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Pre-operative Embolization of Meningioma Leads to Reduced Operating Time and Less Intraoperative Bleeding

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ABSTRACT

Objective: To determine the efficacy of pre-operative meningioma embolization in terms of operating time and intraoperative bleeding.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Department of Neurosurgery, Combined Military Hospital, Rawalpindi Pakistan, from Jan to Dec 2020.

Methodology: Twelve diagnosed cases of intracerebral meningioma were included in the study. The patients were diagnosed cases of meningioma as per pre-operative signs and symptoms, radiological confirmation was done with magnetic resonance imaging, and all were subjected to pre-operative embolization of the tumour with catheter advancement in the arterial system and embolizing the target vessels with polyvinyl alcohol particles, followed by craniotomy and excision of the tumour.

Results: The mean age of the patients was 47±672. 24 years. The mean operating time (from the incision to closure) was 96.17±10.23 minutes. In contrast, the intraoperative blood loss was 325.33±15.43 ml. Six (50.00%) individuals had parasagittal meningioma, 4(33.33%) were of cerebral convexity, while 2(16.66%) had lesions at sphenoid wing.

Conclusion: Meningioma is a quite vascular tumour, and the operative outcome can be improved by pre-operative angioembolization. The reduced vascularity makes the resection easier by decreasing the per-op bleed and operating time.

Keywords: Intraoperative bleed, Meningioma, Operating time, Pre-operative embolization.

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INTRODUCTION

Meningiomas are the second most common tumour of the brain that are mostly benign, non-infiltrative, slow growing and well-circumscribed lesions.[1] They are mostly solitary but can be multiple.[2] They arise from the arachnoid cells so they can be found anywhere between the cranium and brain, ventricles and around the spinal cord.[3] Ectopic meningiomas may present as intraosseous growth of tumours in the cranial vault.[4]

Surgery is the main treatment option for all accessible lesions.[5] High vascularity makes the procedure difficult and affects the extent of resection.[6] Moreover, increased per-op bleeding will also adversely affect the functional outcome of the patient. Pre-operative embolization of meningiomas has been an option to reduce the complications for almost four decades.[7] The tumour characteristics will be changed, chances of gross total resection are increased and operative morbidity will be reduced.[8] Materials used to embolize meningioma include PVA (polyvinyl alcohol) particles, microspheres (large-calibre), detachable coils, ethylene-vinyl alcohol, hyperosmolar mannitol and fibrin glue.[9] Tumour histopathological characteristics are changed following embolization like necrosis, microvascular fibrinoid changes and ischemia of meningioma echo texture. Reduced blood supply leads to hypoxia, thereby inculcating changes in protein expression consistent with enhancement of growth, angiogenesis and production of cytologic changes, including recruitment of macrophages.[10]

This study was designed to determine the efficacy of pre-operative embolization of meningioma in terms of operating time and intraoperative bleeding. Combined Military Hospital Rawalpindi serves as a tertiary care centre for military personnel as well as civilians from the twin cities of Rawalpindi/Islamabad, Gilgit Baltistan, and AJK, an assessment of pre-op angioembolization of meningiomas for effective treatment has to be carried out in order to determine an efficient, effective and resource-saving protocol for patient care and management.

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METHODOLOGY

The prospective longitudinal study was conducted at the Department of Neurosurgery, Combined Military Hospital, Rawalpindi Pakistan, from January to December 2020. The sample size of the study was calculated by using the WHO sample size calculator, taking operating time ranges from 3-12 hours post-embolization (Mean 5.0±5.2 hours).[11] Non-probability consecutive sampling technique was used to enrol the patients in the study.

Inclusion Criteria: Patients of either gender, aged 20-60 years, having no history of any other neurological disease, who presented with signs and symptoms suggestive of intracerebral SOL, admitted from the Outpatient Department as a diagnosed case of meningioma (radiological diagnosis) were included in the study.

Exclusion Criteria: Patients who were previously operated on and had a recurrence of tumour and individuals having chronic ailments like chronic renal failure, diabetes mellitus, bleeding disorders, pregnancy immuno-compromised state, and ischemic heart diseases were excluded from the study.

Written informed consent was taken from all patients in the study, and permission from the hospital's ethical committee was obtained. Name, hospital registration number, age, address, gender and phone number (optional) were noted, and this information was kept confidential by the principal investigator. All the patients underwent six-vessel digital subtraction angiography to locate the tumour blush and feeding vessels, followed by catheter advancement and embolization of the tumour with polyvinyl alcohol particles PVA. All these patients were subjected to craniotomy and tumour excision. Craniotomy was done under general anaesthesia with Propofol, Fentanyl and Atracurium with dosage according to the body weight of the patient. Anesthesia was maintained with a mixture of air, oxygen and Sevoflurane. The same Neurosurgical team performed all surgeries. Operative time (in minutes) was noted from the skin incision to the closure of the wound.

Similarly, per-op bleeding (in ml) was measured by adding the blood collected in the suction machine and drape set. Postoperatively, pain control was achieved with parenteral analgesics like Ketorolac (30mg) 8 hourly for two days; and intravenous Ceftriaxone (1g) 12 hourly was given for five days to all the patients who were kept admitted to the hospital for at least one week.

