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Long term prognosis of ventriculoatrial shunt for idiopathic normal pressure hydrocephalus in the elderly

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Abstract: *Objective:* A retrospective study was conducted to access the long-term prognosis of inserting the Ventriculoatrial (VA) shunt in the elderly for the idiopathic normal pressure hydrocephalus (iNPH). *Material and Methods:* Retrospective data is collected from April 2004 to August 2015, and 1065 patients were selected. Patients who underwent surgical examination or surgery in suspected iNPH were included. Tap test is done in all cases and found to be effective for 968 cases and 656 VA shunts for 614 cases. Out of 614 cases there are 440 cases in which patient age were over 75 years. Of these 440 cases only 141 cases were able to observe 03 years or more after the surgery, 37 deaths and 05 cases with survival and unknown prognosis were found among them. So we analyzed this group mainly in 99 cases that the prognosis after 03 years was known. We access the outcome of VA shunt by the modified Rankin scale (mRS), iNPH grading scale (iNPHGS) and complications in the operative 656 cases and in 03 years follow up of 141 patients. *Results:* Of 141, there are 78 males and 63 females. Age at the time of VA shunt insertion was 81.5 ± 4.1 years and age at final follow-up was 85.2 ± 4.4 years. The proportion of patients who achieved a favorable outcome by complications was 97.9% in 03 years follow-up period and 87.7% in which follow-up is less than 03 years. At the time of VA shunt insertion out of 141, 57 patients lies between 75-79 years, 57 between 80-84, 24 between 85 to 89, and only 03 were found to be 90 years or more. At the time of final follow-up at 03 years, 15 patients lies between 75 to 79 years, 56 between 80 to 84 years, 57 between 85 to 89 years and 23 patents were found to be 90 years or greater. 70 cases or almost 50% exceeded 85 years. At the time of VA shunt 1, 11, 39, 51, 36, 3, 0 patients were in 0 to 6 modified Rankin Scale Score respectively and at 03 years follow-up 8, 19, 32, 29, 9, 2, 37 were in 0 to 6 mRS

respectively. Comparison of the study is done with SIPHONI study on VP shunt and LP shunt. *Conclusion:* Patients suspected of having idiopathic normal pressure hydrocephalus were treated by VA shunt and found no significant difference in serious adverse effects. This study shows that VA shunt is an effective choice for iNPH in the late elderly population, but it needs more randomized control trial to establish its efficacy.

Key words: Idiopathic normal pressure hydrocephalus, Ventriculoatrial shunt, hydrocephalus

Introduction

The clinical triad of cognitive decline, gait and balance impairment, and urinary incontinence with normal cerebrospinal fluid (CSF) pressure measured through lumbar puncture is called normal pressure hydrocephalus (NPH) was described by first described by Hakim and Adams (1). NPH has further subdivided into two, one in which cause is known and the other in which no etiology can be identified or called idiopathic NPH.

Although there has been significant improvement in the field of radiological imaging and despite the development of sensitive imaging modalities the diagnosis of patient having the NPH remain problematic and worse which patients would benefit from the surgical intervention is also very challenging. Even more difficult is to choose the diversion; either peritoneum through ventricle or lumbar spine or from ventricles to the atrium. Because the NPH is relatively a disease affecting the old population and also it is not uncommon for the elderly of having the obesity, constipation, and colorectal cancer and other diseases, performing the ventriculoperitoneal (VP) or lumboperitoneal (LP) shunt is not without complications.

Japan is progressing aging at a remarkably rapid rate compared to other developed countries, especially 2025 when the baby-boomer generation reaches the age of 75, it is predicted that the burden of nursing care and medical social security expanses will increase significantly (2).

At present, VP shunt and LP shunt is the most commonly used intervention and VA shunts are relatively less used. VA shunts are not as much of as VP or LP because of technical issues and reporting of the cardiopulmonary complications. There are also a small number of studies which directly comparing the long-term prognosis VP or LP to VA shunts in iNPH. This study is going to evaluate the long-term prognosis of VA shunts in iNPH and explore the effectiveness of its use in the elderly patients.

