The rate of reoperation in our study was 16.5%. Each patient had 60 Gy of radiation therapy, and they all completed variable cycles of temozolomide adjuvant.At progression, 66 instances (group I) chose a combination of an additional surgical procedure accompanied with chemotherapy regimens, 168 patients (group II) received chemotherapy, and the remainder of the 98 cases (group III) receiving BSC underwent exclusion. Table 1 provides a summary of the key traits of the 234 patients (groups I+II) who made up the study population. The cohort's average age was 59 years old. Regarding EOR, Stupp regimen completion, medical condition at disease recurrence kind, and radiological trajectory of advancement, there were notable differences across groups. After the initial surgery, we were unable to identify any variations in gender, years of age, tumour magnitude or position, health-related comorbidities, or problems. The molecular indicators did not reveal any differences. The uniformity of the chosen cohort is shown by these findings. The median OS was 26 months among the individuals who underwent re-surgery as opposed to 18 months in the nonsurgical category (p = 0.004). PFS varied considerably between cohorts (thirteen months vs. ten months; p = 0.002). Comparing the group receiving re-surgery (ten months) and the group receiving only systemic therapy (nine months), the median PPS did not change substantially (p = 0.143).

Our series' median results for OS and PFS are consistent with previous literature reviews **[21]**. Comparing our rate of repeat surgery (16.5%) to previous research' percentages **[22, 23]** we find that it is marginally lower. This could be affected by several center indications for a "redo" procedure. High-grade glioma continues to be one of the more common diseases associated with a poor prognosis, despite recent modest improvements in the rate of OS and PFS, coupled with the deployment of the Stupp regimen **[12-13]**. Maximum surgical dissection is employed as the established standard of care whenever it is practical. Radiation and temozolomide concurrent and complimentary regimens are then administered. Despite excellent treatment outcomes, tumour regrowth is tragically the norm in virtually all patients. **[14,15]**.Alternatives at this point include other backup chemotherapy strategies, excision, further radiotherapy, or tumour therapeutic fields, either separately or in combination **[16,17]**.

In most cases, individuals who have already undergone a partial resection are not candidates for a second operation. However, some papers include individuals in the "surgical group" who underwent biopsies or even incomplete initial resections **[24-25]**. Additionally, our group does not take into account re-intervention in tumour that has distant, contralateral, or multicentric spread **[30]**. Even while some writers showed benefits in OS with recurrent procedures, multiple resections are rarely taken into account **[21]**. However, our main rationale was radiological tumour development with limited symptoms. Some data show a high probability of patients experiencing new neurological impairments preceding the second operation **[25]**. Different institutions' indications might underestimate or overstate the clinical value of a number of operations.

Data shows that after considering the most important variables at progression, there were no OS differences between the treatment modalities. The sole factor statistically linked to better OS in our cohort appears to be an extended progression-free interval. A favorable clinical circumstance at progression or having undergone surgery in the most current phase of the research (2012–2019) appears to favour PPS in this situation. We come to the conclusion that an extended progression-free duration as well as low ratings (0 or 1) according to the ECOG index at advancement keep influencing OS independently of one another, but if we take into account the date of resection, it appears that a second operation may have a detrimental effect on survival. Our overall total resection percentage in the second procedures is significantly greater than that in other papers **[20-23]**. Our second procedure complication rate (8 out of 66 patients; 12%) was under acceptable ranges and consistent with earlier reports **[22-24]**. Despite good clinical outcomes in patients who underwent reoperation, we were unable to show survival advantages. Reintervention actually appeared to have the opposite effect of survival when it was analyzed as a time related covariate variables. We think that re-intervention investigations **[20-25]** have the potential to introduce a large selection bias that favors the best participants for repeat procedures. According to a number of studies, favorable clinical traits may have a higher impact on surgical cohorts' OS than the actual procedure. A subgroup investigation was conducted previously to better evaluate this question, removing patients in the group serving as a control who were exceptionally unlikely to be evaluated for reoperation, which may have indicated a far less substantial impact of subsequent operations on prognosis **[26]**. But the starting OS variation across the categories was 10.9 months.

