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ESTABLISHING A NEW NEUROINTERVENTIONAL FACILITY IN WEST RAJASTHAN IN GOVT. HOSPITAL IN INDIA (WRGH): INITIAL EXPERIENCE

Neurosurgery

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ABSTRACT

Aim- The aim of this study to evaluate the feasibility of establishing endovascular neurosurgery in remote resource-poor neuro-hospital setup and evaluate its outcome. **Materials and Methods-** We retrospectively reviewed data of neurointerventions performed in our hospital from december 2022 till january 2024. Patient age, diagnosis, preoperative, and postoperative imaging findings were collected and analyzed. Types of procedures, success/failure, procedure-related and procedure-unrelated complications were noted and described. **Results-** Total 125 procedures were done (diagnostic 100, therapeutic 25). Among the 25 cases of therapeutic procedures, angiographic success was noted in 23 cases and failure was noted in 2 cases. Among therapeutic cases (23), patient outcome was categorized as improved (with mRS 0-2 at discharge) in 21 cases and complication occur in 2 cases. morbidity in form of weakness was noted in 1 case and mortality was noted in 1 cases. There were no hemorrhagic complications due to rupture or dissection. **Conclusion-** Endovascular neurosurgery is feasible in resource poor remote rural hospital with outcome comparable to existing literature.

KEYWORDS

Aneurysm Coiling, Digital Subtraction Angiogram, Endovascular Neurosurgery

INTRODUCTION

Neurointervention offers minimally invasive therapies for a wide variety of neurovascular diseases. Over the years it has evolved and established it self as a preferred modality of treatment over conventional open surgical approach. Adoption of endovascular therapy for the management of aneurysms, acute stroke, vascular malformations, presurgical, or palliative embolization has expanded over last three decades. This trend is likely to amplify further with the introduction of innovative endovascular devices.

Considering limited structured courses available in India, number of doctors trained in this field is far less than the existing demand. Further more, the infrastructure needed for the specialty is limited to big hospitals. Hence, most of the experts in the field are available only in major cities of India.[1] While few suburban centers with adequate resources are emerging.[2]. Establishing the department is also hindered by non-availability of good quality of hardware in the rural setup, non-availability of trained cath laboratory technicians and nurses. The article summarizes the feasibility of establishing an endovascular neurosurgical setup in remote rural hospital, where resource availability was limited, still achieving results comparable to existing literature results.

In India, majority of government hospitals do not have neuro-intervention facilities predominantly due to lack of trained individuals and extremely high cost of consumables.[1,3] Only a handful of state government hospitals have these facilities and most of neurointerventions are done in private setups in India which can be afforded only by a limited number of patients.

In Rajasthan, the second govt. funded neurointervention facility was started at our institute in December 2022. We discuss the feasibility of establishing a neuro-intervention setup and comparing its results in a state-owned govt-funded hospital setup in a backward region of central India.

MATERIALS AND METHODS

We retrospectively reviewed data of all diagnostic and therapeutic neurointerventions performed in our hospital from december 2022 till january 2024. Data including patient demographics including age, underlying diagnosis, and preoperative and postoperative imaging findings were collected and analyzed. Types of neurointervention procedures, success/failure of procedure, and procedure-related and procedure-unrelated complications were noted and described.

Procedures were performed on a biplane neuroangiography suite (M/s. GE Healthcare, France, Model Innova IGS630). Appropriate preprocedure imaging (computed tomography/magnetic resonance imaging [CT/MRI]) was performed. Therapeutic endovascular neurointervention procedures were performed under general anesthesia.

The right femoral artery was punctured with an 18G needle and 5F to 9F sheath was inserted. Note that 3000-5,000 IU of heparin were given intravenously as a bolus after which 1,000 IU was repeated hourly till the end of the procedure. Post procedure Dyna CT was done on table before extubation. Post procedure CT was performed for all patients before discharge.

Cases were categorized in the following manner:
(1) Diagnostic procedures : cerebral angiograms,
(2) Neurointervention procedures: aneurysms simple coiling, aneurysm device-assisted coiling, cerebral arteriovenous malformation(AVM) embolization.

Indications of Neurointerventional Therapy

As mentioned above, the important indications of endovascular therapy are:
1. Aneurysm treatment: both ruptured as well as unruptured aneurysms.
2. Large vessel stroke: ClassA, Level I evidence(American Heart Association guidelines).
3. Vascular malformations: arteriovenous malformations (AVMs), dural fistulas and venous anomalies.
4. Preoperative tumor embolization.

Devices, Drugs,and Material Used in Neurointervention Contrast Material

Non ionic contrast agents are used in neurointervention procedure. Judicious use of contrast is advisable to avoid any contrast-related adverse effects, including allergic reactions and nephrotoxicity. Adequate hydration and avoidance of nephrotoxic drugs should be part

of preprocedural planning.

