DOI:10.3978/j.issn.2095-6959.2023.221265

# 心肌酶谱三项对儿童肺炎支原体肺炎病情和预后的评估价值

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[摘 要] **目的：**探究心肌酶谱三项对儿童肺炎支原体肺炎(mycoplasma pneumoniae pneumonia，MPP)病情和预后的评估价值。**方法：**选取2017年1月至2022年2月阜阳市妇女儿童医院收治的104例MPP患儿为研究对象，回顾性分析其临床资料，包括一般资料及实验室资料[乳酸脱氢酶(lactate dehydrogenase，LDH)、谷草转氨酶(aspartate aminotransferase，AST)、肌酸激酶同工酶(creatinine kinase-myocardial band，CK-MB)]。根据患儿病情程度分为轻症组($n$=71)与重症组($n$=33)；再根据随访1年患儿有无肺部后遗症分为预后良好组($n$=95)与预后不良组($n$=9)。比较各组临床资料，用受试者操作特征(receiver operating characteristic，ROC)曲线分析血清AST、LDH、CK-MB对MPP患儿病情程度和预后的评估价值。**结果：**轻症组血清AST、LDH、CK-MB水平均明显低于重症组(均$P$<0.05)；预后良好组血清AST、LDH、CK-MB水平均明显低于预后不良组(均$P$<0.05)。Logistic回归分析显示：AST、LDH、CK-MB均是MPP患儿重症及预后不良的独立危险因素(均$P$<0.05)。ROC曲线分析显示：血清AST、LDH、CK-MB诊断儿童重症MPP的曲线下面积(area under the curve，AUC)分别为0.944、0.961、0.657，预测儿童MPP预后不良的AUC分别为0.935、0.961、0.851，均以LDH的评估效能最高(病情：敏感度=93.94%，特异度=85.92%；预后：敏感度=88.89%，特异度=92.63%)。**结论：**心肌酶谱三项对儿童MPP病情严重程度和预后均具有较高的评估价值，血清AST、LDH、CK-MB水平越高提示患儿病情越重，更易出现预后不良。

[关键词] 肺炎支原体；肺炎；谷草转氨酶；乳酸脱氢酶；肌酸激酶同工酶；儿童

# Value of three items myocardial enzyme spectrum in evaluating the disease severity and prognosis of mycoplasma pneumoniae pneumonia in children

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**ABSTRACT** **Objective:** To explore the evaluation value of three items of myocardial enzymes spectrum on the severity and prognosis of mycoplasma pneumoniae pneumonia (MPP) in children. **Methods:** A total of 104 children with MPP admitted to Fuyang Women and Children's

**收稿日期(Date of reception)：**2022-06-20
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Hospital from January 2017 to February 2022 were selected as the research subjects. The clinical data were retrospectively analyzed, including general data and laboratory data [aspartate aminotransferase (AST), lactate dehydrogenase (LDH), creatinine kinase-myocardial band (CK-MB)]. The patients were divided into a mild group ($n$=71) and a severe group ($n$=33) according to the severity of the disease. They were regrouped according to the 1-year follow-up prognosis, and divided into a good prognosis group ($n$=95) and a poor prognosis group ($n$=9) according to the presence or absence of pulmonary sequelae. The clinical data of each group were compared. The receiver operating characteristic (ROC) curve was used to analyze the value of serum AST, LDH and CK-MB in evaluating the severity and prognosis of the MPP children.

**Results:** The serum AST, LDH, and CK-MB levels in the mild group were significantly lower than those in the severe group (all $P$<0.05). The serum AST, LDH, and CK-MB levels in the good prognosis group were significantly lower than those in the poor prognosis group (all $P$<0.05). Logistic regression analysis showed that AST, LDH, and CK-MB were independent risk factors for severe MPP and poor prognosis (all $P$<0.05). ROC curve analysis showed that the area under the curve (AUC) of serum AST, LDH, and CK-MB in the diagnosis of severe MPP in children were 0.944, 0.961, and 0.657, the AUC of predicting poor prognosis of MPP in children were 0.935, 0.961, and 0.851, respectively. LDH had the highest evaluation efficiency (sensitivity for disease severity 93.94%, specificity for disease severity 85.92%; sensitivity for prognosis 88.89%, specificity for prognosis 92.63%).

**Conclusion:** The three items of myocardial enzyme spectrum have high evaluation values for the condition and prognosis of MPP in children. The higher the serum AST, LDH, and CK-MB levels are, the more severe the disease is and the more likely the prognosis is poor.

