

## 硫酸镁对兔实验性心肌梗塞范围的影响

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**提要** 高位双结扎兔左冠状动脉前降支(LAD)致急性心肌梗塞(AMI), iv MgSO<sub>4</sub> 400 mg/kg使心肌梗塞面积(14±5%)较生理盐水组(22±7%)显著减少, 心前区标测心电图NST、ΣST、ST和NQ亦较生理盐水组显著减少(p<0.05-0.01), 而且未发生室性心律失常。表明MgSO<sub>4</sub>有明显缩小心肌梗塞范围和抗心律失常作用。本实验创用“36分”法测量心肌梗塞面积。

**关键词** 硫酸镁; 左冠状动脉; 心肌梗塞; 心电图描记术

镁剂可抗心律失常<sup>(1,2)</sup>, 最近又被用来治疗急性心肌梗塞(AMI)<sup>(3)</sup>。然而, 有关镁剂对实验性心肌梗塞范围的影响尚未见报道, 本实验探讨了10%MgSO<sub>4</sub>对局麻开胸兔实验性AMI的梗塞范围及心律失常的影响。

### 材料与方 法

心电图正常的杂种兔32只, ♀♂不拘, 并除LAD过短或有变异者5只。参照文献(4)造成实验性AMI。随机分组, NS组(生理盐水), P组(普萘洛尔), M组(10%MgSO<sub>4</sub>)。每组各

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9只, 由于术后1-2d内各组均死亡1只, 故实际受试兔均为8只, 共24只, 体重 $1.7 \pm \text{SD } 0.1 \text{ kg}$ . 术后立即, 24, 48h分别从耳缘iv生理盐水20ml, 普萘洛尔(2mg/kg), 10%  $\text{MgSO}_4$ (400mg/kg)均以生理盐水稀释至20ml, 于30min注完. 术后im青霉素80万IU防感染.

心前区12点标测心电图参照文献(4). 各点以龙胆紫标记,  $1 \text{ mV} = 10 \text{ mm}$ , 纸速50mm/s, 描记后按相应位置剪贴成方阵图(图1). 各参数按人的标准测定. 顺序描记结扎LAD后2, 24, 48, 72h心前区标测心电图, 测量ST段抬高 $\geq 2 \text{ mm}$ 导联数(NST), ST段抬高总和( $\Sigma \text{ST}$ )及平均值( $\overline{\text{ST}}$ ,  $\Sigma \text{ST}/\text{NST}$ ), 病理性Q波导联数(NQ). 在完成第1次标测心电图后紧接着以心电图放大器观察10min, 并记录II导联心电图以了解心律失常的发生情况. 术后72h处死取心, 按常规固定及包埋后按解剖部位依次选用二尖瓣口水平、腱索水平、乳头状肌上缘及下缘水平、心尖部水平5张心肌切片, HE染色, 经投影放大描绘后划分为36分: 二尖瓣口水平面、腱索水平面和乳头状肌上缘水平面各8分, 计24分; 乳头状肌下缘水平面和

心尖部水平面各占6分, 计12分, 总计36分(图2), 逐一观察测量计算每张切片上梗塞区所占的比例数, 5张切片上比例数的均值即为梗塞心肌体积占左心室体积的%. 此外, 我们还用求积仪测量梗塞面积占左心室总面积%. 结果发现二种方法所测出的数值十分接近.

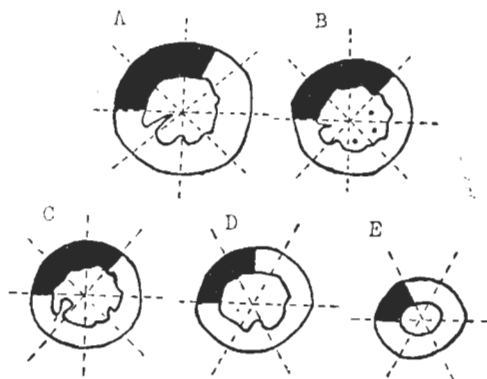


Fig 2. The shade part shows the size of myocardial infarction. A. Ostium valvula bicuspidalis level, the size of infarction is of 2.5/8 (31%). B. Chordae tendineae level, infarction is of 3/8 (38%). C. Margo superior musculi papillares level, infarction is of 3/8 (38%). D. Margo inferior musculi papillares level, infarction is of 1.5/6 (25%). E. Apex cordis level, infarction is of 1/6 (17%).

