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Original Article

Radiology Section

Role of Transarterial Preoperative Embolisation in the Management of Juvenile Nasopharyngeal Angiofibroma: A Prospective Interventional Study

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ABSTRACT

Introduction: Juvenile Nasopharyngeal Angiofibroma (JNA) is a benign yet highly vascular tumour that primarily affects adolescent males. Surgical resection is the standard treatment; however, it is often associated with significant intraoperative blood loss and increased morbidity. Preoperative Transarterial Embolisation (TAE) has emerged as an adjunctive procedure to minimise vascularity, thereby reducing surgical complications.

Aim: To evaluate the impact of preoperative embolisation of JNA on the surgical outcome including intraoperative blood loss, intraoperative time and Intensive Care Unit (ICU) admissions in North Eastern India.

Materials and Methods: The hospital-based prospective interventional study was conducted in the Department of Radiology at Gauhati Medical College and Hospital (GMCH), Guwahati, Assam, India, from November 2023 to October 2024 on 50 patients diagnosed with JNA and referred for preoperative embolisation from the Departments of Ear, Nose and Throat (ENT) and Paediatrics. Patients underwent Contrast Enhanced Computed Tomography (CECT) evaluation by the Philips Brilliance iCT 256 slice CT machine for staging (Radowski). Embolisation was done under the Siemens Artis Zee Biplane Digital Subtraction Angiography (DSA) machine by using Polyvinyl Alcohol (PVA) particles. Preoperative embolisation used PVA particles in all cases and parameters such as stage of tumour, grade of devascularisation, mean intraoperative blood loss, intraoperative time, postoperative complications and Intensive Care Unit (ICU) admission were obtained. These data were entered into Statistical Pacakge for Social Sciences (SPSS) software version 26.0 and Chi-square and Analysis of Variance (ANOVA) tests were applied.

Results: The study included 50 patients (all males) aged 8 to 17 years with mean age of 14.18 years. In the present study, 6 patients (12.0%) were classified as stage IA JNA, while 18 patients (36.0%) had stage IB. All cases were embolised using PVA particles. The mean intraoperative blood loss was 246.16±110.18 mL. The mean operative time was 122.10±41.52 minutes. Mostly grade II devascularisation was achieved in the majority (58%) of patients. There was a significant association between grade of devascularisation and intraoperative blood loss, time and ICU admissions (p-value <0.05). No significant Post-embolisation complications were encountered.

Conclusion: Preoperative embolisation of nasopharyngeal angiofibroma is a safe and effective technique to reduce intraoperative blood loss and reduce postoperative complications. Minor complications may be encountered, but major complications are rare if done using the correct technique.

Keywords: Angiograms, Contrast enhanced computed tomography, Devascularisation, Magnetic resonance imaging, Polyvinyl alcohol particles, Pterygopalatine fissure, Sphenopalatine foramen, Tumour blush

INTRODUCTION

Juvenile Nasopharyngeal Angiofibroma (JNA) is a hypervascular, slow growing, but locally destructive tumour that primarily affects adolescent males. Although rare, it remains a clinically significant entity due to its aggressive local behaviour and high risk of surgical bleeding [1]. JNA accounts for 0.05-0.5% of all head and neck tumours, with a relatively higher incidence in India and Egypt compared to America and Europe. In Asia and the Middle East, reported incidence rates range from 1:5,000 to 1:60,000, indicating notable geographical variability. Such differences highlight that regional, ethnic, and possibly environmental factor may influence the occurrence and presentation of this tumour [2].

Clinically, JNA typically manifests with symptoms related to nasal and nasopharyngeal obstruction, such as nasal blockage, recurrent epistaxis, ear fullness, rhinorrhoea, and facial numbness. Advanced lesions may produce cheek swelling, sinusitis, headaches, visual disturbances, proptosis, and orbital involvement [2]. Due to this wide symptom spectrum and the tumour's deep anatomic location, imaging plays a critical role in determining extent. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) findings, including strong enhancement, flow voids, and characteristic signal patterns, aid in diagnosis [3]. Angiography is essential to define feeding vessels, assess cross-circulation, evaluate internal carotid artery contribution in intracranial spread, and facilitate preoperative embolisation. Surgical resection remains the definitive treatment and Preoperative Vascular Embolisation (PVE) has been shown to decrease operative time and blood loss; however, most studies have small cohorts because of the rarity of the disease [4]. Embolisation is usually performed 24 to 48 hours prior to resection, and the traditional embolisation technique is the trans-arterial approach by catheterisation utilising various embolic agents including microparticles, ethylene-vinyl alcohol copolymer (Onyx), coils or glue [5].