Periprocedural Anticoagulation with Heparin

It is important to remember that the majority of the complications during a neurointerventional procedure is thromboembolic in nature and hence perioperative anticoagulation therapy is vital. All patients under going interventions should be anticoagulated with heparin except if contraindicated. The initial bolus dose is approximately 60to80U/kg followed by 20 to 40U/kg every hour, with an aim to maintain activated partial thromboplastin time of 2 to2.5 times the baseline value. All the catheters and sheaths should also be continuously flushed with heparinized saline(1,000-2,000 Uin1L)with the help of pressure bags as per the institutional protocol.[4]

Catheters

Various catheters are used for diagnostic and therapeutic procedures. Various catheter types include diagnostic catheters, guiding catheters, distal access catheters, and microcatheters.

Embolic Agents

Embolic agents are basically divided into two groups according to their duration of action, that is, temporary and permanent**.** The temporary agents include gelfoam, collagen and thrombin. Permanent agents include particles (polyvinyl alcohol [PVA]), coils (pushable, injectable, and detachable), liquid agents (glue, alcohol, and onyx), and some miscellaneous agents (Amplatzer plug and detachable balloons).[5]

RESULTS

A total of 125 procedures were done. Types of procedures and their outcomes are highlighted in Table 1.

Diagnostic procedure:

Cerebral Angiograms

Total 100 cerebral angiograms were done. Age group ranged from 14 to 80 years, mean age was 48.2 years. Three-dimensional (3D) rotational angiography images were obtained for clear anatomic details. There was no procedure-related morbidity/mortality.

Therapeutic Neurointervention Procedures

***Endovascular Management*:**

Simple coiling/ device-assisted coiling/ arterio venous malformation. A total of 25 procedures were performed in 25 patients, age ranging from 21 to 69 years, with mean age of 49.6 years.Twenty four of these were ruptured ,while one was unruptured large cavernous aneurysms. There were two cases of failure. One case was abandoned due to inability to cannulate the aneurysm and was subsequently clipped. Another case was abandoned due to severe vasospasm and refered to higher center.

Simple coiling was done in 20 cases, stent-assisted coiling was done in 1 cases and embolisation done in two cases. Table 1

Figure 1 & 2 are pre and post operative DSA images of right ICA aneurysm (supra-clinoidal)

Figure 3 & 4 are pre and post operative DSA images of left ICA aneurysm (cavernous)

Table 1 Type and number of procedures performed in neuro endovascular unit

Procedure	Number of procedure
Diagnostic cerebral angiography	100
Simple coiling of Aneurysm	20
Cerebral AVM embolization	2
Stent-assisted coiling	1

Table 2 :Procedures done and their outcomes

Name of procedure	Number of patients	Failure		Complications		Outcome	
				Intra procedural	Postoperative	Mortality	mRS 0–2 at discharge after intervention/ surgery
Diagnostic cerebral angiography	100	0		0	0	0	100
coiling of aneurysm	22	2		3 Vasospasm of ACA, MCA, ICA	1 Hemiparesis dueto MCA spasm 1 recurrent seizures 1decompressive craniotomy 1 hydrocephalus due to IVH	1 Left hemiparesis	1 *Fischergrade4 SAH at admission with severespasm
Stent-assistedcoiling	1	0	0	0	0	0	1
AVM	2	0	0	0	0	0	2
Total	125	2	3	4	1	1	121
neurointerventions+1 surgeries)							

Abbreviations:ACA,anteriorcerebralartery;ICA,internalcarotidarter; MCA, middle cerebral artery; mRS, modified Rankin Scale; SAH, subarachnoid hemorrhage.

Procedure-related complications in the form of vasospasm were noted in three cases, Intraoperative nimodipine was given and vasospasm relieved The one patient developed delayed MCA territory infarct on postoperative day 3 who developed hemi-paresis. Patients recovered with power 3/5at time of discharge.. Decompressive hemicraniectomy was in one patient done for SAH with severe cerebral edema. Patient discharged with power 5/5. One case develop hydrocephalus and EVD was done. one patients had non-procedure-related mortality (patients succumbed to vasospasm).

Follow-up was available for 22 patients ranging from 1-6 month. On follow-up, 20 patients had modified Rankin Scale (mRS) 0 and 1 patients had mRS1 and 1 patient had mRS4 (patients with cerebral vasospasm complication).

Cerebral AVM Embolization

A total of 2 procedures were done of age 25 and 30 years, .Successful, complete embolization was done in one patients and partial embolisation in one patient. Embolization was done using detachable tip microcatheters with injection of liquid embolic agent (onyx) under blank roadmaps. There were no periprocedural complications, morbidity, or mortality. Ten - month follow-up magnetic resonance angiography was avail-able for one patient which showed no residual nidus and one patient follow-up from 1 month.

Summary of Procedure Related Complications

There were no hemorrhagic complications due to rupture or dissection. Ischemic complications were noted in form of cerebral vasospasm complications in three cases.

Summary of Outcomes

***Angiographic outcome*:**

Among the 23 cases of therapeutic procedures, angiographic success was noted in 21 cases, partial success was noted in 2 cases (RR grade 3 occlusion),

Patient outcome: Among therapeutic cases (*n*=23), patient outcome was categorized as improved (withmRS0–2 at discharge) in 21 cases , morbidity in form of weakness was noted in 1 cases, and mortality was noted in 1 cases (Table 2).