Material and Methods

We conducted a retrospective evaluation of 1065 patients from April 2004 to August 2015 who underwent surgical examination in suspected iNPH. We done lumbar puncture tap test to check the effectiveness of the procedure. The tap test was effective for 968 cases and 656 ventriculoatrial shunts for 614 cases. Among the 614 cases, 440 cases were in

which the age at surgery was over 75 years. Of these, only 141 patients were able to observe 03 years or more after surgery. Out of 141, 37 cases meets death and 05 patients with unknown prognosis was found among them. So, we analyzed this group mainly in 99 cases that the prognosis after 03 years was known.

Results

The effect of the VA shunt is done in five stages (Table 1), and also mRS (Table 2) and iNPHGS (Table 3) are also used. There were 495 cases in Evans Index (EI) > 0.3 (67.3%), disproportionally enlarged subarachnoid space hydrocephalus (DESH) only 212 cases (28.9%), (Table 4). The frequency of this DESH is almost the same as the results announced from brain surgery facility in London at the International Society of Hydrophilia. Fulfilling the guidelines, that is, EI>0.3, DESH was only 177 cases (24.1%), which was less than the overall quarter.

Complication of VA shunts was accessed in 656 cases, in which 76 requires intervention including shunt infection in 4 cases, valve part ulcer in 2, venous thrombosis in 4, shunt revision in 40, cardiopulmonary complication in 08, cervical subcutaneous abscess in 02, chronic subdural hematoma in 16 and 35 cases which doesn't need intervention including postoperative brain hemorrhage in 05 cases and chronic subdural hematoma in 30. These adverse events were also observed for more than 03 years were only 2.1% and including which requires intervention venous thrombosis in 2 cases, chronic subdural hematoma in 1 case, shunt revision in 13, and cervical subcutaneous

abscess in 01, while 01 case of post-operative brain hemorrhage and 10 cases of chronic subdural hematoma doesn't need any intervention. During the follow-up period of 3 years or more no cases of shunt infection, valve part ulcer, and cardiopulmonary complications observed.

Discussion

In our study of 141 patients, 78 males and 63 females and average age at the time of VA shunt was found to be 81.5 ± 4.1 years. Age at final follow-up was 85.2 ± 4.4 years. At the time of VA shunt insertion and at final follow-up 57 and 15 cases were in 75 to 79 years of age, 57 and 56 cases were in 80 to 84 years, 24 and 57 cases were in 85 to 89 years and 03 and 22 cases were in 90 or above age respectively (Figure 1).

During the follow-up period of 3 years or more there are out of 141 patients there are 37 deaths within 03 years. Out of 104 patients 33 patents had been observed for 3 to 4 years, 36 for 4 to 5 years, 20 for 5 to 6 years, 11 for 6 to 7 years and only 4 patients for up to 7 years.

This study is trying to compare the effects of shunt in cases under 75 or over 75 years of age. 174 cases were under the age of 75 and 440 cases were over 75 years old. Under 75 years of age patients out of 174, there were 120, 19, 26, 5, 0, and 5 cases which were excellent, good, fair, poor, dead, and undetermined. Over 75 years of age patients out of 440, there were 287, 72, 51, 11, 03, and 16 cases which were excellent, good, fair, poor, dead, and undetermined. If good and more are shunt responder, 79.9% (139 out of 174) at the age of 75 years and 81.6% (359 out

of 440) at the age of 75 and older, were able to judge that the effect of shunt was effective.

The shunt effect is the best prognostic judgment during the postoperative course. About shunt effect, there were 106 cases were excellent, 13 were good, 15 were fair, 4 were poor, and 03 cases of death. One year later follow-up shows prognosis of excellent, good, fair, poor, death and unknown in 97, 14, 8, 2, 19, 1 cases respectively. Three years later follow-up shows prognosis of excellent, good, fair, poor, death and unknown in 63, 10, 7, 19, 37, and 5 cases respectively (Figure 2).

