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Healing of Deep Wound Infection without Removal of Non-Absorbable Dura Mater (Neuro-Patch®): A Case Report

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ABSTRACT: We report on a female patient who received microvascular decompression due to hemifacial spasm. Neuro-Patch® was used during the operation to repair and replace damaged dura mater. Six days after the operation, the incision wound was found to be infected. Abscesses were present deep in the incision. However, because the artificial dura mater was attached so tightly to the original dura mater, the infection was not able to spread inside the skull. After 3 months of meticulous wound cleaning and drug treatment to promote the growth of granulation tissue, we were able to gradually achieve healing of the infection without having to remove the non-absorbable artificial dura mater. By describing this case and the results of a review of the pertinent literature, we discuss the possibility of recovery of an infection without removal of artificial dura mater.

KEY WORDS: dura mater; infection; hemifacial spasm.

I. INTRODUCTION

During neurosurgery operations, because of various factors, the dura mater can be damaged, causing the skull tissues to not close properly postoperatively and requiring repair of the duramater. Currently, the use of artificial dura mater is becoming more and more common.[1] Artificial dura mater is made in two main types: absorbable and non-absorbable.[2,3] If infection occurs in the incision area or inside the skull after using non-absorbable artificial dura mater, doctors often need to remove the artificial dura mater surgically to control infection.[4] Here, we review the case of a patient diagnosed with hemifacial spasm who received a microvascular pressure reduction operation. During the procedure, Neuro-Patch® was used to repair defective dura mater. However, the deep part of the incision wound became infected. Our team treated the infection with meticulous and prolonged dressing-change therapy and the infection was controlled without removing artificial dura mater.

II. CASE REPORT

A 46-year-old female patient presented to our department for diagnosis with 6 years of involuntary left-sided facial spasms. Her main symptoms included twitching and spasm of the left eyelid, causing her left eye to appear smaller. In severe situations, her left face would also appear to twitch. Her previous overall health situation was good, without any obvious unhealthy habits. The diagnosis of left hemifacial muscle spasm was made, and a preoperative MRI 3D-CISS scan was performed that indicated compression of the facial nerve by the anterior inferior cerebellar artery.

In November 2012, the patient received microvascular decompression operation under general anesthesia. The surgery was performed with the patient in the lateral position. A *suboccipital retrosigmoid approach* was used that did not involve opening the mastoid process. There was no excessive bleeding, and the decompression operation went smoothly overall without difficulty. The operation lasted roughly 2 hours. During closure of the skull, a defect in the dura mater was discovered.

The decision was made to use Neuro-Patch® (produced by the Aesculap Corporation in Germany) non-absorbable synthetic dura mater. The patch was cut to 2 × 2 cm, the same size as the bone window, and was attached to the window at the dural surface. The artificial dura mater was sutured to the original dura mater using thin threads and not pulled too tightly. Next, shavings from drilling and a flap from opening the bone window were used to patch the remaining bone defect. Finally, muscles, subgalea, and scalp were sutured. No drainage tubes were inserted, and no antibiotics were used during the course of the operation. However, on postoperative day 5, the patient developed a low-grade fever of 37.5–37.8°C. The incision wound began to develop pain, but no redness or swelling could be seen at that time. Therefore, no special treatment was given. On postoperative day 6, the incision wound showed signs of redness and swelling. The scalp sutures were removed, and a subcutaneous abscess was identified. The pus was immediately removed and cleaned, and drainage gauze was placed into the wound. After one day, purulent fluid oozed out of the deep tissue below the subcutaneous layer; at this time, the suture to the subgalea and scalp was removed as well. Upon removal, muscle necrosis was observed. Deep abscess formations were also found along with necrosis of the bone flap and bone fragments used to fill the defect when closing the wound. After cleaning and removal of the necrotic tissue, pus formation, and exudations, the white artificial dura mater was seen. Fortunately, the artificial dura mater was still tightly attached to the patient's own dura mater, and the necrotic material did not penetrate into the skull. Cerebrospinal fluid did not seem to leak out, either. Culture of the pus revealed the presence of *Pseudomonas aeruginosa*, and the patient received cefoperazone intravenous therapy. In this case, the daily use of drugs to promote granulation tissue growth (epidermal growth factor) and debridement gel (to promote the liquefaction of necrotic tissue) were desirable. In addition, clean dry gauze should be used to fill the abscess and replace the contaminated one. During the first 3 weeks of the infection, due to the large amount of purulent discharge, the dressing was changed twice daily. As the exudations decreased after the initial 3 weeks, the dressing changes were reduced to once daily. Granulation tissue began to grow inside the abscess, and the size of the infectious cavity shrank after 1.5 months. The floor of the cavity was completely composed of artificial dura mater.

