Experimental diffuse brain injury in rat
- Comparative study of Methylprednisolone, hypothermia and MgSO₄ -
- Methylprednisolone, MgSO₄
Methylprednisolone, MgSO₄

1. Methylprednisolone 25 mg/Kg, 25 mg/Kg, 30 mg/Kg, 30 mg/Kg, 40 mg/Kg, 40 mg/Kg, 60 mg/Kg, 60 mg/Kg

2. MgSO₄ 30 μmol/Kg, 4 mg/20 μmol, 4 mg/20 μmol, 4 mg/20 μmol


4. TUNEL assay

β-APP

1 (71.03 ± 0.42%), 2 (67.34 ± 1.07%), 3 (66.43 ± 0.36%), 4 (64.52 ± 1.11%), 5 (69.54 ± 0.53%) (p<0.01)
TUNEL 결과를 보니 D군에서 TUNEL 양이 B군, C군, A군에 비해 유의하게 낮았습니다 (p<0.001). 

B군과 A군 사이의 TUNEL 양은 유의한 차이를 보이지 않았습니다 (p>0.05).

β-APP 양을 측정한 결과, B군이 C군과 A군보다 높게 나타났습니다 (p<0.001).

methylprednisolone의 용량은 (15m g/Kg, 30m g/Kg, 40m g/Kg)로 각각 투여했지만, 이들 간에는 유의한 차이가 관찰되지 않았습니다.

MgSO4의 용량에 따른 TUNEL 양의 변화는 보이지 않았습니다.
Abstract

Given that the diffuse brain injury (DBI) cause high mortality and that the management of DBI is very intricate, countless efforts have been taken to evaluated pathophysiology of DBI both clinically and experimentally. With some hopeful results of these efforts, several new trials for the DBI treatment are being carried out.

In this study, author observed the development of brain injury which is known to be similar to that of the DBI by using a weight drop model and tried to prove the effectiveness of methylprednisolone, hypothermia and MgSO₄ as some means to DBI management.

The first experiment was carried out on methylprednisolone experimental group which 25 Sprague-Dawley rats were divided into five groups. Group 1, a control group, was left untreated after cranial impact. Group 2 was treated with 15mg/Kg of methylprednisolone an hour after the injury, and group 3, 4, and 5 were treated 30, 40, and 60mg/Kg of methylprednisolone respectively an hour after the injury. After 24 hours, rats from all groups were sacrificed and water content of their whole brain was measured.

The second experiment was performed on hypothermia and MgSO₄ experimental group. For this experiment, 80 Sprague-Dawley rats were divided into four group equally; a control group, a group treated with MgSO₄, hypothermia, and MgSO₄ and hypothermia. For hypothermic experimental group, rats were maintained 32°C of their rectal temperature for an hour after the injury and warmed back to their normothermic level over about 30 minutes of period. For MgSO₄ experimental group, rats were treated with 750 umol/Kg of MgSO₄ intramuscularly 30 minutes after the trauma. After 12 hours, 24 hours,
one, and two weeks, rats in each group were sacrificed and their apoptosis and axonal injury were evaluated by marking former one with terminal deoxynucleotidyl-transferase-mediated biotin dUTP nick end labeling (TUNEL) stain and later one with immunohistochemical stain for β-amyloid precursor protein (β-APP).

In methylprednisolone experimental group, there were significant difference between control group (71.03 ± 0.42%) and group 2 (67.34 ± 1.07%), group 3 (66.43 ± 0.36%), and group 4 (64.52 ± 1.11%) (p<0.01) when the water content is assumed as a criterion of brain edema. On the other hand, there were no significance between control group (71.03 ± 0.42%) and group 5 (69.54 ± 0.53%) (p>0.01). In hypothermia and MgSO₄ experiment, all treated groups had significant reduction in each measured time period in apoptotic cells and damaged axonal density which β-APP was marked in comparison with the control group (p<0.001). However, hypothermic group treated with or without MgSO₄ showed significant reduction in apoptotic cells than group treated with MgSO₄ two weeks after trauma (p<0.001). But hypothermic group treated with MgSO₄ showed no significant reduction in apoptotic cells compared with hypothermic group (p>0.05).

