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Using latex film sheet in the fresh cadaveric cow brain for the evaluating brain protection

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ABSTRACT

Objective: Assessment of latex film sheet usage to protect the brain tissue against the harmful mechanical effects of metal microsurgical instruments while doing neurosurgical interventions has been the aim of this experimental study.

Methods: For this experimental study, brains of cows were grouped as ones for which the latex film sheet was used (Group I) and the others the latex film sheet was not used for (Group II). The latex film sheet was sprawled over the left lateral side of the interhemispheric sulcus in Group I. Additionally, three groups of mechanical traumatic effects were created for the effects of metallic surgical instruments as "minor, moderate and severe".

Results: The results showed that there were 11 minor injured brains in Group I (n=15), with the percentage of 73. 34%. This percentage was 26. 67% with four brains in Group II (n=15) with regard to the minor injuries. When it comes to the moderately injured brain parenchyma, the numbers and percentages were 2 and 13. 33% for Group I, and 8 and 53. 33% for Group II. Severe injury numbers and percentages were 2 and 13. 33% for Group I, and 3 and 20% for Group II.

Conclusions: According to the findings of this study, it can be said that the protection of brain tissue from the mechanical injury using the latex film sheet seems to be favorable. The heating effect of the operating microscope's light is also thought to be prevented to some extent with latex film sheet implementation. On the whole, latex film sheet may have favorable effects for the practical microneurosurgery in protecting the brain tissue.

Key words: *Brain protection, training in microsurgery, latex film sheet, operating microscope*

Introduction

Various metal instruments are needed in the course of a microneurosurgical intervention of pathologic lesions located inside the brain tissues. In all kinds of microneurosurgical operations, it is an extremely important and critical issue to protect the neurovascular structure of the brain. Besides theoretically and practically developed microneurosurgical capacity, sometimes more than these are needed in the course of an intervention to the brain tissue in protecting the brain parenchyma from the mechanical injury of metallic microsurgical instruments. Before doing an intervention, proper use of the operating microscope, holding and grasping of the microneurosurgical instruments, proper microsurgical techniques for the opening of arachnoid membranes, safe and delicate neurovascular dissection, and carefully and properly micro-drilling of the cranial base bones are key points to be mastered [1-6].

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During neurosurgical training, practical techniques such as microsurgical operative disciplines as well as theoretical knowledge are the main issues in the preservation of the brain and related structures. [1-5]. However, these basic and essential practicing gained during the residency years are not sufficient. Many neurosurgeons who are interested in microneurosurgery try to gain some additional and advanced progress in improving their microneurosurgical ability including brain protection and delicate microneurosurgical techniques in laboratory training by setting microsurgical training models for them to approach to the orbit and the optic nerve in fresh cadaveric sheep cranium [1-3].

Some other materials may be used to protect the brain tissue against the harmful effects of metal instruments as they may mechanically injure the delicate brain parenchyma and related structures such as cranial nerves and vascular structures in the microneurosurgical operations. In this regard, we aimed in this study to evaluate the latex film sheet in its role of protecting the brain tissue against the hazardous mechanical effects of metal microsurgical instruments. A literature review was done to assess the experimental findings, difficulties, practical methods, and suggestions.

Materials and Methods

For this experimental study, an operating microscope was used to perform all the microneurosurgical activities. To assess the effectiveness of the latex film, a fresh cadaveric uncovered cow brain was used in creating an experimental microneurosurgical brain protection model. In this model, the brains were evaluated under two groups as; the one with latex film sheet (Group I) and the one without it (Group II). A latex film sheet of 4 cm in length and 15 mm in width was spread over the left lateral side of the interhemispheric sulcus of anterior brain surface in Group I. The latex film sheet was held carefully by using a micro bayonet from both sides. The use of latex film sheet was eased and improved by sprinkling some water over the brain surface. Figures 1 and 2 show respectively the dissection procedure of the interhemispheric fissure using the micro bayonet and micro scissor.