Three months after the operation, the size of the infection cavity became very small. Most of the artificial dura mater has been covered by granulation tissue. Purulent discharge from the wound also significantly decreased. However, part of the artificial dura mater, which had not been covered, could still be seen. Hence, we were concerned that the granulation tissue would not adequately cover the artificial dura mater. Would the presence of the artificial dura mater continue to cause infection and abscess reformation? We considered whether to remove the artificial dura mater or not. Because infection was still present, removal of the artificial dura mater might cause the infection to spread inside the dura mater and into the brain. Finally, we chose not to remove the artificial dura mater to see whether the wound would heal. When the wound had healed to the point where only a small opening was seen, a drainage tube was inserted deep into the wound cavity to the location of the artificial dura mater. Thus, exudate from deep inside the wound was able to flow to the outside. The wound was monitored daily for exudations and care was taken to ensure that the area surrounding the wound was cleaned. On day 9 after the operation and insertion of the drainage tube, no more exudates were seen in the drainage tube. Granulation tissue gradually filled the entire cavity at which point the drainage tube was removed 3 months postoperatively. Follow up of the wound did not reveal any redness or swelling. Magnetic resonance imaging (MRI) of the incision wound revealed no infection foci formation (Fig. 1). The infected wound was totally healed (Fig. 2 and Fig 3.).

III. DISCUSSION

Under normal circumstances, if infection occurs in a surgical incision wound, the cause of the infection needs to be cleaned and removed for the infection to heal properly.[5–8] In the past, some studies have reported that infections, such as meningitis,