This study shows that use of consistent dose of methylprednisolone (15, 30, and 40mg/Kg) reduce brain edema but use of high dose of methylprednisolone (cf. 60mg/Kg) is ineffective (so called biphasic phenomenon).

Immunohistochemical stain of β-APP and TUNEL stain were useful for the detection of traumatic axonal and neuronal injury. Findings in the study suggest that both hypothermia and MgSO₄ help to improve damaged pathological cells though simultaneously hypothermia and
MgSO₄ treated group failed to show synergy effect of neuronal and axonal protection. Hopefully, these results will be helpful for the future clinical trials of therapeutic hypothermia and MgSO₄ for the traumatic brain injury.
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I. Lactic acidosis

Lactic acidosis has been shown to be associated with the...
deoxynucleotidyl-transferase-mediated biotin dUTP nick end labeling

β-amyloid precursor protein (β-APP) MgSO₄
II.  

1.  

Marmarou [2] used weight-drop weight-drop weight-drop weight-drop weight-drop 10 mm. 10 mm. 3 mm. 10 mm. 10 mm. (Fig 1).  

2.  

1 300 g 350 g 350 g 350 g Sprague-Dawley rat[3] 5 5 5 5 1 1 1 1 methylprednisolone[3] 15 mg/Kg[3] methylprednisolone 30 mg/Kg[3] 4 40 mg/Kg[3] 5 60 mg/Kg[3] methylprednisolone[3] 30 mg/Kg[3].
2  300-350gm (A; B; MgSO₄, C; D; MgSO₄)
3. (1; 12, 2; 24, 3; 1, 4; 2) 16º·Î³ª´©¾ú´Ù.

3. µÎºÎ¿Ü»óÀǵµÀÔ

chloral hydrate (90mg/Kg, 45mg/Kg) (aron alpha, manufactured by Toa-Gosei Chemicals, Co, Ltd., Tokyo, Japan)

4. Traumatic Dose

lethal dose 50(LD 50) dose (LD 50 50%) moderate traumatic dose
5. 

<table>
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<th>Dose Level</th>
<th>Drug</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Methylprednisolone</td>
<td>15mg/Kg</td>
</tr>
<tr>
<td></td>
<td>Methylprednisolone</td>
<td>30mg/Kg</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Chloral Hydrate</td>
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<tr>
<td></td>
<td>MgSO₄</td>
<td>30°C (37°C)</td>
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<td>30°C</td>
</tr>
<tr>
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<td>MgSO₄</td>
<td>30°C (750umol/Kg)</td>
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<td>MgSO₄</td>
<td>30°C</td>
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</table>

*Rewarming*
chloral hydrate
isotonic saline (100-200 mmHg/15 seconds)
FAM (a mixture of 40% formaldehyde, glacial acetic acid, 100% ethanol; 1:1:8 by volume/20 minutes)
24 hr FAM
FAM (falx cerebri)
2 mm sagittal block
falx cerebri
rotary microtome
3 µm section
xylene

6. 

(1)

β-APP immunohistochemistry

3 µm section xylene
blocking 100 μl 1% bovine serum albumin (BSA) (Boehringer Mannheim) 1:100. 100 μl Tris buffer 4°C 14 days. pH 7.6. Tris buffer 100 μl 10-15°C biotinylated antibody (Dako) 100 μl 10-15°C 15°C 100 μl. Tris buffer 15°C 2-3°C 5-10°C Diaminobenzidine 0.5% Triton X-100 5% 3% H2O2 5% 3% PBS. Equilibration buffer 4-5°C humidified atmosphere 90% 37°C terminal deoxynucleotidyl transferase reaction mixture (0.3 U/μl: Oncor) Working strength stop/wash
buffer (stop/wash buffer 1ml in dextrose water 34ml) 10ml
37°C incubation 10ml 37°C incubation PBS 5ml
3ml washing. Digoxigenin- peroxidase 30ml 10ml
PBS 5ml 3ml washing. AEC kit (Vector Laboratories) 5-6ml
PBS 5ml 3ml washing. methylgreen 10ml 5ml washing 5ml
washing

8. 통계

PC - SAS (ver 6.12) 통계 소프트웨어. Wilcoxon rank sum test, MgSO4 10ml washing 5ml washing 5ml
washing ANOVA with multiple comparisons (Scheff’s method) p<0.05 통계.
III.  לדב"ק

1. LD 50

Moderate brain injury: 1m - 450mg ·

2. ±×·¯³ª

Moderate brain injury: 71.03 ± 0.42%, 67.34 ± 1.07% (p<0.01), 66.43 ± 0.36%, 64.52 ± 1.11% (p<0.01).

