Using gore-tex strip film sheet in the fresh cadaveric cow brain for evaluating brain protection

Beyin doku korunmasını değerlendirmede taze kadavra inek beyinleri üzerinde gore-tex film örtü kullanımı

Using gore-tex film for brain protection

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Öz

Amaç: Bu deneysel çalışmanın amacı cerrahide metalik mikrocerrahi aletlerin beyin dokusu üzerine zararlı mekanik etkilerinden beyin dokusunun korunmasında gore-tex strip-film örtü kullanımını değerlendirmekti. Gereç ve Yöntem: Otuz adet inek beyinleri iki eşit gruba ayrıldı. Gore-tex strip-film örtülü grup (Grup I) ve Gore-tex strip-film örtüsüz grup (Grup II) Grup I 40 mm uzunluk ve 12 mm genişlikte Gore-tex strip-film örtü anterior beyin interhemisferik sulkusun sol duvarına serildi. Metalik mikrocerrahi aletlerin mekanik travmatik etkileri minimal , orta ve şiddetli olarak 3 gruba ayrıldı. Bulgular: Grup I de (n=15), Minimal hasarlı beyin parankimlerinin sayısı 10 (66.67%) bulundu. Grup II (n=15), minimal hasarlı beyinlerin sayısı 3 (20%) idi. Orta hasarlı beyin parankimi sayısı grup I de 3 (20%) iken Group II de 8(53.33%) idi. Şiddetli beyin parankim hasarı sayısı Grup II de 4 (26.67%) iken Grup I de benzer hasar sayısı 2 (13.33%) bulundu. Tartışma: Bu çalışma metal mikrocerrahi aletlerin mekanik hasarından çıplak beyin dokusunu korumada gore-tex film örtü kullanımını göstermektedir. Bu materyal pratik mikrocerrahide beyin dokusunun korunmasında katkı sağlayabilir.

Anahtar Kelimeler

Beyin Koruma; Gore-Tex Stripfilm; Mikrocerrahi; Operasyon Mikroskobu; Mikrocerrahi Eğitimi

Abstract

Aim: The aim of this experimental study was to evaluate the use of gore-tex stripfilm sheet in the protection of brain tissue from the harmful mechanical effect of metallic microsurgical instruments. Material and Method: Thirty uncovered fresh cadaveric cow brains were equally divided into two groups: group with the gore-tex stripfilm sheet (Group I) and without gore-tex (Group II). In Group I, the gore-tex stripfilm sheet, 40 mm in length and 12 mm in width, was sprawled over the left lateral side of the interhemispheric sulcus of anterior brain surface. The mechanical traumatic effects of metallic surgical instruments were divided into three groups : minor, moderate, and severe. Results: In Group I (n=15), the number of minor injured brains was found to be 10 (66. 67%). In Group II (n=15), the number of minor injured brains was found to be 3 (20%). On the contrary, the number of moderately injured brains parenchyma in Group I cow brains was estimated to be 3 (20%). However, the number of moderately injured brains in Group II was found to be 8 (53. 33%). The number of severe injury was found to be 4 (26. 67%) in Group II. The number of same injury was found to be 2 (13. 33%) in Group I. Conclusions: In conclusion, this study showed that protecting the naked brain tissue from the mechanical injury effect of metallic microsurgical instruments using the gore-tex stripfilm sheet is feasible. It is believed that this material might contribute to the practical microneurosurgery in protecting the brain tissue.

Keywords

Brain Protection; Gore-Tex Stripfilm; Microneurosurgery; Operating Microscope; Training Of Microsurgery

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Introduction

Microneurosurgical operations require different metallic instruments during the surgical treatment of pathologic lesion located within the brain tissue. The protection of the neurovascular structures of brain is an extremely important and critical point in all kinds of microneurosurgical interventions. Theoretical knowledge, practical techniques, and microsurgical operative disciplines for protecting delicate brain and related structures located within the cranium are mainly provided during the residency years of neurosurgical education [1, 2]. The hardness, corners and specific shape of the metallic surgical instruments may bruise the delicate brain tissue and related structures including cranial nerves and vascular structures. Some specific materials may be used for parenchymal and neurovascular brain protection.

Theoretical and practical trained microneurosurgical ability is not sufficient in protecting the brain parenchyma from the mechanical injury of metallic microsurgical instruments during the surgical intervention to the brain tissue. Specific microneurosurgical techniques such as proper use of the operating microscope, holding and grasping of the microneurosurgical instruments, proper microsurgical technique of the opening of arachnoid membranes, safe and delicate neurovascular dissection, and carefully and properly microdrilling of the cranial base bones should be learned before performing an operation [1-4].

