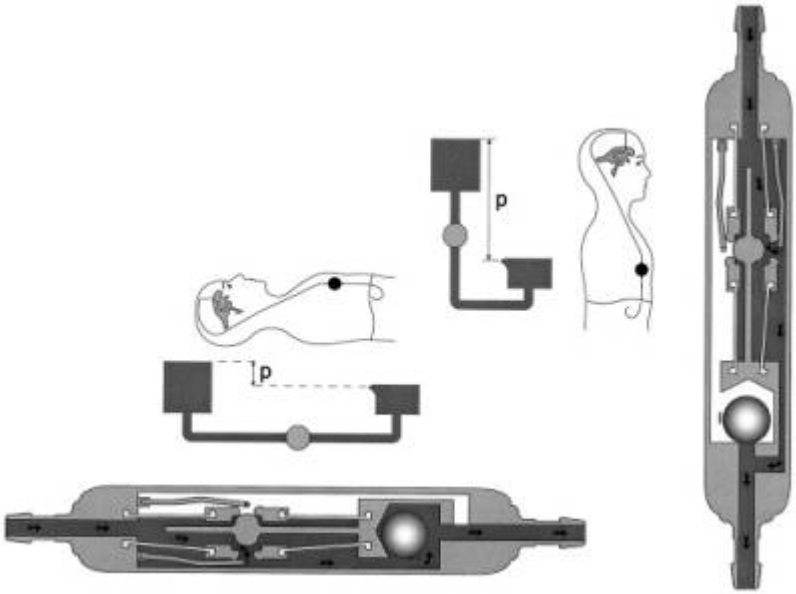
Miethke Dual-Switch



In the past decade, there has been a clear trend towards better outcomes in patients with hydrocephalus, especially those with normal pressure hydrocephalus (NPH). This is partly due to the availability of more sophisticated hardware and a better understanding of implants. However, there is little evidence to show the superiority of a specific type of valve over another. The most commonly reported consequence of hydrodynamic mismatch is shunt overdrainage. Simple differential pressure valves, with a fixed opening pressure or even adjustable valves, lead to non-physiologic intraventricular pressure (IVP) as soon as the patient moves into an upright posture. These valves fail to maintain IVP within physiological limits due to the changes in hydrostatic pressure in the drainage system. To solve this problem more complex third-generation hydrostatic valves have been designed. These gravitational devices aim to reduce cerebrospinal fluid flow through a shunt system when the patient is upright but there are important technical differences between them. Poca et al. reviewed the main characteristics of the Miethke Dual-Switch valve, which includes two valve chambers arranged in parallel: a low-opening pressure valve, designed for working in the supine position, and a second high-opening pressure valve, which starts working when the patient assumes the upright position. This paper specifies the main advantages and drawbacks of this device and provide a series of recommendations for its use. The discussion of this specific gravitational valve allows us to emphasize the importance of using gravitational control in implanted shunts and some the caveats neurosurgeons should take into consideration when using gravitational devices in patients with hydrocephalus. The correct function of any gravitational device depends on adequate device implantation along the vertical body axis. Misalignment from the vertical axis equal to or more than 45° might eliminate the beneficial effect of these devices [1)].

Among the currently available shunt systems, this series is one with the lowest complication rates due to overdrainage and valve obstructions. In patients with NPH, where low opening pressures are essential, the DSV seems to bear an advantage because of a high drainage rate and, in spite of this, a low rate of overdrainage. Even in patients with relatively high CSF protein content, we did not observe any valve obstruction. This study was an open field analysis providing data about the current complication rates of hydrocephalus treatment with this shunt system, outside of a specialized hydrocephalus team or a prospective study trial. However, this study is a retrospective analysis and a

prospective randomized controlled trial is required for the comparison of these valves with other shunt systems, such as programmable and flow-controlled ones is required for the future [2].

