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Technique

Water dissection technique of Toth for opening neurosurgical cleavage planes

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Abstract

Background: The low-pressure water dissection technique of Toth, first reported in 1987, is a method to cautiously open neurosurgical cleavage planes such as the sylvian fissure or the interhemispheric space, and the interfaces between extraparenchymal masses and the adjacent brain. The aim of this technical report is to present our long-term experience with this simple and elegant asset of microneurosurgery and to promote its widespread use.

Method: Water is injected under microscopic control by a handheld syringe with a blunt needle or by an irrigating balloon applying repeated injections of physiological saline into the cleavage plane to open it.

Findings and Conclusion: The water dissection technique of Toth has been extensively used in Budapest and Helsinki in thousands of microsurgical cases, in removal of meningiomas and to open sylvian and interhemispheric fissure. In our experience, there have been no noticeable complications, and we recommend this technique for widespread use. It is a very inexpensive, simple, and effective method not requiring any expensive or complicated devices.

Keywords: Water dissection technique; Subarachnoid space; Cleavage plane; Meningioma; Sylvian fissure dissection; Microsurgery

1. Introduction

One of the least known and most elegant techniques in microneurosurgery is the use of WDT. Water dissection technique, using the separating effect of injected low gentle pressure physiological saline, was introduced by Toth et al [18] in early 1980s and published in 1987 (Fig. 1). It is a simple method to cautiously open natural preformed cleavage planes such as the sylvian fissure or the interhemispheric space, and the interfaces between the cortex and extraparenchymal lesions such as meningiomas, aneurysms, and AVMs. The aim of the present technical report is to present our long-term experience with the low-pressure water dissection technique as an adjunct to everyday microneurosurgical practice. An early comparison of microsurgery with and without WDT was done by Toth et al [18], but no randomized trial has been conducted comparing the pros and cons of the technique.

In the original article by Toth, the method was called "water jet dissection technique." However, in later publications on a method called "water jet resection technique," using high pressure, the tissue incision in experimental conditions appeared [5,7,10,11,17], and it has also been introduced into the clinical field, for example, cornea [3], liver [6,19], and kidney [1,15] surgery. Frankly, these two are completely different methods indeed. Toth water dissection is a gentle microsurgical method, but the water jet resection works more like a "destructive knife."

Abbreviations: AVMs, arteriovenous malformations; WDT, Water dissection technique; MCA, middle cerebral artery.

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2. Neurosurgical cleavage planes

A microneurosurgeon faces many cleavage planes to be gently opened, thus avoiding damage to the brain tissue by compression. These cleavage planes include (*a*) natural but adherent spaces such as the sylvian fissure in front of middle cerebral artery aneurysms and insular tumors, the interhemispheric space above falcine or third ventricle tumors and distal anterior cerebral artery aneurysms, the space between the tonsils and medulla behind posterior inferior cerebellar artery aneurysms, and the way into the fourth ventricle; and (*b*) interfaces formed between brain tissue and solid extraparenchymal masses, and so on. Meningiomas and large/giant aneurysms, which grow in eloquent cortical or deep areas, may push these areas to unexpected directions or bury them into the cleavage plane. After widening the cleavage planes with WDT, the microsurgical methods to separate cleavage planes include classic sharp opening of arachnoidal adhesions and dissection of vessels and nerves with intermittent use of bipolar or jeweller forceps, suction, microscissors, and surgical pads to make the way. In our current practice, we avoid the use of retractors as much as possible [8].

We provide the water jet by a 20- to 50-mL syringe with a blunt steel needle or a plastic flexible needle (Fig. 2A), but an irrigating balloon is also feasible. The irrigation pressure is hand-controlled according to the microscopical view of the ongoing dissection, and consequently it requires learning the feasible applications (Fig. 2B). This technique does not need special equipment, and it is easily adapted to everyday microsurgical practice. We do not find constant pressure irrigation provided by a pump or a pressurized cuff on a saline bag practical because the jet pressure cannot be adopted according to the anatomical findings.