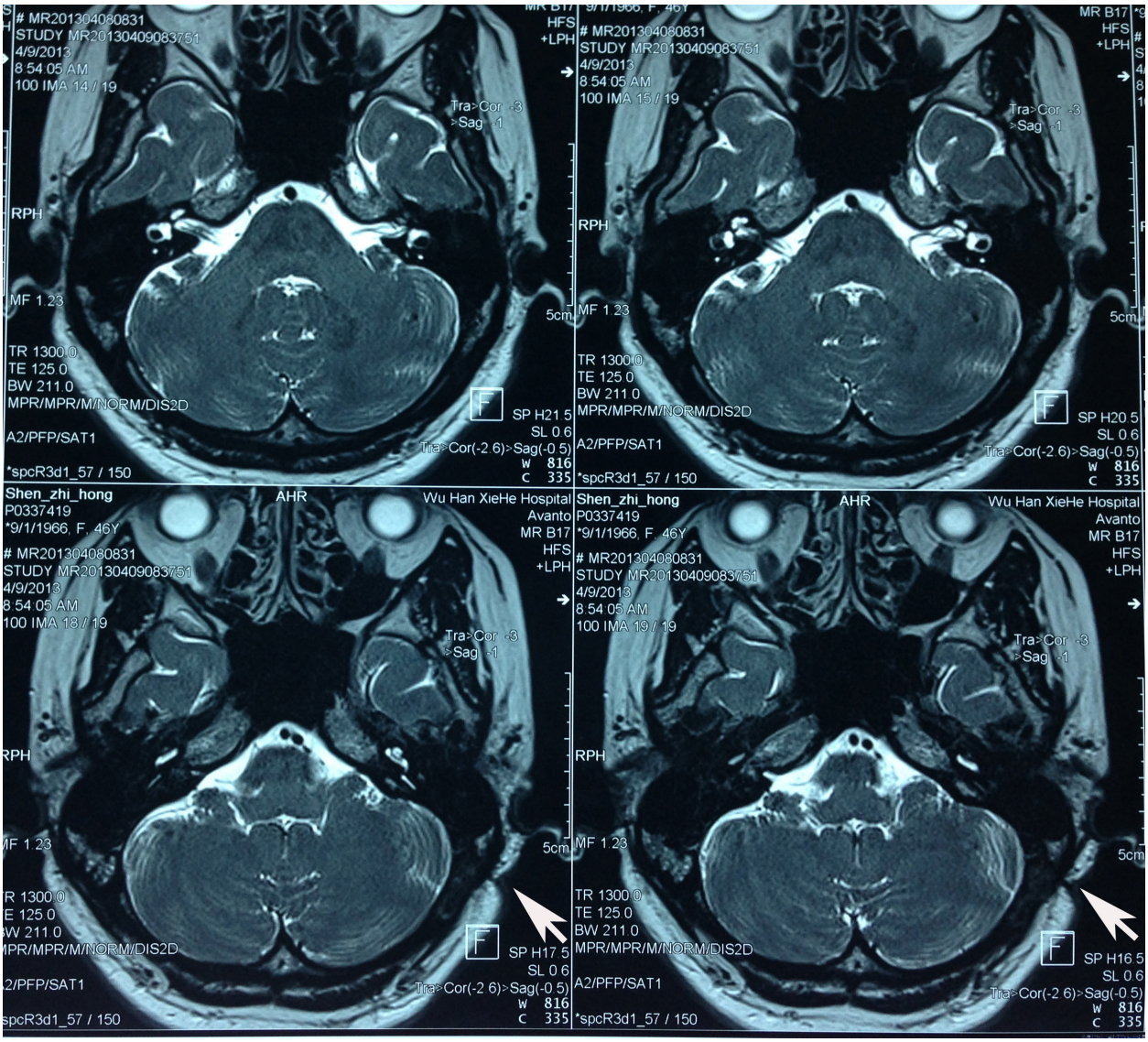

FIG. 1: At 4 months after the operation and 1 month after the complete healing of the wound, a MRI (3D-CISS) scan was performed. The depression of the skin in the wound area can be seen (↖); the dura mater is intact with the artificial dura mater closely attached to the patient's own dura mater and is very difficult to distinguish. There were no abscesses superficial to the dura mater.

abscesses, osteitis, and empyema, due to the use of Neuro-Patch® can only be treated by removing the artificial dura mater.[2,9] However, this case presented a special dilemma. Due to the fact that the only barrier separating the infected tissue from the intracranial tissue was the artificial dura mater, removing it might have caused the infection to spread into the brain and may have resulted severe infection of the central nervous system. Therefore, we decided to retain the artificial dura mater and, through daily debridement, wound disinfection, and use of drugs to promote granulation tissue growth, the infection was gradually reduced. Fortunately, in the end, the infection was controlled, the wound healed, and no abscesses formed even with the presence of the infection source (artificial dura mater). We conclude

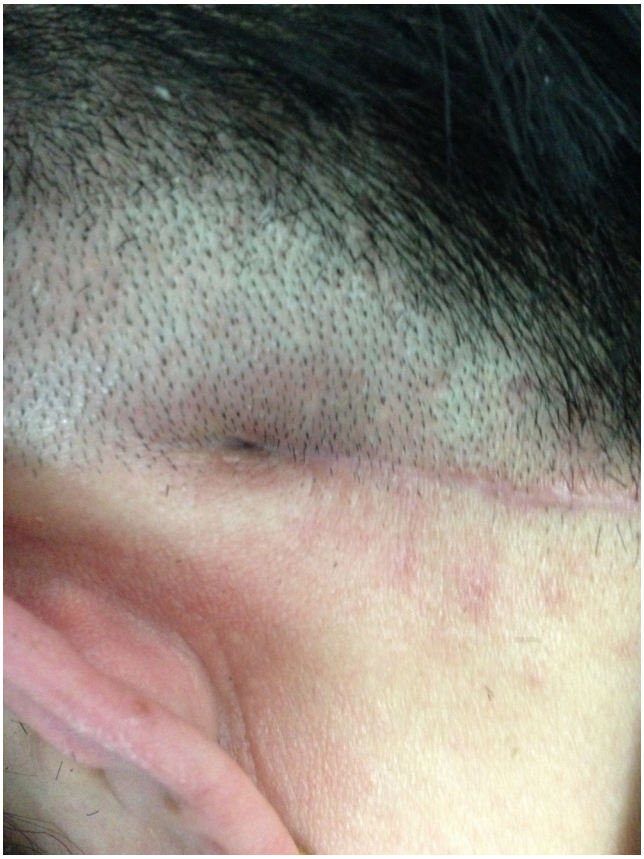

FIG. 2: The incision wound after healing approximately 4 cm posterior to the ear. Due to missing bone matter, a depression appears in the skin. No redness, swelling, or tenderness appeared around the wound area.