## 结 果

**心前区标测心电图** 术后2, 24, 48, 72h, P和M组的NST,  $\Sigma \text{ST}$ ,  $\overline{\text{ST}}$ 和NQ(除2h各组均未出现病理性Q波外)均明显少于SN组, 而M组中的某些指标又少于P组(表1).

**病理学检查心肌梗塞范围** 表2表明各组兔体重相互接近, 但梗塞范围却显著不同, P、M组均明显小于NS组, M组又较P组为小, 与上述标测心电图相符合.

**心律失常** 术前各组心率无明显差异, 术后2h各组兔心率变化见表2. NS组心率明显增快, 而P、M组不增快, 反有所减慢. 每只兔在完成首次心前区标测心电图后紧接着心电

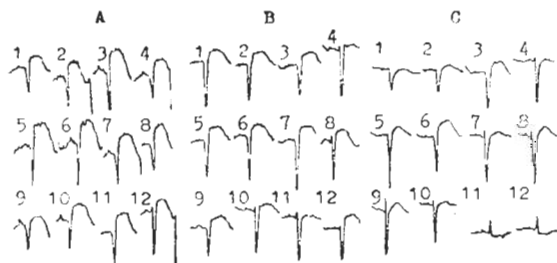


Fig 1. Influence of  $\text{MgSO}_4$  on precordial ECG mapping of rabbits on d 1 after occlusion of LAD. (A) iv saline 20 ml. NST 12,  $\Sigma \text{ST}$  51 mm,  $\overline{\text{ST}}$  4.3 mm, NQ 12. (B) iv propranolol 3.3 mg. NST 9,  $\Sigma \text{ST}$  23.5 mm,  $\overline{\text{ST}}$  2.6 mm, NQ 7. (C) iv 10%  $\text{MgSO}_4$  670 mg. NST 2,  $\Sigma \text{ST}$  4.5 mm,  $\overline{\text{ST}}$  2.3 mm, NQ 4.

(NST = Lead number of ST segment elevation  $\geq 2 \text{ mm}$ , NQ = number of pathologic Q wave)

Tab 1. Precardial electrocardiogram of ST segment and abnormal Q wave in saline (NS), propranolol (P) and 10% MgSO<sub>4</sub> (M), 2-72 h after occlusion of LAD of rabbits. n=8,  $\bar{x} \pm SD$ . \*\*p<0.05, \*\*\*p<0.01 vs NS, †p<0.05, ††p<0.01 vs P

| Group |    | 2 h        | 24 h      | 48 h       | 72 h       |
|-------|----|------------|-----------|------------|------------|
| NST   | NS | 11.2±1.5   | 10.5±2.0  | 9±4        | 7±4        |
|       | P  | 7±5**      | 7.5±1.9** | 5.4±2.8**  | 4.0±1.8    |
|       | M  | 8±4        | 5±3***    | 0.5±0.9††† | 0.1±0.4††† |
| ST    | NS | 8±3        | 4.2±1.2   | 3.1±1.0    | 2.7±0.7    |
|       | P  | 4.8±2.7**  | 3.3±0.8   | 2.7±1.3    | 2.4±1.2    |
|       | M  | 4.0±1.0*** | 2.4±1.1** | 0.9±1.8††  | 0.4±1.1††† |
| NQ    | NS | —          | 9±3       | 9±3        | 9±4        |
|       | P  | —          | 3.9±2.8** | 4.6±1.8**  | 4.9±1.6**  |
|       | M  | —          | 5.6±1.8** | 5.8±2.0**  | 5.9±1.9**  |