We did not use any equipment to protect the brain in Group II. For the dissection, distraction and separation of interhemispheric fissure, micro bayonet, micro scissor, micro dissector, the metallic tip of the aspirator, and bipolar forceps were used in both of the groups.

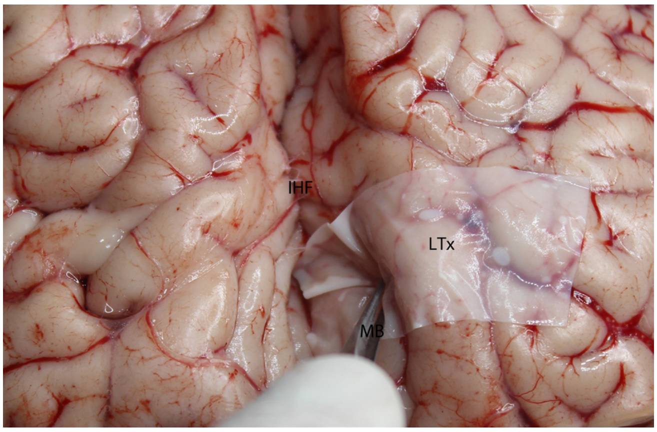

Figure 1. Dissection process of the interhemispheric fissure using the micro bayonet is shown in this figure (LTx: Latex film sheet, MB: Micro bayonet, IHF: Interhemispheric fissure).

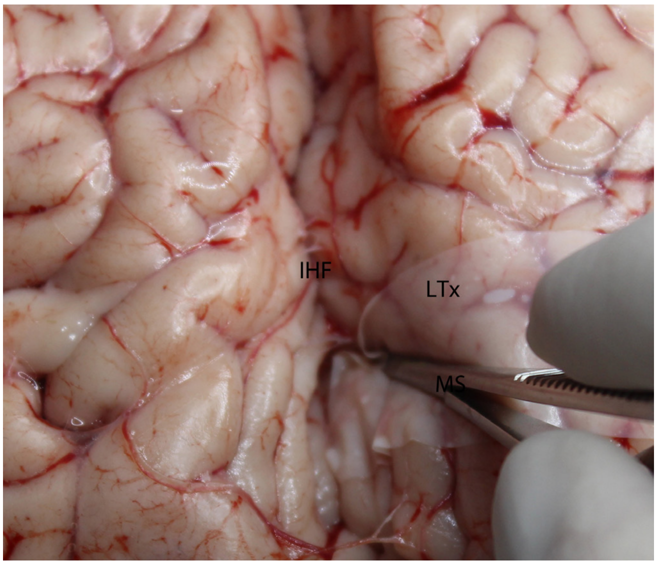

Figure 2. Dissection process of the interhemispheric fissure using micro scissor is shown in this figure (LTx: Latex film sheet, MS: Micro scissor, IHF: Interhemispheric fissure).

The arachnoid membrane over the interhemispheric fissure was initially cut using a micro scissor. The fissure was then separated and distracted using the micro bayonet, micro dissector, and the tip of the aspirator. The corpus callosum was seen after microdissection and separation phase. Using metallic Leyla retractor 1 cm in width of the retractor blade, further separation and distraction were done following the completing of dissection of the interhemispheric fissure. In 20 minutes, a two-centimeter separation from the opposite brain hemisphere was done. The latex film sheet was not used for protecting brain tissue in Group II operations. All the operating procedures mentioned above were done in the same way at the same time for both of the groups.