3. Cleavage planes of meningiomas, giant aneurysms, and AVMs

Meningiomas usually rather compress than infiltrate the adjacent cortex or cranial nerves (Fig. 3A and B). The tumor-cortex interface is crossed by varying numbers of small feeding arteries and veins to be interrupted, nonfeeding arteries, sometimes embedded in meningioma tissue, and veins to be preserved. Benign meningiomas may partially disrupt the arachnoidal and pial layers, which combined with softened, gliotic, and edematous cortex, make the true arachnoidal cleavage plane hard to maintain [16]. Genuine infiltration of the brain, seen at least in grade III tumors [9], also makes the surgical cleavage uncertain. High-quality magnetic resonance imaging and computed tomography may give valuable data on the cleavage plane, infiltration of the cortex, vascular supply, and encasement vessels [2,4,13,14,16]. In large/giant aneurysms that may be filled with thrombus, previously incompletely coiled or otherwise indicating reconstruction of its neck, it may be necessary to dissect the sac loose from the adjoining brain tissue and arteries before resection of the sac and clipping the neck or reconstruction of the parent vessel. In AVMs, enlarged and convoluted vessels and the nidus need to be carefully separated from adjacent, possibly eloquent areas using their gliotic cleavage (see Video 1).

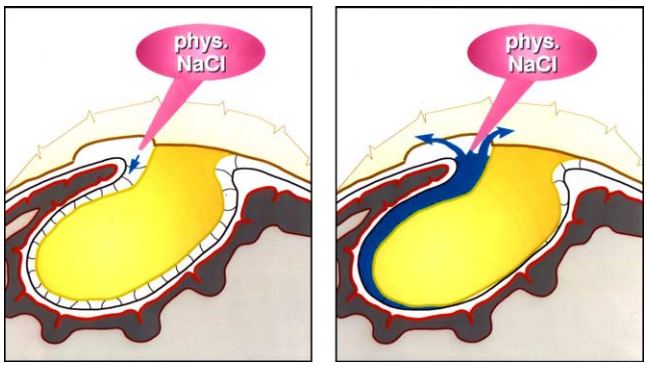

Fig. 1. Principle of WDT.

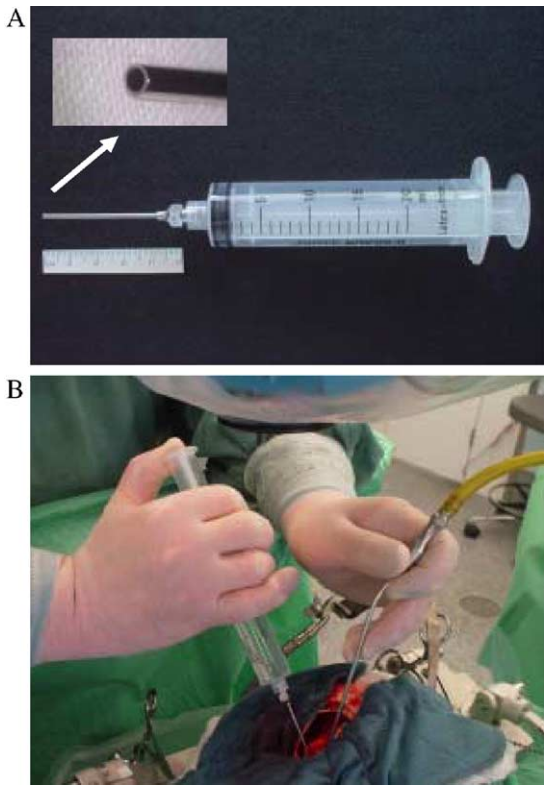

Fig. 2. A: Simple syringe. B: Intraoperative picture demonstrates the separation effect of low-pressure WDT under microscope.

4. Opening the sylvian fissure

We usually approach nearly all middle cerebral artery aneurysms directly by opening the fissure laterally, beginning with jeweller forceps and then continuing with