Regarding the functional status of the patients after VA shunt we use modified Rankin Scale Score. It is considered that mRS 2 or more is independent. In the preoperative cases, 51 cases (36.3%) were independent. One year later, 86 out of 121 surviving (71.1%) were independent. Three years later, 59 out of 99 surviving (59.6%) were independent (Figure 3).

We compare our study with previous multicenter, prospective cohort study; Study of Idiopathic Normal Pressure Hydrocephalus on Neurological Improvement (SINPHONI). In SINPHONI for VP Shunt (3); the number of cases were 100 and in 15% severe adverse effects develop. In SINPHONI 2 for LP Shunt (4) 93 cases were enrolled; out of this 22% develop adverse effects. Our study comprises 656 cases and out of this 12.3% develop adverse effects.

Conclusion

In our study of VA shunt for iNPH serious complications were few even in patients who were 75 years old or older at the time of surgery

and 03 years or more after surgery. The prognosis of 3 years after VA shunt even in elderly is better than before surgery at 74% in mRS. Approximately 25% of the cases meet the diagnostic criteria of guidelines. Although our study shows VA shunt surgery is an effective choice for iNPH, there is need for other randomized control trials.

TABLE 1

Determining effect of VA Shunt	
Excellent	mRS improvement, MMSE 3 or better, or incontinence
Good	Although mRS has not improved, it reduces the burden on care-givers, increased patient activity
Fair	Only slight improvements are observed, no effect (facial expression improved, walking was slightly improved)
Poor	Worsening
Dead	Death

TABLE 2

Modified Rankin Scale Score	
0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead

TABLE 3

Grading Scale Score for NPH	
Gait disturbance	0=normal 1=unstable, but independent gait 2=walking w/ one cane 3=walking w/ two canes or a walker frame 4=walking not possible
Dementia	0=w/in normal range 1= no apparent dementia but apathetic 2 -socially dependent but independent at home 3 =partially dependent at home 4 =totally dependent
Urinary incontinence	0=absent 1= absent but w/ pollakisuria or urinary urgency 2 =sometimes only at night 3 =sometimes even during the day 4 =frequent

TABLE 4

	non-DESH	DESH	Total
EI ≤ 0.3	304	35	239
EI > 0.3	318	177 (24.1%)	495 (67%)
Total	522	212 (28.9%)	734

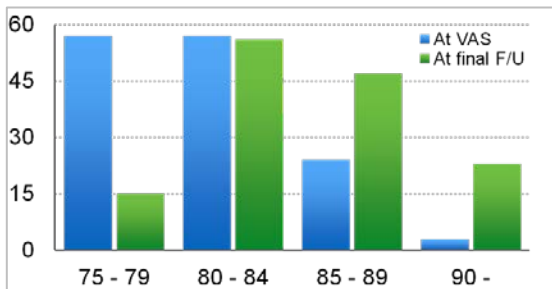


Figure 1

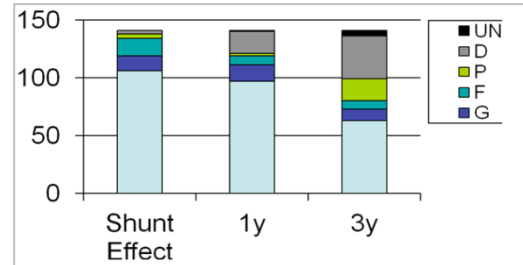


Figure 2

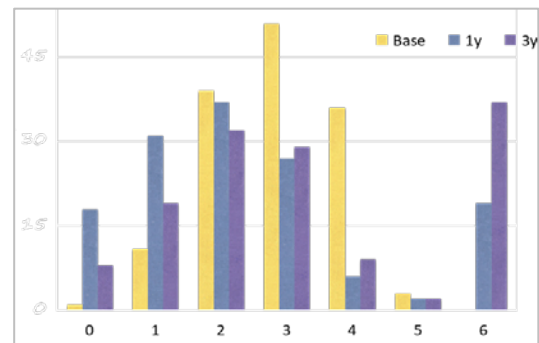


Figure 3

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