Metallic surgical instruments may mechanically injure the delicate brain parenchyma and related structures such as cranial nerves and vascular structures in the microneurosurgical operations. Some specific materials may be used in protecting brain tissue from the harmful effect of metallic instruments. The aim of this experimental study was to evaluate the use of gore-tex stripfilm sheet in protecting brain tissue from the harmful mechanical effect of metallic microsurgical instruments. Experimental findings, difficulties, practical methods, and suggestions were discussed in line with the existing literature.

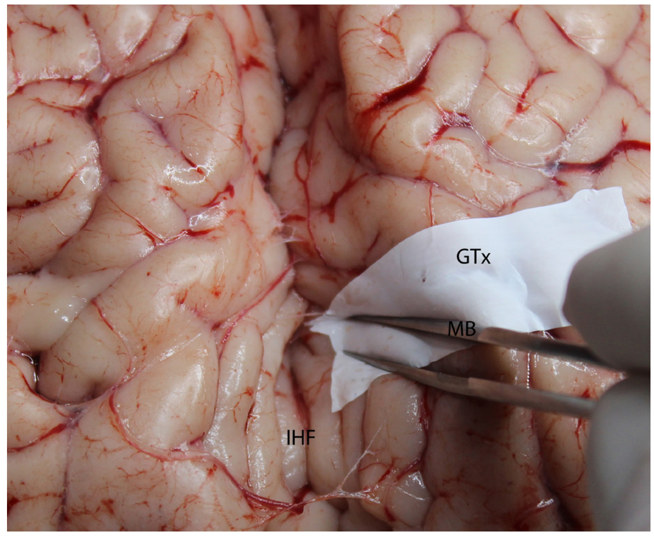

Figure 1. Dissection process of the interhemispheric fissure using microbayonet is shown in this figure (GTx: Gore-tex stripfilm sheet, MB: Microbayonet, IHF: Interhemispheric fissure)

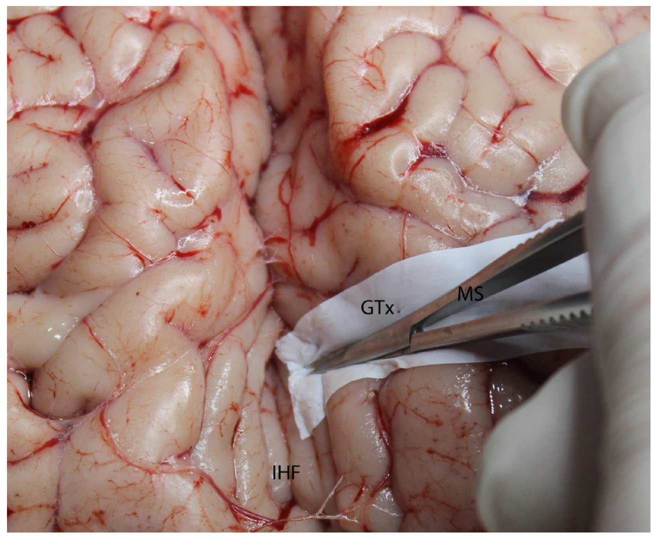

Figure 2. Dissection process of the interhemispheric fissure using microscissor is shown in this figure (GTx: Gore-tex stripfilm sheet, MS: Microscissor, IHF: Interhemispheric fissure)

Material and Method

All microneurosurgical activities were performed under the operating microscope in this experimental study. An experimental microneurosurgical brain protection model was created using fresh cadaveric uncovered cow brain for evaluating the efficacy of gore-tex stripfilm sheet. The cow brains were equally divided into two groups: group with the gore-tex stripfilm sheet (Group I) and group without gore-tex stripfilm sheet (Group II). In Group I, the gore-tex stripfilm sheet, 40 mm in length and 12 mm in width, was sprawled over the left lateral side of the interhemispheric sulcus of anterior brain surface. The gore-tex stripfilm sheet should be held carefully from both ends using a microbayonet. It is a very thin and easily curled material. Sprinkles of some water over the brain surface before sprawling of gore-tex stripfilm sheet facilitated the use of material. Dissection of the interhemispheric fissure using microbayonet and microscissor is shown in Figures 1 and 2.

In Group II, no material was used for brain protection. Microbayonet, microscissor, microdissector, the metallic tip of aspirator and bipolar forceps were used in the dissection, distraction and separation of interhemispheric fissure in the two groups.

