ORIGINAL ARTICLE

EXPERIENCE AND OUTCOME OF VENTRICULAR-ATRIAL SHUNT: A MULTI CENTRE STUDY

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Background: Ventriculoperitoneal (VP) shunt has been widely utilized in the treatment of hydrocephalus as a safe option but there is recent literature evidence that ventricularatrial **(**VA) shunt is not as notorious for its complications as proclaimed, to analyse and report our success with this procedure we conducted our study. **Methods:** A total of 64 patients undergoing VA shunting were included in this case series study conducted at RMC and Allied hospital Rawalpindi. The data was collected over a period of 4 years from, 1st June 2010 to 1st June 2015. **Result:** Our study included 64 patients who underwent a VA shunt for hydrocephalus. Their age ranged from 25 to 75 years. Most of the patients were females (60%). The following complications were observed with 2 (3.12%) patients having blockage of the shunt at the neck, 3 (4.68%) suffered from glomerulonephritis, 2 (3.1%) had post-operative neck hematoma, 4 (6.25%) had wound infection, short lower end of the tube was found in 3 (4.68%), migrated lower end (into the subclavian) was seen in 1 (1.56%). Mortality was 1(1.56%). These results were comparable to other studies. **Conclusion:** Neurosurgeons have been doing a VA shunt as a second procedure, after a VP shunt when the need due to a complication was encountered. We however share our experience regarding ventriculo-atrial shunting, as first choice procedure, because of its low incidence of shunt blockage unlike VP shunt, which has high rate of shunt blockage and therefore warrants repeated surgeries.

Keywords: VA Shunt, VP shunt, Hydrocephalus, Glomerlulonephritis, Neck hematoma

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INTRODUCTION

Hydrocephalus is excessive accumulation of CSF (cerebrospinal fluid) in the ventricular chain. It can be due to many causes such as space occupying lesion, infections, inflammatory conditions, traumatic causes or congenital disorders that may impede the drainage of CSF. To divert excessive CSF and decrease the intracranial pressure various modalities that can be utilized are external ventricular drainage, ventriculoperitoneal (VP) shunt, ventricularatrial (VA)shunt, Lumbar-peritoneal (LP) shunts ; among the above, VP shunt is commonly utilized to treat hydrocephalus but VP shunt blockage; remains a significant cause of morbidity and therefore an obstacle in the successful outcome of hydrocephalus. Although less common then a VP shunt, VA shunt is still used to manage hydrocephalus.[1]

Ventricularatrial shunts were first used in 1952 as standard treatment for hydrocephalus.[2] Various sites namely cardiac atrium, pleural cavity, ureter, fallopian tubes, bladder and gastric lumen have been used as alternative for distal CSF flow, particularly in situations when serosal surface of abdomen is not conducive for absorption.[3]

Treatment of hydrocephalus, after multiple VP shunt failures, due to blockage; remains a challenge. We on the other hand, used a VA shunt as primary procedure to see its efficacy as literature shows that its rate of blockage is less than VP shunt.[4]

Ventricularatrial shunts are generally avoided due to their high rate of mortality, morbidity and because of technical/operative difficulties. However some recent reports show that VA shunt is now becoming a popular alternative[2], irrespective of whether a VP shunt was utilized initially for the treatment of hydrocephalus or not.

Newer techniques have been devised and advanced monitoring methods have been instituted to improve the efficacy of this treatment as chang *et al*., described in his minimally invasive percutaneous technique, utilizing trans-oesophageal echocardiogram and the endovascular placement was done by Gonzales et al., we however used the conventional open technique in which a transverse incision is made in the neck below the mandible and blunt dissection done to expose the internal jugular vein.[5]

The goal of our study was to share our experience regarding VA shunt, which though requires surgical skills, yet is an important alternative in cases where VP shunting may not be possible or appropriate.

MATERIAL AND METHODS

This was a descriptive case series in which VA shunt, was applied in 64 patients who suffered from hydrocephalus; this was done by the department of neurosurgery at District Head quarter hospital and

Holy Family hospital, Rawalpindi from, 1st June 2010 to 1st June 2015. Categorical variables studied were Age, gender, complications, and evaluated, retrospectively.

