

SURGICAL MANAGEMENT OF HYDROCEPHALUS – MODERN TECHNIQUES AND LONG-TERM OUTCOMES

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Abstract: Surgical treatment remains the cornerstone of hydrocephalus management. Over the past decades, significant progress has been made in shunt technology and endoscopic procedures. This article discusses current surgical techniques, perioperative care, and long-term outcomes in patients with hydrocephalus.

Keywords: hydrocephalus, ventriculoperitoneal shunt, endoscopic third ventriculostomy, ETV, shunt complications, programmable valve.

Introduction

The primary objective of surgical treatment is to restore physiological cerebrospinal fluid circulation or provide an alternative drainage pathway. Despite technological advancements, surgical management remains associated with complications, emphasizing the importance of careful patient selection and long-term follow-up.

Ventriculoperitoneal (VP) Shunting

VP shunt placement is the most widely used surgical procedure. Modern systems include programmable valves, anti-siphon devices, and antibiotic-impregnated catheters. These innovations have reduced—but not eliminated—complication rates.

Shunt-related complications include obstruction, infection, overdrainage, underdrainage, slit ventricle syndrome, and mechanical failure. Children are particularly susceptible to shunt malfunction due to growth-related issues.

Endoscopic Third Ventriculostomy (ETV)

ETV is an established alternative for obstructive hydrocephalus, particularly aqueductal stenosis. The procedure involves creating an opening in the floor of the third ventricle to allow direct CSF flow to the basal cisterns. The success of ETV depends on patient age, etiology, and previous infections or hemorrhage.

The combination of ETV with choroid plexus cauterization (ETV+CPC) has demonstrated promising results, particularly in infants.

Other Surgical Techniques

Ventriculoatrial and ventriculopleural shunts are used when the peritoneal cavity is unsuitable. Lumboperitoneal shunts may be considered in selected cases of communicating hydrocephalus and normal pressure hydrocephalus.

Perioperative Management

Advances in anesthesia, aseptic technique, and perioperative antibiotic prophylaxis have reduced surgical morbidity. Postoperative neuroimaging, clinical surveillance, and patient education are essential components of long-term care.

Long-Term Outcomes

While many patients experience significant clinical improvement after surgery, long-term neurological and cognitive outcomes depend on the underlying cause, age at treatment, and presence of comorbidities. Lifelong follow-up is often required, particularly in pediatric cases.

Future Directions

Research is focused on bioengineered shunt materials, smart valves with real-time pressure monitoring, and pharmacological modulation of CSF production.

Conclusion

Surgical management of hydrocephalus continues to evolve. Individualized treatment strategies and technological innovations offer improved outcomes, but complication prevention and long-term follow-up remain central challenges.

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