---

101 consecutive adult patients with hydrocephalus who required shunt surgery. The opening pressure was 5 or 10 cmH(2)O for the supine position and 30 or 40 cmH(2)O for the upright position depending on the sitting height. The results clearly showed that the DSV can regulate the intraventricular pressure (IVP) to 5 to 10 cmH(2)O in the supine and almost zero in the upright position, independently of posture. Ninety-four of the 101 patients received the DSV and 86 patients showed some clinical improvement. However, three patients required irrigation of subdural hematoma and six were thought to suffer underdrainage (4 probable and 2 possible). Such underdrainage probably resulted from the relatively high opening pressure in the supine position of 10 cmH(2)O and the bedridden state of these patients. This problem may be solved by the DSV with the 5 cmH(2)O setting in the supine position. The DSV can maintain physiological IVP in hydrocephalic patients independently of posture and provides generally satisfactory clinical outcome, but cannot prevent all inadequate drainage-related problems [3].

Due to the prompt switching function when the patient changes posture (lying down, standing, sitting, slanting etc.), the Miethke gravity-assisted valve (Miethke GAV) is more suitable in such cases than the Miethke Dual-Switch valve (DSV) [4]

A total of 54 patients with normal-pressure hydrocephalus (NPH) were treated; 30 patients received an Aesculap-Miethke GA-Valve (Miethke GAV; counterbalancer), and in 24 patients an Aesculap-Miethke Dual-switch-Valve (DSV; switcher) was implanted. The opening pressure of the posture-independent valve was 5 cm H2O in both devices. The outcome was clearly better with the usage of the GAV than with the DSV. The frequency and severity of complications was pronounced in the DSV group. We recommend the Aesculap-Miethke-GAV valve with a low opening pressure in a posture-independent valve for patients with NPH [5].

In a series of 202 adult patients with different etiologies treated with a ventriculo-peritoneal shunt including the hydrostatic Dual-Switch-valve (DSV), 21 cases were suspected of suffering from underdrainage. Using a new algorithm we were able to differentiate obstruction in 6 patients from functional underdrainage in 15 cases, thus we saw an indication to reimplant a DSV with a lower opening pressure in the latter.

The reasons for functional underdrainage were multifold in our series, especially the intraperitoneal pressure is still a “black box”. Despite the ability of the DSV to avoid clogging and to minimize overdrainage by its high-pressure-chamber, it remains difficult to determine the optimal opening pressure of the low-pressure-chamber of the DSV for ideal clinical improvement. Therefore a new hydrostatic gravitational “programmable” valve (proGAV), entitled on avoiding the disadvantages of other adjustable devices, has been developed and implanted in 16 patients with promising results [6]

1)

Poca MA, Gándara DF, Rosas K, Alcina A, López-Bermeo D, Sahuquillo J. Considerations in the Use of

Gravitational Valves in the Management of Hydrocephalus. Some Lessons Learned with the Dual-Switch Valve. J Clin Med. 2021 Jan 12;10(2):246. doi: 10.3390/jcm10020246. PMID: 33445418; PMCID: PMC7830811.

2)

Hertel F, Züchner M, Decker C, Schill S, Bosniak I, Bettag M. The Miethke dual switch valve: experience in 169 adult patients with different kinds of hydrocephalus: an open field study. Minim Invasive Neurosurg. 2008 Jun;51(3):147-53. doi: 10.1055/s-2008-1065337. PMID: 18521785.

3)

Tsunoda A, Maruki C. Clinical experience with a dual switch valve (Miethke) for the management of adult hydrocephalus. Neurol Med Chir (Tokyo). 2007 Sep;47(9):403-8; discussion 408. doi: 10.2176/nmc.47.403. PMID: 17895613.

4)

Meier U, Kiefer M, Neumann U, Lemcke J. On the optimal opening pressure of hydrostatic valves in cases of idiopathic normal-pressure hydrocephalus: a prospective randomized study with 123 patients. Acta Neurochir Suppl. 2006;96:358-63. doi: 10.1007/3-211-30714-1_74. PMID: 16671485.

5)

Kiefer M, Meier U, Eymann R. Gravitational valves: relevant differences with different technical solutions to counteract hydrostatic pressure. Acta Neurochir Suppl. 2006;96:343-7. doi: 10.1007/3-211-30714-1_71. PMID: 16671482.

6)

Sprung C, Miethke C, Schlosser HG, Brock M. The enigma of underdrainage in shunting with hydrostatic valves and possible solutions. Acta Neurochir Suppl. 2005;95:229-35. doi: 10.1007/3-211-32318-x_47. PMID: 16463855.