Despite the available global literature, there remains a lack of focused research on JNA within Northeast India, a region with distinct demographic, genetic, and environmental characteristics compared to the rest of the country. The documented higher incidence of JNA in India [6] overall suggests that subregional differences may exist, yet no comprehensive epidemiological or clinical studies have been conducted specifically in the northeastern states. This creates a significant knowledge gap, particularly because healthcare delivery, accessibility to imaging, and referral patterns in Northeast India differ from those in other parts of the country. These factors

may influence not only detection rates but also the staging at presentation and the therapeutic options chosen.

Furthermore, existing literature on JNA largely originates from tertiary centres in metropolitan India or international Institutions [7]. These studies may not accurately reflect the clinical profile of patients from Northeast India, where variations in ethnicity, sinonasal anatomy, and genetic background could potentially modify disease patterns. Data on imaging characteristics, tumour vascularity, angiographic anatomy, and response to preoperative embolisation are especially limited for this population. Additionally, surgical outcomes, recurrence rates, and postoperative morbidity have not been systematically evaluated in the Northeastern setting. Without such data, clinicians in the region must rely on external evidence, which may not be fully generalisable.

Given these gaps, a dedicated study focusing on JNA in Northeast India is crucial. It would help establish local incidence, characterise clinical and radiological presentation patterns, and evaluate treatment outcomes specific to this population. Such evidence could guide region-appropriate diagnostic protocols, optimise surgical planning, and ultimately improve patient care in an area where data is currently sparse. Thus, the present study aimed to evaluate the impact of preoperative embolisation of JNA on the surgical outcome, including intraoperative blood loss, intraoperative time and postoperative ICU admissions in North Eastern India.

MATERIALS AND METHODS

The hospital-based prospective interventional study was conducted from November 2023 to October 2024 in the Department of Radiology at Gauhati Medical College and Hospital (GMCH), Guwahati, Assam, India. Institutional Ethics Committee approval (MC. No. 190/2007/Pt-11/Oct,2023/49) was taken.

Inclusion criteria: Patients diagnosed with JNA and referred for preoperative embolisation from the Departments of ENT and Paediatrics of GMCH.

Exclusion criteria: Patients with known allergies or hypersensitivity to contrast agents or other medications used in the procedure, patients with a history of bleeding disorders or other coagulation abnormalities, patients with a history of previous JNA treatment (embolisation with or without surgery) and patients who are unable or unwilling to give informed consent for the procedure.

Sample size calculation: Sample size is calculated using Wayne Daniel Formula

$$\text{Sample size} = Z^2 \{P \times (1-P)\}/d^2$$

Z=Z value (e.g., 1.96 for 95% confidence interval)

P=Prevalence of JNA, expressed as a decimal

Here taken as 0.5 (1)

d=precision, here taken as 0.14 (since JNA is rare, precision is adjusted to achieve a feasible sample size). The sample size was calculated to be 49 (rounded off to 50).

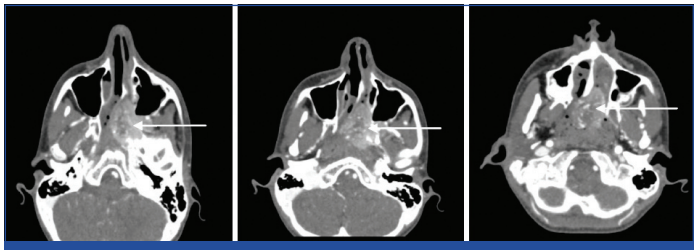
Study Procedure

Eligible patients were provided with informed consent and underwent CECT using a Philips Brilliance iCT 256 slice CT machine for the staging of the tumour (Radowski D et al.,) [8].

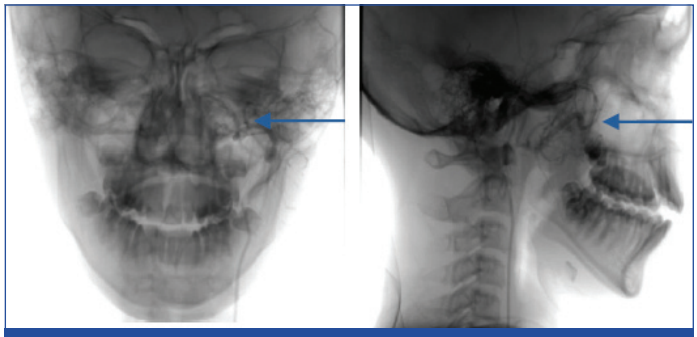
All patients underwent pre-embolisation angiograms using a Siemens Artis Zee Biplane DSA Machine to determine the extent of tumour vascularity and the tumour feeding arteries, after which embolisation was done using PVA particles.