The operation was started with the cutting of arachnoid membrane over the interhemispheric fissure using the microscissor. It was followed by the separation and distraction of fissure using microbayonet, microdissector, and the tip of aspirator. Microdissection and separation were continued until the corpus callosum was reached. Following the completing of dissection of the interhemispheric fissure, advanced separation and distraction were performed using metallic Leyla retractor 1 cm in width of the retractor blade. Two-centimeter separation from the opposite brain hemisphere was performed for 20 min. In Group II, the gore-tex stripfilm sheet was not used protecting brain tissue. All aforementioned operating procedures were performed in the same way for the same time.

Next, all operated brains were sliced regularly (0.5 cm) from the anterior to the posterior direction for evaluating the harmful effects of metallic instruments and open biopsy micro-separator on the brain parenchyma. All brain slices were evaluated under the magnification of operating microscope in terms of contusion, tearing, distortion, and other traumatic features. The mechanical traumatic effects of metallic surgical instruments were divided into three groups: minor, moderate, and severe.

Results

Thirty uncovered fresh cadaveric cow brains were used in this experimental feasibility study. In Group I (n=15), the number of minor injured brains was found to be 10 (66.67%). The appearance of minimally injured brain section operated with the Gore-Tex stripfilm sheet is shown in Figure 3. In Group II (n=15), the number of minor injured brains was found to be 3 (20%). On the contrary, the number of moderately injured brains parenchyma in Group I cow brains was estimated to be 3 (20%). However, the number of moderately injured brains in Group II was found to be 8 (53.33%). The appearance of moderately injured brain section operated without the Gore-Tex is shown in Figure 4. The number of severe injury was found to be 4 (26.67%) in Group II. The number of same injury was found to be 2 (13.33%) in Group I. The evaluation of sliced cow brains under magnification of the operating microscope revealed that the use of an open biopsy micro-separator might protect the brain parenchyma from the harmful effect of microsurgical metallic instruments during the surgical intervention in compared with the direct use of a microbayonet, a microscissor and a metallic aspirator. The evaluation of sliced cow brain under the magnification of operating microscope revealed that the use of gore-tex stripfilm sheet protected the brain parenchyma compared with Group II specimens from the harmful effect of microsurgical metallic instruments during the surgical intervention.

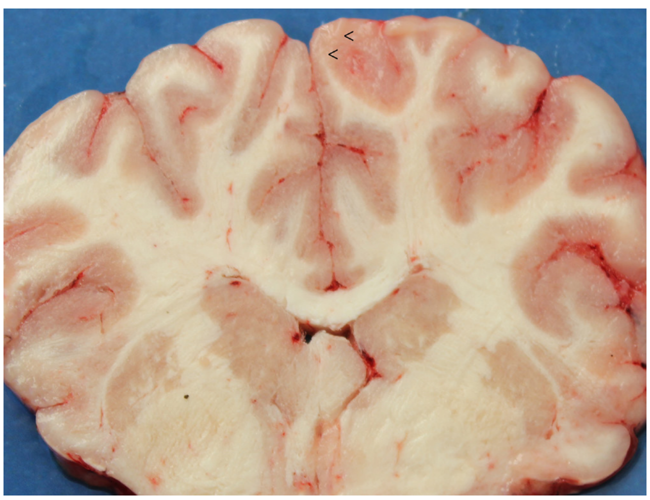

Figure 3. The appearance of minimally injured brain section operated with Gore-Tex stripfilm sheet is shown in this figure (arrows shows the goretex side).

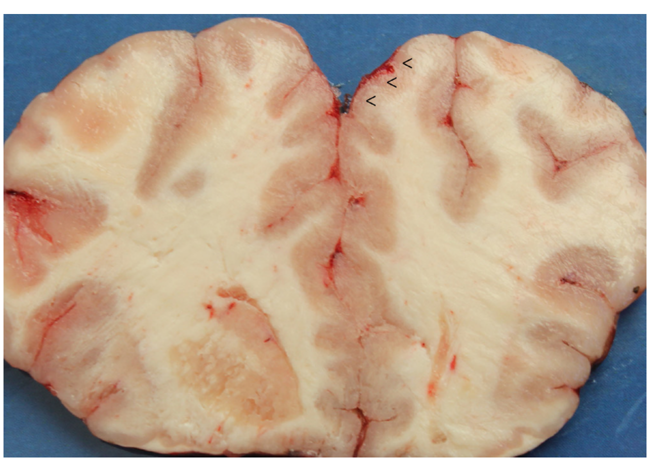

Figure 4. The appearance of moderately injured brain section operated without Gore-Tex is shown in this figure (arrows shows the injured area).