Modified Rankin Score

Management of Cost of Consumables

All the procedure were done free of cost for all patients using

MUKHYAMANTRI Chiranjeevi Swasthya Bima Yojana (MMCSBY). In this way, we were able to treat all patients free of cost.

DISCUSSION

Our institute is located in Western Rajasthan which has a population of 8.36 Crores (2023) with a large portion comprising of rural and tribal population. Being a backward state, 14.7% population of Rajasthan is below poverty line. Whatever limited neurointervention facilities present in the state, are mainly located in the private sector, which cannot be afforded by majority of population in the area. Poor patient needing neurointervention had to travel large distances (200–500miles) to get these facilities in a public institute. As a large number of these cases need to be done on an emergency basis, a large population was deprived of these treatment facilities.

Establishing a new neurointervention facility in a government setup in a backward region is challenging. The main barriers are lack of equipment, deficiency of cathlaboratory trained individuals, lack of awareness, lack of consumables,and the extremely high cost of consumables for neurointerventions.

Neurointernvention lab was established in Dr. S.N. Medical college, M.D.M Hospital, jodhpur, rajasthan, India, in Dec 2022 where biplane neuroangiography suite (M/s GE Healthcare, France, Model Innova IGS 630) was installed. Neurointerventions were done by a team comprising of neurosurgeons, and anesthetists.

We had to face several limitations leading to difficulty in establishment of the neurointervention facility. Nursing staff with no previous training in cath-laboratory were individually trained by conducting multiple lectures, boot camps, and hands-on training sessions. Similarly, general radiography technicians (trained only in handling X-ray radiography)were trained to handle biplane neuroangiography machine with the help of application experts and neuroradiologist. Teaching sessions were conducted by the neuroradiologist to train them in basic views of angiography, acquiring DynaCT, roadmaps, 3D acquisitions, and in reducing radiation exposure.

Collaboration with multiple departments was established to provide care for patients requiring neurointervention. Neurosurgery, neurology, internal medicine, and anesthesia departments were actively involved in patient care. Initially, multiple seminars and sessions were conducted with these departments to familiarize the type of case which would benefit from neurointervention. Sessions were also conducted with residents attending the emergency services, who would be the first contact of many of these cases. They were also trained regarding the protocol to be followed for stroke patients. Similar training was also pro-vided to technicians working at CT/MRI scan center to prioritize stroke patients.

Due to lack of awareness among the practicing doctors in the region of availability of neurointervention services, multiple interactive awareness sessions were also conducted out-side the institute. Awareness among public was also created using media outlets. Gradually, we started getting referrals not only from within the city but also from neighboring cities with patients travelling 200 to 300 miles, due to lack of any other nearby public-funded facility for these procedures.

There was no established chain of supply of neurointervention consumables in the region. Due to remote location and no previous established infrastructure, companies had to be convinced to start supply in the region. After appointment of required personnel, the supply chain was established. Initially, consumables were dispatched from cities like Jaipur, or Delhi.

Another major barrier was the high cost of consumables due to which most patients cannot afford neurointerventions. MMCSBY is an ambitious project launched by the chief minister to help the poor patients with an aim toward universal health coverage.[5]We utilized this scheme to provide financial support for neurointervention cases.

Results of our newly established center show procedural success rate of 92% (23/25), failure rate 8% (2/25), with 4% procedure-related morbidity (1/25), and zero proce-dure-related mortality(0/25),which are comparable to the available literature.[3,6] With availability of diagnostic angiography, management of cerebral vascular lesions have improved. Many of the complex cases which require detailed neurovascular anatomical information before neurosurgical procedures such as AVM, dural fistulas, etc. had to be referred to higher centers previously. With the availability of diagnostic and therapeutic angiographic procedures, these cerebrovascular disorders are now being successfully managed at our institute.

We suggest that team work with collaboration of neurosurgeons, anesthetists, neurologists, physicians, nursing staff, and technicians is absolutely essential for starting neurointervention services. With the help of government's efforts of establishing infrastructure at public-funded institutions, and provision of universal health coverage schemes ,these facilities can be provided even in remote places. This can help in significantly reducing the burden on tertiary health centers. Such an effort at other places in the country will also help to provide access to these high-end neurointervention facilities for the general masses free of cost in the public sector

CONCLUSION

Advanced neurointervention services can be provided even in backward regions in WRGH with outcomes similar to existing literature. The barriers can be overcome by supplying more government hospitals with angiography laboratory equipment and by training more doctors in the field of neurointervention. Training of nurses, general radiographers, and paramedical staff in cath-laboratory can be done at the institute level. Proper use of government schemes such as MMCSBY will allow the poorest of the patients to get access to these life-saving procedures. With these efforts, our center is now capable of successfully handling majority of vascular neuro intervention cases which had to be referred to higher centers previously.

Ethical Approval

The study has been approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed Consent

Informed consent was gathered from the patient and consent to publish images was obtained.

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Conflict of Interest

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