**KEY WORDS** mycoplasma pneumoniae; pneumonia; transglutaminase; lactate dehydrogenase; creatinine kinase-myocardial band; children

肺炎支原体(mycoplasma pneumoniae，MP)是社区获得性肺炎常见微生物病原，由其引发的肺炎支原体肺炎(mycoplasma pneumoniae pneumonia，MPP)在儿童群体中的发病率较高，为15%~30%[1]。MPP并非完全自限性疾病，MP感染不仅会引起肺实质病变，还可累及多个器官、系统，心肌损伤是临床MPP患儿较为常见的肺外并发症之一[2]。然而，MPP产生的心肌损伤缺乏特异性表现，易被忽视，延误治疗，影响预后[3]。心肌酶谱三项是临床常用检查指标，包括乳酸脱氢酶(lactate dehydrogenase，LDH)、谷草转氨酶(aspartate aminotransferase，AST)、肌酸激酶同工酶(creatinine kinase-myocardial band，CK-MB)，常被用于辅助诊断心肌梗死、心肌炎等疾病，是反映心肌损伤程度的重要量化指标[4]。而儿童因年龄小、免疫力弱等因素心肌更易受到损害。研究[5]显示，新型冠状病毒肺炎儿童心肌酶增高的比率明显高于成人患者，提示临床应警惕肺炎患儿心肌受损。许姜姜等[6]研究也发现，难治性MPP患儿的血清LDH等心肌酶及感染指标水平明显高于普通患儿，提示心肌酶谱可能与MPP患儿病情程度密切相关。基于此，本研究旨在探究心肌酶谱三项对儿童MPP病情和预后的评估价值。

## 1 对象与方法

### 1.1 对象

本研究为回顾性研究，符合医学伦理且通过阜阳市妇女儿童医院医学伦理委员会审批[审批号：阜六伦审2022第(14)号]。选取2017年1月至2022年2月阜阳市妇女儿童医院收治的MPP患儿为研究对象。纳入标准：1)确诊为MPP；2)年龄1~13岁，生长发育

正常；3)临床资料完整。排除标准：1)病原菌检查发现合并其他细菌感染；2)合并免疫缺陷、凝血异常、脑瘫及心肌炎等严重基础疾病；3)合并急性上呼吸道感染、肺结核等其他呼吸系统疾病；4)转院或失访。共纳入104例，根据患儿病情程度分为轻症组($n$=71)与重症组($n$=33)；再根据随访1年后患儿有无肺部后遗症分为预后良好组($n$=95)与预后不良组($n$=9)。

### 1.2 分组标准

轻症：发热时间≤5 d，胸部X线检查显示为肺炎、支气管炎，无肺外合并症。重症：发热时间>5 d，胸部X线检查显示有胸腔积液、大片实变影，有肺外合并症[7]。

预后良好：胸部X线检查显示患儿肺部组织恢复正常。预后不良：有局限性肺气肿、支气管扩张、闭塞性细支气管炎等表现。

### 1.3 治疗方法

1)所有患儿均行阿奇霉素静脉滴注3 d，剂量为10 mg/(kg·d)，随后改为阿奇霉素口服，总疗程为21 d。治疗7 d后，复查MP-IgM及炎症指标，对炎症指标明显升高的患儿加用β-内酰胺类抗生素，如头孢呋辛。2)对重症患儿使用短疗程糖皮质激素治疗，甲泼尼龙琥珀酸钠静脉滴注3~5 d，剂量为1.0~1.5 mg/(kg·d)。3)视个体情况予以祛痰、退热、平喘治疗。

### 1.4 心肌酶谱检测

患儿入院24 h内采集静脉血3 mL，离心分离出血清待测，使用全自动生化分析仪(DIMENSION-RXL型，美国杜邦)及配套试剂检测血清AST、LDH、CK-MB水平。

### 1.5 统计学处理

数据用SPSS 24.0统计软件进行处理分析。计量资料均符合正态分布，记为均数±标准差($\bar{x}\pm s$)，以独立样本$t$检验作比较；计数资料记作例(%)，以$\chi^2$检验作比较；使用受试者操作特征(receiver operating characteristic，ROC)曲线分析血清AST、LDH、CK-MB对MPP患儿病情程度和预后的评估价值。$P$<0.05为差异有统计学意义。

## 2 结 果

### 2.1 一般资料比较

轻症组与重症组相比、预后良好组与预后不良组相比，在性别、年龄、发病至入院时间方面差异均无统计学意义(均$P$>0.05)。重症组、预后不良组患儿发热持续时间均明显长于轻症组、预后良好组(均$P$<0.05，表1)。其中，轻症组患儿均预后良好，重症组中预后良好24例、预后不良者9例。

### 2.2 心肌酶谱比较

轻症组血清AST、LDH、CK-MB水平均明显低于重症组(均$P$<0.05，表2)；预后良好组血清AST、LDH、CK-MB水平均明显低于预后不良组(均$P$<0.05，表3)。

### 2.3 MPP患儿病情程度及预后的影响因素

将AST、LDH、CK-MB作为自变量，以MPP患儿病情程度及预后为因变量，行logistic回归分析，结果显示：AST、LDH、CK-MB均是MPP患儿重症及预后不良的独立危险因素(均$P$<0.05；表4，5)。