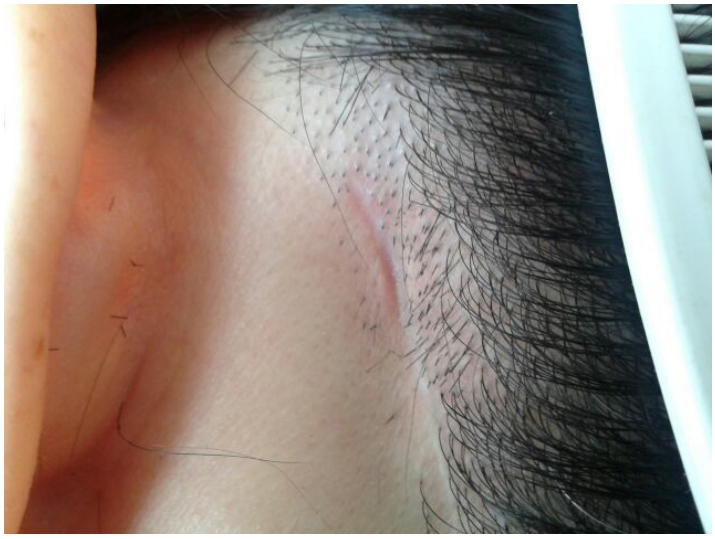

FIG. 3: Approximately 1 year postoperatively; the sinus has disappeared and the depression is becoming leveled with the surrounding tissue.

that, as long as the local conditions are favorable, the infection source does not necessarily have to be removed for the wound to heal. A similar event has also been previously reported.[10]

Artificial dura mater (Neuro-Patch® in this case) is a kind of patch made from high-purity polyurethane microporous fiber to a manufacturer specified thickness of 0.5 ± 0.05 mm. In its production, the dissolved polyurethane is injected by a special nozzle in a rotating cylinder. Through various nozzle movements and angle changes, the polyester fiber is woven into a wool-like structure. This fibrous microporous structure provides a support and platform for the tissue cells to grow on.[11]

A study on Neuro-Patch® found that 1–3 days after its implantation, the surrounding connective tissue cells (fibroblasts and some immunological cells) began to migrate into the pores of the implant, and collagen protein was being produced.[12] At this point, the artificial dura mater was firmly attached to the original dura mater to achieve good subdural closure. This explains why the infection did not penetrate into the brain in this case.

In addition, the granulation tissue had gradually filled the infection cavity. Thus, with proper wound exudation drainage, the wound was able to heal even with the foreign body present. Among previous studies conducted on operations involving infections caused by implants, numerous reports have indicated that the implants do not need to be removed.[13–15] Instead, antibiotics were used to aid wound healing. Healing of infections in the presence of implants can take place only if certain measures are taken. One of these measures is the use of narrow-spectrum antibiotics specifically designed to reach the area of infection and fight the pathogenic bacteria culprit. Another measure is to ensure the complete removal or absorption of residual necrotic tissue within the cavity. However, the healing of some infections can be delayed due to bacteria making its way inside the foreign body. If this happens, antibiotics are unable to reach these bacteria to carry out their effect. We considered the fibrous structure formed by the artificial dura mater, which allows primary tissue cells to penetrate it. These tissue cells contain immune cells that kill bacteria within the artificial dura mater and also fill its pores. Granulation tissue then gradually surrounds it. Also, due to the excellent durability and tissue compatibility of the Neuro-Patch®, rejection of this artificial dura mater is relatively rare because no inflammatory granulation tissues form.[16] Finally, healing is achieved.

This case reflects only one patient, and all of the observations were done only on this patient. This report does not necessarily reflect these kinds of cases in general, nor was it compared against a control group. However, this case demonstrates that healing of a post-operative incision wound infection without removing the Neuro-Patch® is possible.

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