3. ±×·¯³ª

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(p>0.01)(Table 1, 2)(Fig 3).

5. MgSO₄

1) β - APP

β - APP profiles (midbrain and pontomedullary junction), retraction ball, reactive axonal processes, 400 axons (-), 6-150 axons (+), 150-300 axons (++), over 300 (+++). β - APP profiles (midbrain and pontomedullary junction), retraction ball, reactive axonal processes, 400 axons (-), 6-150 axons (+), 150-300 axons (++)

MgSO₄ (p<0.001). MgSO₄ (p<0.05), MgSO₄ (p<0.01) (32°C) (Table 3). MgSO₄ (p>0.05) (p>0.05) (Fig 4).
2) TUNEL

Apoptotic Index (AI) = \frac{The \ number \ of \ Apoptotic \ cells}{The \ total \ number \ of \ cells} \times 100

Apoptotic cells

Table 4

<table>
<thead>
<tr>
<th>AI (%)</th>
<th>MgSO4</th>
<th>MgSO4</th>
<th>MgSO4</th>
</tr>
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<tbody>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(p < 0.001) MgSO4 (p > 0.05), 20 (p < 0.001) MgSO4 (P > 0.05).
IV.

A dam s ² 2) ÀºÀÌ·¯ÇÑ ¹Ì¸¸¼º³ú¼Õ»óÀÍÄ¡¸íÀûÀγú¼Õ»óÀÇ 13-28%¸¦Â÷ÁöÇÑ´Ù°íº¸°íÇÏ¿´À¸¸ç½ÇÁ¦ÀÓ»ó¿¡¼­µµ³úÄÄÇ»ÅÍ´ÜÃþÃÔ¿µ¼Ò°ßÀ»º¸ÀδٰíÇÏ¿´´Ù. Marshall 42) ÀºÁßÁõµÎºÎ¿Ü»óȯÀÚÀÇ 55%¿¡¼­¹Ì¸¸¼º³ú¼Õ»óÀ»º¸À̸ç 12.6%¿¡¼­´Â. Adams ² 2) Àº¹Ì¸¸¼º³úÃà»è¼Õ»óÀǵ¿¹°¸ðµ¨·Î¹«°Ô¿Í³ôÀ̸¦ÀÌ¿ëÇÑÀÚÀ¯³«Çϳú¼Õ»ó¸ðµ¨À»¹ßÇ¥Çϸ鼭 A dam s ² 2) Àº%%ÀÔµÈÀÚÀ¯³«ÇÏÇüÅÂÀdzú¼Õ»ó¸ðµ¨À»»ç¿ëÇÏ¿´´Ù. À̸𵨿¡ÀÇÇѳú¼Õ»óÀº½ÇÁ¦ÀÓ»ó»óȲ¿¡¼­ÀǰæÇè°úÀ¯»çÇÑȯ°æÀ» - 23 -
Methylprednisolone

1961 Galicich French. Methylprednisolone is a glucocorticoid that is 4 times more potent than lysosome. Methylprednisolone is also a potent arachidonic acid eicosanoid. It is used in the treatment of calcium ion 2,3-diphosphoglyceric acid. Calcium ion is a cGMP. Methylprednisolone is also used in the treatment of hall. Hall 15mg/Kg 30mg/Kg. (Na + K)-AT Pase. Methylprednisolone is also used in the treatment of giannotta 6. Methylprednisolone is also used in the treatment of dexamethasone. Methylprednisolone is also used in the treatment of giannotta. Methylprednisolone is also used in the treatment of giannotta.
Hall [29] as well as methylprednisolone (biphasic action) 21/45/37. 

β-APP 9 as well as silver 21/48/56/37. 

axon transport 21/48/56/37. 

silver 21/48/56/37.

Axonal retraction balls 21/46/37. 

β-APP 9 as well as silver 21/48/56/37. 

β-APP profile 21/48/56/37.