Angiographic devascularisation was assessed by comparing pre- and post-embolisation tumour blush on control angiography and quantified using image tracing. Percentage reduction in tumour blush was categorised for analysis; this approach follows previously published percentage-based grading systems by Chaloupka JC et al., who used 0-30%, 30-70%, 70-95%, 95-99%, 100%) and is consistent with recent JNA embolisation series that report mean percent (%) devascularisation. For simplicity in the present study, devascularisation was grouped as Grade I (<50%), Grade II (50-75%), and Grade III (>75%) [9].

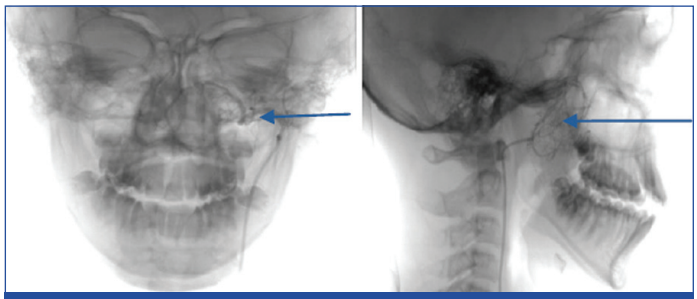
The patients were taken for surgical resection within 24-48 hours of the embolisation procedure and followed-up for parameters like intraoperative blood loss, intraoperative time, ICU admissions and postoperative complications [Table/Fig 1-3].



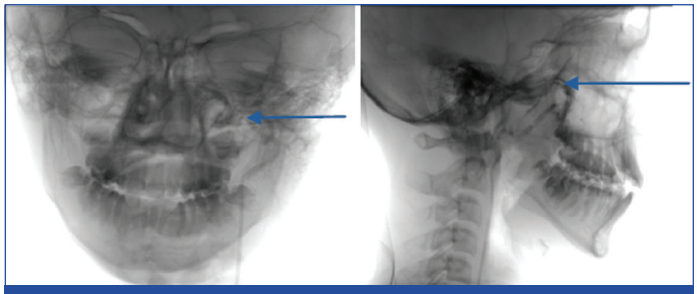
[Table/Fig-1a]: Case 1: Left-sided JNA (Enhancing tumour epicentered in left sphenopalatine foramen with minimal extension to medial pterygomaxillary fissure) (Stage IIA).



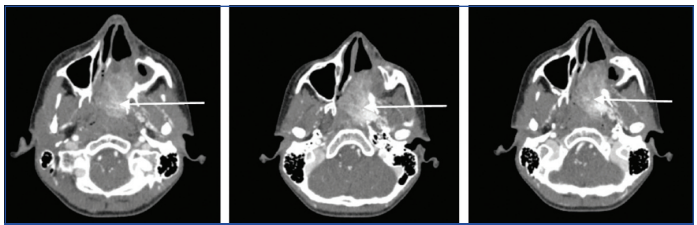
[Table/Fig-1b]: Pre-embolisation showing tumour blush.



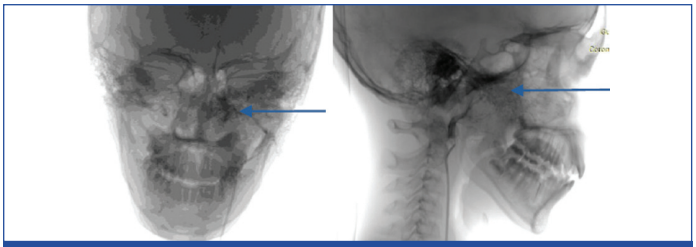
[Table/Fig-1c]: Embolisation.



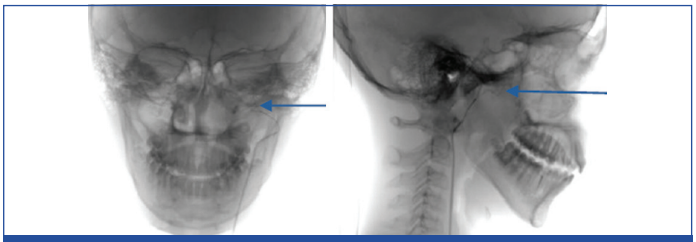
[Table/Fig-1d]: Post-embolisation with almost none residual tumour blush (Grade III devascularisation).