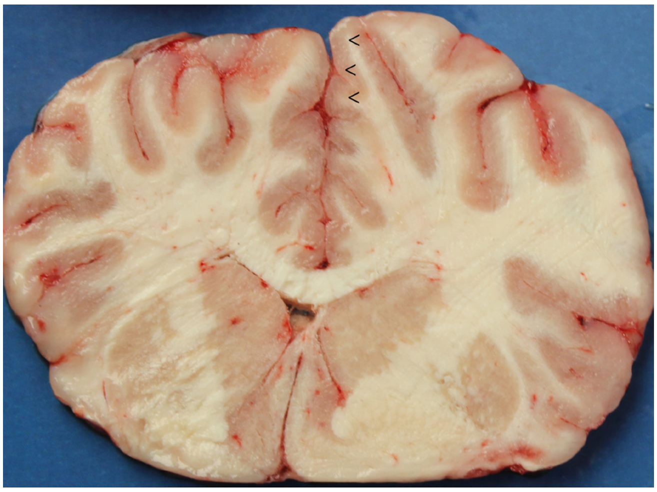

Figure 3. The appearance of minimally injured brain section operated with Latex strip film sheet is shown in this figure (arrows show the latex side).

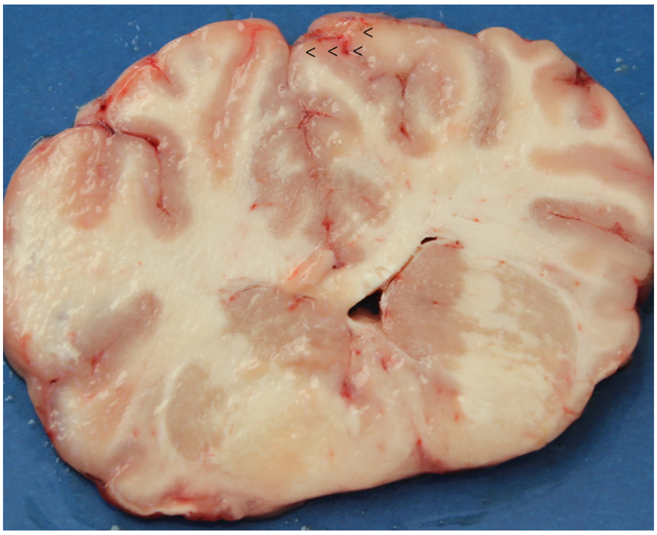

Figure 4. The appearance of moderately injured brain section operated without Latex is shown in this figure (arrows show the injured area).

Following these implementations, slicing of (0.5 cm, regularly) all the operated brains from the anterior to the posterior direction were done for the assessment of the harmful effects of metallic instruments and open biopsy micro-separator on the brain parenchyma. Assessment of brain slices was performed under the operating microscope about contusion, tearing, distortion, and other traumatic features. The mechanical traumatic effects of the metal surgical instruments were grouped under "minor, moderate, and severe" complications. In light of the evaluations, the findings for minor complications were evaluated as the surgical specimens showing no pial injury, cortical laceration, and separation upon the surgical implementation. Concerning the moderate complications, it can be said that a pial injury can be detected, but there is no cortical laceration. For a severe complication, the presence of pial and cortical injury, laceration and separation can be suggested.

Results

The results of the study showed that, of the brains of thirty cadaveric cows that were uncovered and fresh, there were 11 minor injured brains in Group I (n=15), with the percentage of 73.34%. A picture of a minimally injured brain with latex film sheet application can be seen in Figure 3. This percentage was 26.67% with four brains in Group II (n=15) about the minor injuries. When it comes to the moderately injured brain parenchyma, the numbers and percentages were 2 and 13.33% for Group I, and 8 and 53.33% for Group II, which showed a sharp increase in Group II. Figure 4 shows the moderately injured brain section operated without latex film sheet. Severe injury numbers and percentages were 2 and 13.33% for Group I, and 3 and 20% for Group II. According to the assessments done, the use of an open biopsy micro-separator may help to protect the brain parenchyma against hazardous effects of metal microsurgical equipment in the phase of operation when compared to direct use of a micro bayonet, a micro scissor, and a metallic aspirator. Evaluations about sliced cow brain in Group I made under the operating microscope showed that the use of latex film sheet protected the parenchyma against hazardous effects of microsurgical metallic instruments during the surgical intervention when compared to the specimens of Group II.