Tab 2. Myocardial infarction and heart rates of rabbits after occlusion of LAD in saline (NS), propranolol (P) and MgSO<sub>4</sub> (M). n=8,  $\bar{x} \pm SD$ . \*\*p<0.05, \*\*\*p<0.01 vs NS.

| Group | Extent of infarction (%) | Heart rates      |           |
|-------|--------------------------|------------------|-----------|
|       |                          | Before occlusion | After 2 h |
| NS    | 22±7                     | 139±7            | 163±5     |
| P     | 15±6**                   | 144±7            | 138±11*** |
| M     | 14±5**                   | 141±8            | 131±10*** |

放大器观察 10 min, 并记录有关心律失常. NS 组兔发生室性早搏, 心室交替电压有 5/8 只; P 组兔发生室性早搏有 2/8 只; M 组未发现室性心律失常. 见图 3. M 组与 NS 组比较有显著差异(p<0.05).



Fig 3. Ventricular arrhythmia (lead II) in rabbits 2 h after occlusion of LAD. A) iv saline 20 ml caused ventricular electrical alternation. B) iv propranolol 3.2 mg caused ventricular premature beats. C) iv 10% MgSO<sub>4</sub> 668 mg, no ventricular arrhythmia was seen.

## 讨 论

本实验结果表明 MgSO<sub>4</sub> 能显著缩小心肌

梗塞范围, 能明显改善兔实验性 AMI 后心前区 ST 段抬高及减少病理性 Q 波, 而且还能减慢 AMI 后兔的心率和具有预防和抗室性心律失常. 在与已知有缩小实验性心肌梗塞面积和抗心律失常的普萘洛尔进行的对照实验中也得以证实. 以上表明 MgSO<sub>4</sub> 可作为治疗 AMI 的一种有用药物.

本实验创用“36”分法测量心肌梗塞范围, 此法简便易做, 可望作为估计实验性心肌缺血损伤程度的一种辅助指标.

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## Influence of magnesium sulfate on sizes of myocardial infarction in rabbits

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**ABSTRACT** Myocardial infarction was made in open-chest rabbits. Immediately after the occlusion of the anterior descending branch of left coronary artery (LAD), 10% MgSO<sub>4</sub> 400 mg/kg was iv to 8 rabbits. The same doses of MgSO<sub>4</sub> were given 24 and 48 h later. Saline (20 ml) and propranolol (2 mg/kg) were given separately to another 2 groups of rabbits for comparison.

The results showed that: (1) The extents of the experimental myocardial infarction were  $14 \pm 5$ ,  $15 \pm 5$  and  $22 \pm 7\%$  for magnesium sulfate (M), propranolol (P) and saline group (NS), respectively. (2) The epicardial ST segment elevation was improved (NST :  $8 \pm 4$ ,  $0.1 \pm 0.4$ ;  $7 \pm 5$ ,  $4.0 \pm 1.8$  and  $11.2 \pm 1.5$ ,  $7 \pm 4$ .  $\overline{ST}$  :  $4.0 \pm 1.0$ ,  $0.4 \pm 1.1$ ;  $4.8 \pm 2.7$ ,

$2.4 \pm 1.2$  and  $8 \pm 3$ ,  $2.7 \pm 0.7$  for (M), (P) and (NS) 2 and 72 h after LAD). (3) The numbers of pathologic Q wave were decreased ( $5.6 \pm 1.8$ ,  $5.9 \pm 1.9$  and  $9 \pm 3$ ,  $9 \pm 4$  for (M) and (NS) groups 24 and 72 h after LAD). (4) The heart rates were declined ( $131 \pm 10$ ,  $138 \pm 11$  and  $163 \pm 5$  for (M), (P) and (NS), respectively. (5) The ventricular arrhythmia was eliminated in the group treated with (M), as compared with (NS),  $p < 0.05$ .

To conclude, the (M) treatment is apparently beneficial in reducing the size of the experimental myocardial infarction.

**KEY WORDS** magnesium sulfate; coronary vessels; myocardial infarction; electrocardiography