Statistical Package for Social Sciences (SPSS) version 23:00 was used to analyze the data. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. One-way analysis of variance (ANOVA) was applied to gauge the mean differences among the groups. The *p*-value of 0.05 or less was taken as significant.

RESULTS

The mean age of 12 patients was 47.67±3.52 years, ranging from 44-50 years. The mean age of male patients was 47.00±3.26 years. About 6(50.00%) individuals had parasagittal meningioma, 4(33.33%) were of cerebral convexity, and 2(16.66%) had lesions at the sphenoid wing, shown in the Figure. The mean operating time from the incision to closure was 96.17±10.23 min, whereas the average intraoperative blood loss was 325.33±15.43 ml. The average blood transfused to the patients was 343.75±10.23ml (Table).

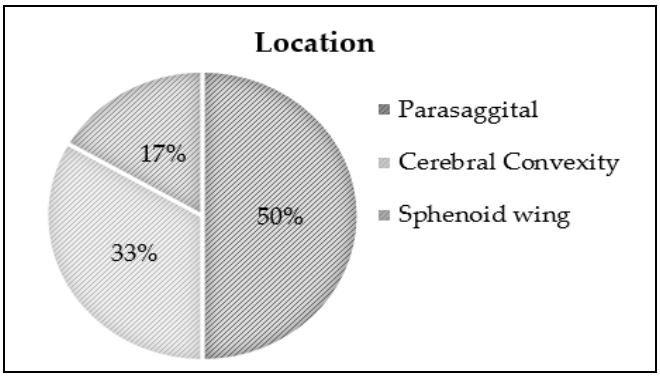

Figure: Distribution of Lesions (n=12)

Table: Distribution of Average Blood Transfused to the Patients (n=12)

Blood Transfusion (n=12) (ml)	Operating Time (n=12) (min)	Intra Operative Blood Loss (n=12) (ml)	*p*-value
343.75±10.23	96.17±10.23	325.33±15.23	0.05

DISCUSSION

Meningiomas are highly vascular tumours, and their resection results in the loss of an enormous amount of blood (approximately 200ml-2000ml).[12] Preoperative meningioma embolisation has multiple benefits, such as decreased tumour size, reduced blood loss, increased chances of complete resection and lessening morbidity.[13] Like every procedure, it is also associated with many complications such as contrast allergic reaction, oedema of the tumour, iatrogenic injury to the vessels or brain and ischemic infarct of the regional brain tissue.[14] In the last two decades, various attempts

have been made to assess the outcome of pre-operative angioembolization, but still, there needs to be more data available. Various agents have been used for embolisation and are broadly classified as particle, glue and liquid embolisation.[15] Commonly, meningiomas are supplied by the external carotid artery (dural branches), including those arising most from the accessory meningeal, middle meningeal, ascending pharyngeal or occipital branches. Internal carotid artery branches like the inferolateral trunk, meningohypophyseal trunk, ophthalmic artery and pial feeders may also contribute.[16] Ischemia of the brain is the most common complication, especially if the pial vessels are embolized. Careful selection of patients and following the safety protocols help in the reduction of morbidity and mortality.[17,18]

Shah *et al*. studied the therapeutic options available for pre-operative embolization of meningiomas and concluded that pre-operative angioembolization of the tumour makes the resection easier.[19] Moreover, they showed that the liquid embolizing agents are superior to the particulate ones, as the latter carries more chances of haemorrhage.[19]

Similarly, another study concluded that whitening and softening of the tumour due to pre-operative embolization makes debulking easier.[13] Moreover, they also stated that none of their patients required an allogeneic blood transfusion. Haemorrhagic complications occurred in two of their patients, and only one patient had transient cranial nerve palsy. In another study there was a significantly reduced blood loss to the volume of tumour ratio in the embolism patients (p<0.007). Moreover, the tumours with major feeding vessels from the external carotid artery have better outcomes after embolization than those with feeders from the internal carotid artery (p<0.02).[11] Another study concluded that pre-operative embolization markedly reduced per-operative bleeding and operating time and made the Kawase approach of the surgery more manageable (p<0.05).[18] This is in accordance with our results and favours our conclusion. To sum up, to achieve better post-operative outcomes for patients with meningioma, it is recommended to embolize the tumour pre-operatively because it will reduce the per-op bleeding and operating time. This will ultimately reduce the mortality and morbidity associated with the disease.

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LIMITATION OF STUDY

This study has been conducted at a single centre with a limited number of patients, so the results must be generalised to only some of the population. A multi-centric and multi-ethnic study must be conducted for a more comprehensive statistical analysis.

CONCLUSION

Meningioma is a very vascular tumour, and the treatment of choice is operation, but there are chances of an enormous amount of blood loss during the procedure. The operative outcome can be improved by pre-operative angioembolization of the lesion. The reduced vascularity makes the resection easier by decreasing the per-op bleed and operating time. Thereby reducing the overall morbidity and mortality of the patients.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AAK & HUK: Data acquisition, concept, study design, critical review, approval of the final version to be published.

KAB & SAQ: Data analysis, data interpretation, approval of the final version to be published.

SAA, AH & BS: Critical review, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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