Discussion

Protecting the brain with it's arterial and venous vascular structure and cranial nerves during microneurosurgical intervention is a critical and extremely important issue in the surgical practice of neurosurgery. Regional microneurosurgical neuroanatomy and microsurgical instruments should be known and recognized for a safe microneurosurgical intervention. The use of these instruments with an appropriate microsurgical technique is crucial [1]. It is imperative that surgical techniques should be repeated several times on appropriate models to successfully maintain and terminate microsurgical interventions including appropriately protecting neurovascular tissue [1].

Before performing a real operation on human beings, it is extremely necessary to have the capability of some metallic surgical devices to be used in the microneurosurgical intervention. Moreover, it is required for the person to develop his or her own abilities and create integrated personal surgical techniques for the appropriate protection of brain [1-3]. Vascular end-to-end, end-to-side, side-to-side anastomosis; aneurysm clipping; and sylvian fissure dissection may be given as an example for microsurgical training models [2-5]. On the contrary, gaining detailed theoretical and practical microneurosurgical training on microsurgical models is not enough for brain protection. Advanced protection needs the use of some surgical materials during the surgical intervention. In the routine neurosurgical practice, cotton paddies, some elastic materials and limited use of brain retraction are all used for protecting the brain.

In this experimental model, fresh cadaveric cow brains were used for evaluating the efficacy of gore-tex stripfilm sheet in brain protection. An appropriate and successful model should have some similarities with the represented model. In contrast, another important issue is the easily obtainable and low-cost properties with the short and easy preparation of the model before use under the operating microscope without including any complicated steps. When taking into consideration the ethical issues, live models compromise some problematic limitations in experimental practice besides the aforementioned disadvantages. Some advantages are foreseen when evaluating the cow brain under the light of aforementioned parameters. Because the fresh cadaveric cow brain is not a living model, local ethical committee permission is not required. The fresh cadaveric cow brains were used in this study because of ethical convenience and similarities with the human brain.

Considering all these features together, the cow brain should be regarded as a suitable model in the experimental microneurosurgical brain protection. Few differences exist between the human and cow brains. The human brain is larger in size and shape when compared with the cow's brain. Cow brains do not have as many gyri and sulci compared with human brains. The human brain of an adult weighs about 1200-1500 g, and is 10-20 cm long. A cow's brain is elongated in shape, whereas a human brain is rounded. However, some other differences exist in human and cow brains, but almost all mammalian brains are similar. Except some anatomical differences, the interhemispheric sulcus and the arachnoid membrane of human and cow brains have the same characteristic features.

In this experimental model, similar microsurgical instruments were used during dissection, separation and distraction of the brain. Micro-scissor, the tip of micro-aspirator and micro-bayonet were used during the operation. The operating site was on the left side in all-fresh cadaveric subjects. The left side of brain hemisphere was covered with gore-tex stripfilm sheet. As the dissection progressed the gore-tex stripfilm sheet was carefully pulled deep into the dissected and separated interhemispheric sulcal space. The metallic brain component of Leyla retractor was kept for 20 min on the right hemisphere to retract the brain 2 cm lateral from the opposite hemisphere with standard chain retraction resistance. This is the final part of experimental process.

Contusion, distortion, and laceration were evaluated on the sliced brain materials using the operating microscope. The differences between protected and unprotected brain slices in terms of traumatic brain injury were quite clear. The protected brain hemispheres have less contusion, distortion, and laceration injury compared with the unprotected brain hemispheres. Laceration and distortion are more common injuries in unprotected brain hemisphere.

The evaluation of the sliced cow brain under the magnification of the operating microscope revealed that using of gore-tex stripfilm sheet protected the brain parenchyma in comparison with no stripfilm.

Conclusion

This study showed that protecting the naked brain tissue with the gore-tex stripfilm material from the mechanical harmful effect of metallic microsurgical instruments is feasible. İt is believed that this material might contribute to the practical microneurosurgery in protecting brain tissue under the magnification of operating microscope.

No animal or human studies were carried out by the authors for this article.

There are no financial resources that could be considered potential conflict of interest regarding the manuscript or its submission.

There is no conflict of interest.

Authors declare that they are responsible for the article's scientific content in the Copyright Transfer Form of the submitted article. These responsibility areas include study design, data collection, analysis and interpretation, writing, preparation and scientific review of the contents, and approval of the final version of the article.

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