Axonal transport 21/48/56/37. 

β-APP profile 21/48/56/37.

Apoptosis as well as necrosis [23/15/22/39/40]. Apoptotic body 15/16/22/39/40. Apoptotic body 15/16/22/39/40.

Apoptotic body 15/16/22/39/40.

1) chromatin as well as DNA fragmentation 23/39/61/62. 

2) macromolecule as well as endonucleosomal DNA fragmentation 23/39/61/62. 

Apoptosis as well as necrosis 23/39/61/62. 

non-NMDA, NMDA 23/39/61/62.

Ca2+/Mg2+dependent
endonuclease, DNA, apoptosis, and

23)

Koizumi (axolemma) 37,53,60. Koizumi 37) 3

nitric oxide (NO) 37,53,60. Koizumi 37)

β-APP. Au 2 24)

β - amyloid precursor protein (therapeutic window)

axon transport. Au axonal profile β - amyloid precursor protein

apoptosis}. Au apoptotic death
apoptosis, apoptotic pathways, endonuclease, transcription factors, apoptosis, apoptosis, apoptosis,

Apoptosis, 2, 12, 24, NMDA (N-methyl-D-aspartate) channel, blocker, (Exitotoxin)

Heath, 31, 12, 24, (free magnesium ion)

- 27 -
°¡¾ø´Â°ÍÀ¸·Îº¸¾Æ½Ã°£ÀÌÁö³ª¸éÇ÷ -³ú°ü¹®À»ÅëÇÑÀ¯ÀÔÀÌÂ÷´ÜµÊÀ»º¸¿©Áִ°ÍÀ̶ó°íÇß´Ù. ²©Áִ°ÍÀ̶ó°íÇß´Ù. ³ú°ü¹®ÀǺ¯ÇüÀÌ ¿ÔÀ»¶§ÁÖÀÔÇϴ°ÔÁß¿äÇÒ°ÍÀ¸·ÎÆÇ´ÜµÇ¸ç¿Ü»óÈľî´ÀÁ¤µµ½Ã°£ÀÌ. ²©½Ã°£º°·Î AI¿Í¥â -APPÀǹßÇöÁ¤µµ·Î³úº¸È£È¿°ú¸¦ÃøÁ¤ÇÏ¿´´Ù. 2ÁÅÖ±îÁöÀå±â°£¿¡°ÉÃÄÁö¼ÓÀûÀ¸·Î³úº¸È£È¿°ú¸¦º¸ÀÓÀ»¾Ë±¸ÀÖ¾úÀ¸¸ç. ²©½ÃµµÇÏ¿´À¸¸ç, °¢Ä¡·á¹ýÀ»´Üµ¶À¸·Î»ç¿ëÇÑ´Ù, ØÄ¡·á±º¿¡´ëÇØÀ¯ÀÇÇÑ. »ó½ÂÈ¿°ú´Â¾ø¾ú´Ù ±×ÀÌÀ¯´ÂµÎ°¡ÁöÄ¡·á¹ýÀÌÁÖ·ÎÀÌÂ÷¼Õ»ó±âÀü¿¡ÀÛ ¿ëÀ»ÇϹǷμ­·Î»óÃæµÇ°Å³ªºñÀÇÁ¸ÀûÀαâÀü¿¡ÀÛ¿ëÇÏ¿©»ó½ÂÈ¿°ú°¡³ªŸ³ªÁö¾Ê°Å³ª, ÀÛ¿ë½Ã°£´ëÀÇ»óÀ̼ºÈ¤ÀºÃà»è°ú½Å°æ¼¼Æ÷ÀǼջó±âÀüÀÌ»óÀÌÇϱ⶧¹®À̶ó°íÃßÃøµÃ´Ù. Áö±Ý±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸¸¸À»ÇؿԴÙ. ±×·ÎÀÎÇØ¿Ü»óÈÄ ²ÅÖ±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸. ²¬±¸¿¡¼­µµ¿Ü»óÈÄ 30ºÐ¿¡¸¶±×³×½·À»ÁÖÀÔÇÏ ¿ÔÀ»¶§ÁÖÀÔÀº¿Ü»óÁ÷ÈÄÇ÷ -³ú°ü¹®ÀǺ¯ÇüÀÌ. ²©½Ã°£º°·Î AI¿Í¥â -APPÀǹßÇöÁ¤µµ·Î³úº¸È£È¿°ú¸¦ÃøÁ¤ÇÏ¿´´Ù. 2ÁÅÖ±îÁöÀå±â°£¿¡°ÉÃÄÁö¼ÓÀûÀ¸·Î³úº¸È£È¿°ú¸¦º¸ÀÓÀ»¾Ë±¸ÀÖ¾úÀ¸¸ç. ²©½ÃµµÇÏ¿´À¸¸ç, °¢Ä¡·á¹ýÀ»´Üµ¶À¸·Î»ç¿ëÇÑ´Ù, ØÄ¡·á±º¿¡´ëÇØÀ¯ÀÇÇÑ. »ó½ÂÈ¿°ú´Â¾ø¾ú´Ù ±×ÀÌÀ¯´ÂµÎ°¡ÁöÄ¡·á¹ýÀÌÁÖ·ÎÀÌÂ÷¼Õ»ó±âÀü¿¡ÀÛ ¿ëÀ»ÇϹǷμ­·Î»óÃæµÇ°Å³ªºñÀÇÁ¸ÀûÀαâÀü¿¡ÀÛ¿ëÇÏ¿©»ó½ÂÈ¿°ú°¡³ªŸ³ªÁö¾Ê°Å³ª, ÀÛ¿ë½Ã°£´ëÀÇ»óÀ̼ºÈ¤ÀºÃà»è°ú½Å°æ¼¼Æ÷ÀǼջó±âÀüÀÌ»óÀÌÇϱ⶧¹®À̶ó°íÃßÃøµÃ´Ù. Áö±Ý±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸¸¸À»ÇؿԴÙ. ±×·ÎÀÎÇØ¿Ü»óÈÄ ²ÅÖ±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸. Methylprednisolone, ³ú°ü¹®ÀǺ¯ÇüÀÌ MgSO₄ ³ú°ü¹®ÀǺ¯ÇüÀÌ ¿ÔÀ»¶§ÁÖÀÔÀº¿Ü»óÁ÷ÈÄÇ÷ -³ú°ü¹®ÀǺ¯ÇüÀÌ. ²©½Ã°£º°·Î AI¿Í¥â -APPÀǹßÇöÁ¤µµ·Î³úº¸È£È¿°ú¸¦ÃøÁ¤ÇÏ¿´´Ù. 2ÁÅÖ±îÁöÀå±â°£¿¡°ÉÃÄÁö¼ÓÀûÀ¸·Î³úº¸È£È¿°ú¸¦º¸ÀÓÀ»¾Ë±¸ÀÖ¾úÀ¸¸ç. ²©½ÃµµÇÏ¿´À¸¸ç, °¢Ä¡·á¹ýÀ»´Üµ¶À¸·Î»ç¿ëÇÑ´Ù, ØÄ¡·á±º¿¡´ëÇØÀ¯ÀÇÇÑ. »ó½ÂÈ¿°ú´Â¾ø¾ú´Ù ±×ÀÌÀ¯´ÂµÎ°¡ÁöÄ¡·á¹ýÀÌÁÖ·ÎÀÌÂ÷¼Õ»ó±âÀü¿¡ÀÛ ¿ëÀ»ÇϹǷμ­·Î»óÃæµÇ°Å³ªºñÀÇÁ¸ÀûÀαâÀü¿¡ÀÛ¿ëÇÏ¿©»ó½ÂÈ¿°ú°¡³ªŸ³ªÁö¾Ê°Å³ª, ÀÛ¿ë½Ã°£´ëÀÇ»óÀ̼ºÈ¤ÀºÃà»è°ú½Å°æ¼¼Æ÷ÀǼջó±âÀüÀÌ»óÀÌÇϱ⶧¹®À̶ó°íÃßÃøµÃ´Ù. Áö±Ý±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸¸¸À»ÇؿԴÙ. ±×·ÎÀÎÇØ¿Ü»óÈÄ ²ÅÖ±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸. ²¬±¸¿¡¼­µµ¿Ü»óÈÄ 30ºÐ¿¡¸¶±×³×½·À»ÁÖÀÔÇÏ ¿ÔÀ»¶§ÁÖÀÔÀº¿Ü»óÁ÷ÈÄÇ÷ -³ú°ü¹®ÀǺ¯ÇüÀÌ. ²©½Ã°£º°·Î AI¿Í¥â -APPÀǹßÇöÁ¤µµ·Î³úº¸È£È¿°ú¸¦ÃøÁ¤ÇÏ¿´´Ù. 2ÁÅÖ±îÁöÀå±â°£¿¡°ÉÃÄÁö¼ÓÀûÀ¸·Î³úº¸È£È¿°ú¸¦º¸ÀÓÀ»¾Ë±¸ÀÖ¾úÀ¸¸ç. ²©½ÃµµÇÏ¿´À¸¸ç, °¢Ä¡·á¹ýÀ»´Üµ¶À¸·Î»ç¿ëÇÑ´Ù, ØÄ¡·á±º¿¡´ëÇØÀ¯ÀÇÇÑ. »ó½ÂÈ¿°ú´Â¾ø¾ú´Ù ±×ÀÌÀ¯´ÂµÎ°¡ÁöÄ¡·á¹ýÀÌÁÖ·ÎÀÌÂ÷¼Õ»ó±âÀü¿¡ÀÛ ¿ëÀ»ÇϹǷμ­·Î»óÃæµÇ°Å³ªºñÀÇÁ¸ÀûÀαâÀü¿¡ÀÛ¿ëÇÏ¿©»ó½ÂÈ¿°ú°¡³ªŸ³ªÁö¾Ê°Å³ª, ÀÛ¿ë½Ã°£´ëÀÇ»óÀ̼ºÈ¤ÀºÃà»è°ú½Å°æ¼¼Æ÷ÀǼջó±âÀüÀÌ»óÀÌÇϱ⶧¹®À̶ó°íÃßÃøµÃ´Ù. Áö±Ý±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸¸¸À»ÇؿԴÙ. ±×·ÎÀÎÇØ¿Ü»óÈÄ ²ÅÖ±îÁöÀǸ¹Àº¿¬±¸µéÀº½Å°æ¼¼Æ÷³ªÃà»è¼Õ»ó¿¡´ëÇÏ¿©ºÐ¸®µÈ¿¬±¸. ²¬±¸¿¡¼­µµ¿Ü»óÈÄ 30ºÐ¿¡¸¶±×³×½·À»ÁÖÀÔÇÏ ¿ÔÀ»¶§ÁÖÀÔÀº¿Ü»óÁ÷ÈÄÇ÷ -³ú°ü¹®ÀǺ¯ÇüÀÌ. ²©½Ã°£º°·Î AI¿Í¥â -APPÀǹßÇöÁ¤µµ·Î³úº¸È£È¿°ú¸¦ÃøÁ¤ÇÏ¿´´Ù. 2ÁÅÖ±îÁöÀå±â°£¿¡°ÉÃÄÁö¼ÓÀûÀ¸·Î³úº¸È£È¿°ú¸¦º¸ÀÓÀ»¾Ë±¸ÀÖ¾úÀ¸¸ç. ²©½ÃµµÇÏ¿´À¸¸ç, °¢Ä¡·á¹ýÀ»´Üµ¶À¸·Î»ç¿ëÇÑ´Ù, ØÄ¡·á±º¿¡´ëÇØÀ¯ÀÇÇÑ. »ó½ÂÈ¿°ú´Â¾ø¾ú´Ù ±×ÀÌÀ¯´ÂµÎ°¡ÁöÄ¡·á¹ýÀÌÁÖ·ÎÀÌÂ÷¼Õ»ó±âÀü¿¡ÀÛ ¿ëÀ»ÇϹǷμ­·Î»óÃæµÇ°Å³ªºñÀÇÁ¸ÀûÀαâÀü¿¡ÀÛ¿ëÇÏ¿©»ó½ÂÈ¿°ú°¡³ªŸ³ªÁö¾Ê°Å³ª, ÀÛ¿ë½Ã°£´ëÀÇ»óÀ̼ºÈ¤ÀºÃà»è°ú½Å°æ¼¼Æ÷ÀǼjiang. - 28 -
V. 