Clinically, most patients frequently presented with headache, nausea and vomiting and altered consciousness. The diagnosis of hydrocephalus was determined by physical, neurological and neuro-radiological criteria. All patients underwent CT scan of the brain (plain) to confirm the diagnosis of hydrocephalus.

Patients over the age of 15 years, those who had abdominal surgeries and patients who had repeated VP shunt blockage were included in the study.

Children less than age of 15 years were excluded because they had more chance of developing cardio-pulmonary complications later on in life. After taking permission from the hospital ethical committee all the patients fulfilling the criteria were enrolled in the study. Written informed consent was taken from the relatives and advantage of this procedure was explained. All patients were admitted for indoor assessment and treatment.

All patients went through same surgical technique. A transverse skin incision is made, cantered on the anterior border of the sternocleidomastoid muscle, 2–4 cm below the angle of the mandible. The platysma is cut, and the anterior border of the sternocleidomastoid muscle is reached with sharp and blunt dissection to expose the internal jugular vein and opened. The tip of the catheter, is positioned just above the right atrium .We measured the length of the distal catheter from the cranial burr hole to a point 1 cm below the manubrium sternal joint and then the distal end was cut to the proper length. The atrial end and the ventricular ends are then connected to the reservoir.[5]

Outcome of the procedure (VA shunt) was analysed, with the help of radiological (check CT Scan brain plain) and clinical/neurological outcome of the patient. Follow up was performed at 2 weeks, then at 2 months. On each follow up, patients were examined for signs and symptoms of raised intracranial pressure, along with CT scan brain (plain), to look for for any reduction in the size of the ventricles.

RESULTS

The study included 64 patients with hydrocephalus. Their age ranged from 25 to 75 years with a mean age of 51.34 years with SD of 15.2. 24 (37.5%) were males and remaining 40 (62.5 %) were females.

Out of 64 patients, 4 patients had normal pressure hydrocephalus, 20 patients had space-occupying lesion in the brain and 40 patients were post meningitic.

Complications are shown in table-1, with 2 (3.12%) patients having blockage of the shunt at the neck which occurred at 6 months and other at 3 years interval, respectively. They were re explored and lower end was replaced. During this 5 year study 3(4.68%) patients suffered from glomerulonephritis, due to VA shunt which were removed and replaced with a VP shunt. 2(3.1) patients had a post-operative neck hematoma which was evacuated on the same day, 4 (6.25 %) patients had wound infection, they were treated by removal of the shunt. Shorter distal end of the VA shunt was found in 3(4.68%) patients, migrated lower end (into the sub-clavian) was seen in 1 (1.56%) patient, on check x-rays on 1st post op day, which were revised/adjusted. Mortality was 1 (1.56%) seen in the six month, due to pulmonary embolism secondary to DVT (deep venous thrombosis).

Table-1: Complications of VA shunt

Complications	n=13	Percentage
Shunt blockage at neck	2	3.1%
Glomerulonephritis	3	4.68%
Postop neck hematoma	2	3.1%
Wound infection	4	6.25%
Short lower end of shunt	3	4.68%
Migrated lower end of shunt into subclavian vein	1	1.56%
Mortality	1	1.56%

DISCUSSION

We conducted this study, to document our experience of inserting a VA shunt for the treatment of hydrocephalus as a first option and compared it, with a VP shunt, which is a more routinely performed procedure .The pathophysiological reason that favors, the success of this procedure is based on two factors, one that because of the fact that the increasing obesity epidemic causes a raised intra-abdominal pressure and secondly, patients in whom abdominal surgeries have been performed are at a greater chance of having intra-abdominal adhesions and therefore a failed shunt[6] due to obstruction.

Ventricularatrial shunt in the past has been inserted by percutaneous method. Gonzales *et al* inserted the shunt by endovascular technique. Ellegard *et al* also reported placing an ultrasound guided shunt. In all these methods the result was safe, quick and easy procedure with no accidental damage to the surrounding structures like the carotid or the lung apex.[5] In our study the open conventional method was used in which the distal catheter was inserted just above the right atrium via the internal jugular vein.

Numerous complications have been reported in literature and the most commonly occurring are catheter obstruction, infection or arrhythmias[6]. VP shunt malfunction remains the most frequent reason for shunt

revisions. A study of 11 years,[7] concluded, that shunt blockade was responsible for 11% of the causes of shunt malfunction. In comparison, in VA shunt done in our study the blockage rate was only 3.1%.

In Columbia University medical centre a study was undertaken for the duration of 9 years for normal pressure hydrocephalus in which VA and VP shunt were inserted and the data was retrospectively analysed, comparing the two surgical options. It was found, that the rate of complications with both the procedures remained the same with no cardiopulmonary complication. This is similar to our study of 5 years; where there were no cardiac complications. Literature shows that the reason for this favoured outcome was due to the fact that none of the VA shunts were inserted into children, as long duration of the VA shunt was the factor, leading to cardiac complications, similar to our study, where children were excluded as well.[6]

In our study, local wound infection was the commonest complication (6.25%), and occurred in the first three months, which was confirmed with clinical findings and laboratory investigations. They were treated by appropriate antibiotic therapy. In a previous 10 year old study the rate of infection was 27%. It occurred in the first 2 months. It was irrespective of the type of shunting procedure done. The organism responsible was (MRSA) ,which was best dealt with removal of the infective shunt apparatus and initiating antibiotics .The timing of the infection and the similarity of the organism (MRSA) suggested that the organism is introduced during the procedure ,which evoked us to improve the aseptic technique.[8]. In addition there was a 15.7% infection rate with the VA shunt in Shurtleff's[1] 12-year study, almost twice as ours. Further studies are however, required to formulate guidelines, concerning aseptic measures, which can result in a decline in infection rate. This is common and comparable in VA and VP shunt.

The second most common complication was seen in 4.68% (3) patients who suffered from glomerulonephritis, clinically these patients had low grade fever and repeated proteinuria .These patients were seen by nephrologists who suggested removal of the shunt. Shunt nephritis has been reported not only with VA shunt but also with VP shunt, the cause of which is a simple infection of the shunt apparatus. Although according to literature the frequency is declining over the last decade, recent reports still show its prevalence .The frequency of shunt infection, despite being high, only 0.7–2.3% of the patients, actually develop shunt nephritis.[4] These patients improve with dialysis and require removal of the VA shunt. Interestingly shunt nephritis, is also seen in cases, where a VP shunt was inserted, although the frequency being very low.[9]

In centres, which are called highest quartile volume providers with more than 121 admissions per year the mortality rate was 0.3%and mortality rates for centres where admission rates were less than 28 per year (low quartile volume centres) had a mortality rate of 0.8%. These are comparable, to our result with mortality of 1.5%.[10]

Some surgeons are of the opinion that the VA shunt is difficult to place appropriately just above the atrium, it decreases its usefulness. There are however many methods to confirm the placement of the distal catheter in a VA shunt (fluoroscopic vs seldinger technique) as compared to a VP shunt where the placement can only be confirmed after surgery.[11] In another study it was proposed that the catheter should be left just above the right atrium, to avoid thrombus formation in the superior vena cava or subclavian vein.[12,13] In our study the distal catheter was placed, just above the right atrium, to avoid any arrhythmias.[11]

CONCLUSION

Our study derived the conclusion that adult, above the age of 15, irrespective of their gender, who suffered from hydrocephalus, due to any underlying pathology, benefited from a VA shunt due to fewer incidences of blockage and therefore less repeated surgeries. However it requires surgical skills for neck dissection. Moreover, the question that which patients can safely undergo a VA shunt without having the complications is answered to some extent as our study showed and literature confirms our finding of comparable complications to VP shunt. With ongoing experience and improvement in surgical expertise, complications will be relatively rare.

AUTHOR'S CONTRIBUTION

NA performed all the surgeries and managed the complications and supervised the paper writing. AAK wrote the paper under NA's guidance. MY compiled the data.

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