Data shows that the effect of important factors affecting prognosis were found using a univariate proportional hazard assessment. The findings showed that OS was significantly correlated with patients having a minimum of six phases of temozolomide (p =0.001), having a PFS equivalent to or greater than 10 months (p= 0.001), low score on the ECOG scale at advancement (p = 0.002), and being a member of the re-surgery category (p = 0.006). When PPS is taken into account as the final result, our findings show that patients who were in good medical condition at advancement (p = 0.002) and individuals that were identified and managed recently (2012-2019,

p = 0.021) are linked to prolonged PPS. Treatment modality (p = 0.16) and longer PFS (p = 0.836) had been no longer linked to improved survival. Since there is no approved second-line chemotherapy drug, patients typically receive treatment based on clinical situation. For recurrent glioblastoma, bevacizumab has demonstrated a high rate of response when used in clinical usage **[7-8].** However, this momentary effect might be brought on by changes in vascular permeability. Both separately and in combination, the nitrosurea-based therapy modalities of lomustine and fotemustine provide modest extra survival effects **[9].** Newer methods, such as immunotherapy, targeted medications, or creative radiation treatments, have shown intriguing effects in clinical tests, although more proof is needed **[10].**

Data shows that at progression, there were no OS differences between the treatment modalities. The sole factor statistically linked to better OS in our cohort appears to be an extended progression-free duration. A favorable clinical circumstance at progression or having undergone surgery in the most current phase of the research (2012–2019) appears to favor better PPS in this situation. Re-intervention has not been shown to increase survival, according to certain research **[22-26]**. Similar PPS rates were reported by De Bonis *et al.* who also showed that PPS was more common in patients receiving chemotherapy solely than in those receiving surgery alone **[24].** Patients who got only chemotherapy at advancement were contrasted with those who received both treatments, with no further impact on survival, by Michaelsen *et al.* **[25].** Additionally, some studies **[27-28]** did not track the results back to the start of the trend.

Our survival analysis has the following drawbacks: Because individuals with improved overall health and with surgically treatable lesions are taken into consideration for subsequent procedures, its retrospective nature necessarily entails selection bias. Additionally, the relatively small number of samples opposed to other multicenter studies **[22]** lowers the statistical analysis's power and the ability to determine the significance of reoperation in reoccurring glioblastoma. Our time-dependent analysis, however, will provide new information for prospective future meta-analyses. Another benefit of using a single institutional collection of information is that it makes it easier to compare more comparable groups and reduces the possibility of confounding effects between various neurosurgical units. The majority of research is retrospective because, primarily for ethical reasons, it is challenging to consider doing a prospective, randomized study to answer this topic. Another issue that is considered by other authors and is absent from our retrospective examination is quality of life of patients.

In a previous research, it was concluded that surgery improves survival for recurrent GBM. Second surgery is most beneficial for patients in which time to tumour recurrence is greater than six months **[27].** The role of surgery in treating recurrent glioblastoma multiforme (GBM) is still up for debate. Previous research suggested that surgery would only somewhat improve survival and would have a high rate of morbidity. Nonetheless, more recent research indicates improved survival, which could be linked to improved adjuvant treatment options and surgical techniques **[28].** The authors of a study examined the differences in O(6)-methylguanine-DNA methyltransferase (MGMT) status between primary and recurrent tumours and assessed the prognostic significance of several biomarkers in recurrent GBM. The results showed that MGMT methylation status was a significant predictor of the prognosis for patients with recurrent GBM who had carmustine wafer implantation in addition to surgery; as such, it was helpful in forecasting the course of GBM therapy at recurrence **[29].**

There is debate regarding the best course of treatment for individuals with recurrent glioblastoma multiforme (GBM). Gamma knife surgery (GKS) and/or reoperation may be options for these patients. The role of GKS for gliomas that relapse has not been extensively studied, and the outcomes have not been contrasted with reoperation. A previous study compared the survival and complication rates of GKS with reoperation for recurrent GBMs in order to verify the safety and effectiveness of the procedure. It was found that when a small GBM recurs, GKS may be a better option than open surgery because it has a significantly reduced complication rate and may even increase survival over reoperation **[30].** Glioblastoma multiforme (GBM) almost never goes away after initial treatment with radiation, chemotherapy, and surgical resection. In certain cases, treating recurrences may involve surgery. The goal of the study was to develop a preoperative scale that would forecast the patient's survival following surgery for recurrent glioblastoma multiforme. A preoperative scale to identify patients who are likely to have poor, intermediate, or good relative outcomes following surgical resection of a recurrent GBM tumour was developed and validated. Using this straightforward scale could help with clinical trial design and patient counselling regarding available treatments **[31].** In the multivariate analysis, apparent diffusion coefficient (ADC) histogram skewness was a distinct predictor of survival **[32].** Another research stated that second surgery has better results in recurrent GBM **[33].**

Conclusion:

The median OS was 26 months among the individuals who underwent re-surgery as opposed to 18 months in the nonsurgical category. PFS varied considerably between re-surgery groups (thirteen months) vs. non-surgical group (ten months). Comparing the group receiving re-surgery (ten months) and the group receiving only systemic therapy (nine months), the median PPS did not change substantially. Our second procedure complication rate was under acceptable ranges and consistent with earlier reports**.** Despite good clinical outcomes in patients who underwent reoperation, we were unable to show survival advantages.

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Conflict of Interest: None

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