Discussion

The brain is a delicate organ including arterial and venous vascular structure and cranial nerves, and the protection of these structures during the implementations in neurosurgery is a critical and extremely important issue. A safe microneurosurgical intervention necessitates a thorough mastery of knowledge over regional microneurosurgical neuroanatomy and microsurgical instruments [3-5]. It is undoubtedly vital to acknowledge the applicable microsurgical technique in using these instruments, and it is also indispensable to repeat such techniques for a considerable amount of times on proper models to provide microsurgical interventions in which the neurovascular tissue is sufficiently protected [1-5].

It is essential to have competence in the use of various metal surgical instruments in microsurgery before real interventions in humans. Along with this, an individual should establish his or her techniques and create individualized and integrated surgical techniques to protect the related brain structures adequately. Microsurgical training models may include vascular end-to-end, end-to-side, side-to-side anastomosis; aneurysm clipping; and Sylvian fissure dissection as examples [1-4]. Brain protection requires more than acquiring detailed theoretical and practical microneurosurgical skills training. Further protection necessitates many surgical materials while doing a surgical implementation. Conventional protection models in practice commonly include cotton paddies, various elastic materials and limited use of brain retraction for brain protection.

Our experimental model made use of fresh cadaveric cow brains to evaluate the effectiveness of latex film sheet. Within this regard, an applicable model should have included similarities with the given model. Up to date, it was an important problem that there was not an ideal model with easy to find and cost-effective with a simple preparation. Given the ethical concerns, in addition to these drawbacks, live models may expose some limitations during experimental practice. In the light of these conditions, some benefits were anticipated before the analyses done with the cow brains. Any permission of ethical committee was not required as the cadaveric cow brain was not a living model. Ethical advantages and their similarities with the anthropogenic brain have driven us to use fresh cadaveric cow brains in this study.

Cow brain can be evaluated as an appropriate model for brain protection in the experimental microneurosurgery when all these aspects are taken into consideration. There is less difference between human and cow brain stem. One of these is that the human brain is larger than the cow brain about size and shape. Cow brains also don't have as many gyri and sulci as the ones of humans. The shape of the anthropogenic brain shows a round characteristic with a length of 10-20 cm and a weight of 1200-1500 gr. while the cow brain has an extended shape. Even though some additional differences may exist between them, nearly all mammal brains are similar. The interhemispheric sulcus and the arachnoid membrane of human and cow brains have the same characteristic features apart from many anatomical variations [6].

The interventions of dissection, separation, and distraction of the brain were done with similar microsurgical instruments in this study. For the operation, micro scissor, the tip of the micro aspirator and micro bayonet were used. For all-fresh cadaveric subjects, the operating zone was chosen to be the left-side. Latex film sheet was applied to the left-side of the brain hemisphere. The latex film sheet was attentively pulled deep into the dissected and separated interhemispheric sulcal space during the further execution of the dissection. At the last stage of our experimental process, we held the metal brain component of the Leyla retractor in the right hemisphere for 20 minutes in order to retract the brain 2 cm laterally from the other half of the hemisphere with standard chain retraction.

We assessed the existence of contusion, distortion, and laceration on sliced brain materials under the operating microscope. A distinction between protected and unprotected brain slices in the scope of traumatic brain injury could be easily made. We encountered less contusion, distortion and laceration injuries on brain hemispheres protected with the latex film sheet. Contrary to this, unprotected brain hemisphere showed face laceration and distortion injuries very frequently.

Conclusions

According to the findings and evaluations of this experimental study, it can be stated that the use of latex film material to cover the open brain tissue to protect it from the hazardous effects of metal microsurgical instruments has some favorable effects. It is affirmed that such material may be useful as a measure of brain tissue protection and may make a valuable contribution to practical microneurosurgery while working under magnification of operating microscope in this regard.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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