물질로는 금단수용성의 메틸프레드리손(methylprednisolone)과 알칼리성의 MgSO₄의 두 가지를 사용하였다. MgSO₄는 단백질의 공정능성을 증가시키며, 금단수용성의 메틸프레드리손은 뇌질환물질 출혈을 완화시킨다. MgSO₄를 사용한 유프로토]])은 TUNEL을 사용하여 β-APP을 조사하였다.
References


32. Heath DL, Vink R: Improved motor outcome in response to magnesium therapy received up to 24 hrs after traumatic diffuse


59. Tsuda T, Kogure K, Nishioka K, et al: Mg²⁺ administered up to twenty-four hours following reperfusion prevents ischemic damage of the CA1 neurons in the rat hippocampus. Neuroscience 44: 335-341, 1991


Table 1. Wet and dry weight (gram) of rat brain in each group

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<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
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<td><strong>Dry Weight</strong></td>
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<td>2.4</td>
<td>2.4</td>
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<td><strong>Wet Weight</strong></td>
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<td>2.21</td>
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<tr>
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<td>Group 2</td>
<td>Group 3</td>
<td>Group 4</td>
<td>Group 5</td>
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<td>1</td>
<td>70.48</td>
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<td>65.83</td>
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<td>65.93</td>
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<td>3</td>
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<td>66.81</td>
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<td>Mean</td>
<td>71.03</td>
<td>67.34</td>
<td>66.43</td>
<td>64.52</td>
<td>69.74</td>
</tr>
<tr>
<td>STD</td>
<td>± 0.42</td>
<td>± 1.07</td>
<td>± 0.36</td>
<td>± 1.11</td>
<td>± 0.53</td>
</tr>
</tbody>
</table>

STD : Standard deviation
<table>
<thead>
<tr>
<th></th>
<th>12 hours</th>
<th>24 hours</th>
<th>1 week</th>
<th>2 weeks</th>
</tr>
</thead>
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<tr>
<td>Control</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>MgSO₄</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>MgSO₄ - Hypothermia</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

(-) negative, (+) weak, (++): moderate, (+++): strong
Table 4 Apoptotic index (AI) of each group in TUNEL stain

<table>
<thead>
<tr>
<th>Group</th>
<th>12 hours</th>
<th>24 hours</th>
<th>1 week</th>
<th>2 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>50±0.7</td>
<td>38.6±4.0</td>
<td>29.8±0.6</td>
<td>17.6±1.7</td>
</tr>
<tr>
<td>MgSO₄</td>
<td>35.6±2.6</td>
<td>24±3.4</td>
<td>20.6±2.2</td>
<td>11.4±0.2</td>
</tr>
<tr>
<td>Hypothermia</td>
<td>31±1.3</td>
<td>22.4±1.3</td>
<td>15±3.6</td>
<td>3.5±2.0</td>
</tr>
<tr>
<td>MgSO₄ + Hypothermia</td>
<td>35.4±3.1</td>
<td>23±1.1</td>
<td>19.2±3.7</td>
<td>5.4±1.6</td>
</tr>
</tbody>
</table>

Values are expressed as the means ± standard deviation
Fig 1. Experimental traumatic device, schematic drawing. This device consists of a transparent plexiglass cylinder (inner diameter 19mm, outer diameter 25mm, height 220cm) and plexiglass sides (12cm X 12cm X 43cm) that contain form with known spring constant and ring stand with clamp. The bottom opening of cylinder is located in just upon head of rat and centered on stainless steel helmet.
Fig 2. Diagram of the rat skull with helmet. The helmet located between coronary and lambdoidal suture along the centerline. The Helmet measuring 10mm in diameter and 3mm in thickness, made with stainless steel.
Fig 3. Brain tissue content(%) of each group is plotted.

When the water content was assumed as the criterion of brain edema, there was significant difference between group 1(71.03 ± 0.42%) and group 2(67.34 ± 1.07%), group 3(66.43 ± 0.36%), group 4(64.52 ± 1.11%)(p<0.01). On the other hand, there was no significance between control group(71.03 ± 0.42%) and group 5(69.74 ± 0.53%)(p>0.01). This study shows that mega doses of methylprednisolone in 15, 30, or 40mg/Kg reduce brain edema, but no effect in the group treated with 60mg/Kg methylprednisolone. The effect of methylprednisolone is biphasic.