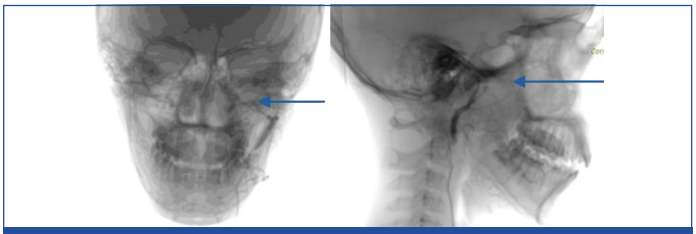
[Table/Fig-2a]: Case 2: Left-sided JNA (Enhancing tumour epicentered in left sphenopalatine foramen with full occupation of pterygomaxillary fissure with local mass effect) (Stage IIB).



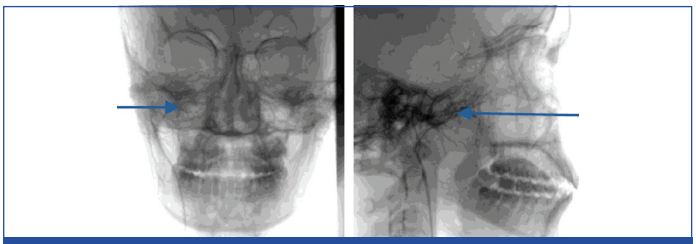
[Table/Fig-2b]: Pre-embolisation showing tumour blush.



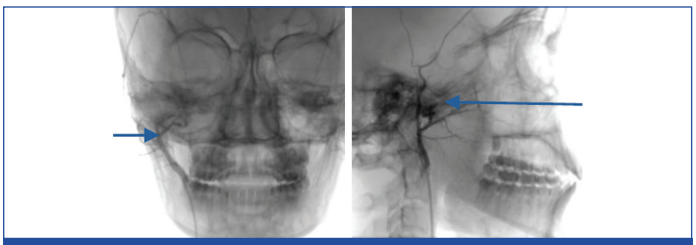
[Table/Fig-2c]: Embolisation.



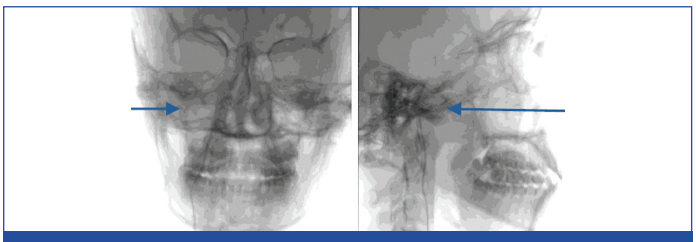
[Table/Fig-2d]: Post-embolisation with almost none residual tumour blush (Grade III devascularisation).



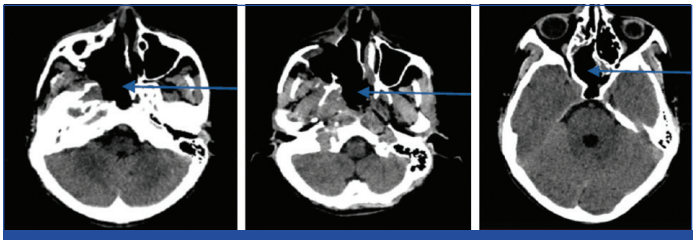
[Table/Fig-3a]: Case 3: Right-sided JNA (Stage IIB) with Grade III devascularisation of tumour post-embolisation and complete excision. Pre-embolisation showing tumour blush on the right-side.



[Table/Fig-3b]: Embolisation.



[Table/Fig-3c]: Post-embolisation with almost none residual tumour blush.



[Table/Fig-3d]: Post-operative CT showing complete excision of the tumour.

STATISTICAL ANALYSIS

Data regarding stage of tumour, grade of devascularisation, mean intraoperative blood loss, intraoperative time, postoperative complications and ICU admission were obtained. These data were entered into SPSS 26.0 software and Chi-square and ANOVA tests were applied. Logical conclusions were drawn.

RESULTS

The study included patients with ages ranging from 8 to 17 years. 31 patients (62%) were between 13 to 15 years old. Only 4 (8%) cases were of the 8 to 12 age group. All of the patients were males [Table/Fig-4].

