Ventriculoperitoneal shunts to control hydrocephalus in adults

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Abstract— Hydrocephalus is a neurological disorder where there is an increased build up of cerebrospinal fluid (CSF) in the brain[1]. One of the most prominent ways to treat this condition is the use of a ventriculoperitoneal (VP) shunt. Studies conducted are used to understand what the best treatment will be for certain patients with hydrocephalus. The overall goal of these studies is to determine how technologies can be improved and how different valves can impact patient’s health.

I. INTRODUCTION

Ventriculoperitoneal (VP) shunts came about in the 1960’s as a way for excess cerebrospinal fluid from the ventricles in the brain to be diverted to another part of the body where it can be reabsorbed[1]. Patients who have subarachnoid hemorrhages, bleeding, or an overproduction of CSF in the lateral ventricle of the brain can lead to increased intracranial pressure leading to a need for a VP shunt placement[2]. The continued evolution of VP shunts is an important question that medical doctors, engineers and product design companies must look for in the future.

II. METHODS

General shunt design includes three main components consisting of a ventricular proximal catheter, distal catheter, and a valve. These three main components work in conjunction to provide a pathway for excess CSF in the ventricles to be funneled out and reabsorbed in the peritoneal cavity.[3]. A study was conducted to demonstrate differences in efficacy of various types of VP shunts including gravity assisted valves (GAV) and a programmable valve [1]. A programmable valve incorporates a ball and cone design with a spring action that can be adjusted noninvasively by a magnet [4]. A GAV is a complex valve that utilizes level bounds of when a person is sitting and standing to allow different levels of fluid to be drained at different angles, lowering the chance of overdrainage seen in other types.

The study group consisted of 111 patients who required a VP shunt placement due to various types of hemorrhaging of the brain. Groups of the 111 patients were placed with seven different types of GAV and programmable GAV’s. The programmable valve allows the neurosurgeon a way to non-invasively adjust the pressure or flow rate of the valve according to the intracranial pressure in the patient’s head.

III. RESULTS

The mean survival rating of the shunts in the study was 268 weeks. The average survival rate for a GAV was 222 weeks compared to 286 for all of other types, while programmable valves averaged 264 weeks. Seven out of ten patients exhibited underdrainage with the GAV, 6 of which were bedridden patients.

IV. DISCUSSION

Although the technology of VP shunts has developed over the years its still rudimentary status is demonstrated by the high failure rates post surgery. The programmable valve is a viable option for neurosurgeons so that they can non-invasively adjust the pressure of the valve and therefore reduce the rate of shunt revisions, but it demonstrates a similar survival time as other VP shunts, which is one of the main disadvantages of current shunt technology.

Some of the advantages seen in the newer technologies is the non-invasive adjustment, and lower failure rates than in the past, yet not as low as it can be. Some of the future aspirations in this field is to create an electric and self assessing valve that can adjust itself based on input into sensors, allowing for live input of the patient’s physiological state. This technology is still in its infancy but could be a viable option in the near future [2].

REFERENCES