Age (in years)	n (%)
8 to 12	4 (8.0)
13 to 15	31 (62.0)
16 to 17	15 (30)
Total	**50 (100.0)**

[Table/Fig-4]: Age distribution of patients.

Six patients (12.0%) were classified as stage IA JNA, while 18 patients (36.0%) had stage IB, making it the most common stage. Stage IIA was observed in 14 patients (28.0%), whereas 8 patients (16.0%) were categorised under stage IIB. The least common stage was stage IIC, which was found in 4 patients (8.0%) [Table/Fig 5].

Stage of JNA	n (%)
IA	6 (12.0)
IB	18 (36.0)
IIA	14 (28.0)
IIB	8 (16.0)
IIC	4 (8.0)
Total	**50 (100.0)**

[Table/Fig-5]: Stages of JNA embolised.

All cases were embolised using PVA particles. The mean intraoperative blood loss was 246.16±110.18 mL. The mean operative time was 122.10±41.52 minutes. In the study, no post-embolisation complications were encountered. Among the patients, 8 (16.0%) were classified as having grade I devascularisation, while the majority 29 patients (58.0%), had grade II devascularisation, grade III devascularisation was observed in 13 patients (26.0%) [Table/Fig-6].

Grades of devascularisation	n (%)
Grade I	8 (16.0)
Grade II	29 (58.0)
Grade III	13 (26.0)
Total	**50 (100.0)**

[Table/Fig-6]: Grade of devascularisation embolised.

Among the 50 patients, 28 (56.0%) did not require ICU admission, while 22 patients (44.0%) required ICU admission after surgical resection [Table/Fig 7].

ICU admission	n (%)
No	28 (56.0)
Yes	22 (44.0)
Total	**50 (100.0)**

[Table/Fig-7]: No. of ICU admission cases.

Patients with grade I devascularisation had the highest mean intraoperative blood loss (285.25±123.98 mL), followed by those with grade II devascularisation (247.24±108.70 mL). The lowest intraoperative blood loss was observed in patients with

grade III devascularisation, with a mean of 219.69±92.50 mL. A statistically significant association was found between the grade of devascularisation and intraoperative blood loss (p-value=0.001). Statistically significant association was observed between the grade of devascularisation and intraoperative time (p-value=0.001), as determined by the ANOVA test [Table/Fig-8].

Grade of devascularisation	Grade I	Grade II	Grade III	p-value
Intraoperative blood loss	285.25±123.98	247.24±108.70	219.69±92.50	0.001*
Intraoperative time	131.25±41.89	117.07±45.18	107.69±33.20	0.001*

[Table/Fig-8]: Association between grade of devascularisation with intraoperative blood loss and intraoperative time.
*- statistically significant by ANOVA test

Among patients with grade I devascularisation (n=8), the majority 7 patients (87.5%) required ICU admission, while only 1 patient (12.5%) did not. In contrast, patients with grade II devascularisation (n=29) had a lower ICU admission rate, with 12 patients (41.4%) requiring ICU care and 17 patients (58.6%) not needing ICU admission. Among those with grade III devascularisation (n=13), 3 patients (23.1%) required ICU admission, whereas the majority 10 patients (76.9%) did not require ICU care. Significant association was observed between grade of devascularisation and ICU admission (p-value=0.02) [Table/Fig 9].

Grades of devascularisation	No ICU admission	ICU admission	Total	p-value
Grade I	1 (12.5%)	7 (87.5%)	8 (100.0%)	0.02*
Grade II	17 (58.6%)	12 (41.4%)	29 (100.0%)	
Grade III	10 (76.9%)	3 (23.1%)	13 (100.0%)	
Total	28 (56.0%)	22 (44.0%)	50 (100.0%)	

[Table/Fig-9]: Association between grade of devascularisation and ICU admission.
*- statistically significant by Chi -quare test

DISCUSSION

The investigation evaluated the impact of preoperative embolisation of JNA on the surgical outcome, including intraoperative blood loss, intraoperative time and ICU admissions in North East India. The study included 50 patients (all males) aged 8 to 17 years with mean age of 14.18 years that is in concordance with Vakharia K et al., [10]. Most patients having stage IB tumour aligning with Giorgianni A et al., [11] and Abouzeid W et al., [12]. All of the patients were embolised using PVA particles similar to the study conducted by Giorgianni A et al., [11].

In the study, across all vascular supplies, 8 patients (16.0%) had grade I vascularisation, most (29) patients (58.0%) had grade II vascularisation, and 13 patients (26.0%) had grade III vascularisation. However, in the study done by El Shaikh Ahmed A et al., [4], most had grade III devascularisation (50%) followed by grade II (33.3%). All the JNA cases were embolised before surgery. Surgery without embolisation was done earlier. However, now-a-days most JNA resection is done with preoperative embolisation [13].

In the study, the mean intraoperative blood loss was 246.16±110.18 mL. It is consistent with the studies conducted by Abouzeid W et al., [12], Kasem MAHO et al., [13] and Al Helo SY et al., [14] where mean intraoperative blood loss in embolised group was 225 mL, 300 ml and 150 mL, respectively. In the study, the mean operative time was 122.10±41.52 minutes. It is consistent with studies done by Abouzeid W et al., [12], Al Helo SY et al., [14] and Kasem MAHO et al., [13] where the mean operative time was 150 mins, 126 mins and 150 mins respectively. Out of the 50 patients, 28 (56.0%) did not require ICU admission, while 22 patients (44.0%) required ICU admission during the postoperative period. It is consistent with the study done by Bora KK and Das S [15], where most patients (71%) didn't need ICU admission.

In the present study, patients with grade I devascularisation had the highest mean intraoperative blood loss (285.25 mL), followed by those with grade II devascularisation (247.24 mL). The lowest intraoperative blood loss was observed in patients with grade III devascularisation, with a mean of 219.69 mL. A statistically significant association was seen between devascularisation grade and intraoperative blood loss (p-value=0.001). This is consistent with the findings by Abouzeid W et al., [12] and Kasem MAHO et al., [13] that preoperative embolisation devascularises these tumours and results in reduced intraoperative blood loss, where the mean blood loss was 225 mL and 150 mL, respectively.

The mean intraoperative time for patients with grade I devascularisation was 131.25±41.89 minutes, while for those with grade II devascularisation, it was 117.07±45.18 minutes. Patients with grade III devascularisation had a mean intraoperative time of 107.69±33.20 minutes. A statistically significant association was observed between the grade of devascularisation and intraoperative time (p-value=0.001), as determined by the ANOVA test. This is consistent with the findings by Abouzeid W et al., [12] and Kasem MAHO et al., [13] that preoperative embolisation devascularises these tumours with a lower mean intraoperative time during surgery, where the mean intraoperative time was 150 mins.

Among patients with grade I devascularisation (n=8), the majority 7 patients (87.5%) required ICU admission, while only 1 patient (12.5%) did not. In contrast, patients with grade II devascularisation (n=29) had a lower ICU admission rate, with 12 patients (41.4%) requiring ICU care and 17 patients (58.6%) not needing ICU admission. Among those with grade III devascularisation (n=13), 3 patients (23.1%) required ICU admission, whereas the majority 10 patients (76.9%), did not require ICU care. A significant association was observed between the grade of devascularisation and ICU admission (p-value=0.02). This matches the findings by Abouzeid W et al., [12] and Kasem MAHO et al., [13] that preoperative embolisation reduces the blood supply of these tumours with lower intraoperative blood loss and consequently leads to reduced ICU admission. The application of preoperative transarterial embolisation reduces intraoperative blood loss, intraoperative time and the number of postoperative ICU admissions with increased grade of post- embolisation devascularisation.

Limitation(s)

The present study focused primarily on short-term surgical outcomes, lacking long-term follow-up data on recurrence and complications. Additionally, being a single-centre study, the findings may not apply to other Institutions with different surgical and embolisation techniques, like direct puncture embolisation.

CONCLUSION(S)

The present hospital-based prospective study highlights the safety and efficacy of embolisation done preoperatively in the surgical management of JNA. By evaluating 50 male patients aged 8 to 17 years, the study demonstrated that higher grades of devascularisation achieved in preoperative trans-arterial embolisation significantly reduce intraoperative blood loss and operative time while improving surgical outcomes by reducing postoperative ICU admission rates. So, it may be used as part of the multidisciplinary approach for managing highly vascular JNA.

Future research can include multiple tertiary hospitals across the Northeast to improve the generalisability of clinical, angiographic, and surgical outcome data. Trials comparing various embolic materials (PVA particles, Onyx, glue, coils) could assess differences in devascularisation, intraoperative blood loss, complication rates, and cost-effectiveness. Prospective studies including postoperative quality-of-life assessments, nasal function outcomes, and patient-reported symptom scores would provide a more holistic understanding of treatment impact.

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- Manual Googling: Dec 25, 2025
- iThenticate Software: Dec 27, 2025 (3%)

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