**表1 各组一般资料比较**

**Table 1 Comparison of general data of each group**

| 组别 | $n$ | 性别/[例(%)] | | 年龄/岁 | 发病至入院时间/d | 发热持续时间/d |
|---|---|---|---|---|---|---|
| | | 男 | 女 | | | |
| 轻症组 | 71 | 37 (52.11) | 34 (47.89) | 6.21±1.94 | 2.34±0.73 | 5.64±1.82 |
| 重症组 | 33 | 16 (48.48) | 17 (51.52) | 6.16±1.73 | 2.19±0.69 | 7.59±2.23 |
| $t/\chi^2$ | | 0.119 | | 0.126 | 0.992 | 4.727 |
| $P$ | | 0.731 | | 0.900 | 0.324 | <0.001 |
| 预后良好组 | 95 | 49 (51.58) | 46 (48.42) | 6.22±2.03 | 2.28±0.71 | 6.08±2.02 |
| 预后不良组 | 9 | 4 (44.44) | 5 (55.56) | 5.92±1.71 | 2.42±0.76 | 8.14±2.35 |
| $t/\chi^2$ | | 0.167 | | 0.429 | 0.562 | 2.884 |
| $P$ | | 0.682 | | 0.669 | 0.575 | 0.005 |

### 2.4 心肌酶谱三项评估MPP病情程度的ROC曲线分析

ROC曲线分析显示：血清AST、LDH、CK-MB诊断儿童重症MPP的曲线下面积(area under the curve，AUC)分别为0.944、0.961、0.657(表6，图1)。

### 2.5 心肌酶谱三项预测MPP预后的ROC曲线

ROC曲线分析显示：血清AST、LDH、CK-MB预测儿童MPP预后不良的AUC分别为0.935、0.961、0.851(表7，图2)。

**表2 轻症组和重症组心肌酶谱比较($\bar{x}\pm s$)**

**Table 2 Comparison of myocardial enzymes between mild and severe groups ($\bar{x}\pm s$)**

| 组别 | $n$ | AST/(U·L$^{-1}$) | LDH/(U·L$^{-1}$) | CK-MB/(U·L$^{-1}$) |
|---|---|---|---|---|
| 轻症组 | 71 | 49.58±9.86 | 412.43±127.51 | 16.92±5.02 |
| 重症组 | 33 | 73.26±14.17 | 726.54±152.08 | 19.11±5.27 |
| $t$ | | 9.869 | 10.987 | 2.038 |
| $P$ | | <0.001 | <0.001 | 0.044 |

AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶。

**表3 预后良好组和预后不良组心肌酶谱比较($\bar{x}\pm s$)**

**Table 3 Comparison of myocardial enzymes between the good prognosis group and the poor prognosis group ($\bar{x}\pm s$)**

| 组别 | $n$ | AST/(U·L$^{-1}$) | LDH/(U·L$^{-1}$) | CK-MB/(U·L$^{-1}$) |
|---|---|---|---|---|
| 预后良好组 | 95 | 55.22±15.39 | 491.35±138.96 | 17.23±5.31 |
| 预后不良组 | 9 | 76.87±11.46 | 731.12±124.38 | 21.68±3.54 |
| $t$ | | 4.106 | 4.986 | 2.457 |
| $P$ | | <0.001 | <0.001 | 0.016 |

AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶。

**表4 MPP患儿病情程度影响因素的logistic回归分析**

**Table 4 Logistic regression analysis of influencing factors of severity of MPP**

| 指标 | $\beta$ | $SE$ | Wald $\chi^2$ | $P$ | OR | 95% CI |
|---|---|---|---|---|---|---|
| AST | 0.343 | 0.089 | 14.853 | <0.001 | 1.409 | 1.184~1.678 |
| LDH | 0.412 | 0.115 | 12.835 | <0.001 | 1.510 | 1.205~1.892 |
| CK-MB | 0.637 | 0.256 | 6.192 | 0.013 | 1.891 | 1.145~3.123 |

MPP：肺炎支原体肺炎；AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶。

**表5 MPP患儿预后影响因素的logistic回归分析**

**Table 5 Logistic regression analysis of prognostic factors of MPP children**

| 指标 | $\beta$ | $SE$ | Wald $\chi^2$ | $P$ | OR | 95% CI |
|---|---|---|---|---|---|---|
| AST | 0.396 | 0.103 | 14.781 | <0.001 | 1.486 | 1.214~1.818 |
| LDH | 0.366 | 0.124 | 8.712 | 0.003 | 1.442 | 1.131~1.839 |
| CK-MB | 0.497 | 0.186 | 7.140 | 0.008 | 1.644 | 1.142~2.367 |

MPP：肺炎支原体肺炎；AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶。

**表6 血清AST、LDH、CK-MB对重症MPP的诊断价值**

**Table 6 Diagnostic value of serum AST, LDH, and CK-MB for severe MPP**

| 指标 | 最佳截断值 | AUC | $P$ | 95% CI | 敏感度/% | 特异度/% |
|---|---|---|---|---|---|---|
| AST | >61.11* | 0.944 | <0.001 | 0.881~0.980 | 84.85 | 94.37 |
| LDH | >537.51* | 0.961 | <0.001 | 0.903~0.989 | 93.94 | 85.92 |
| CK-MB | >20.35* | 0.657 | 0.012 | 0.558~0.748 | 54.55 | 81.69 |

*单位为U/L。AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶；MPP：肺炎支原体肺炎；AUC：曲线下面积。

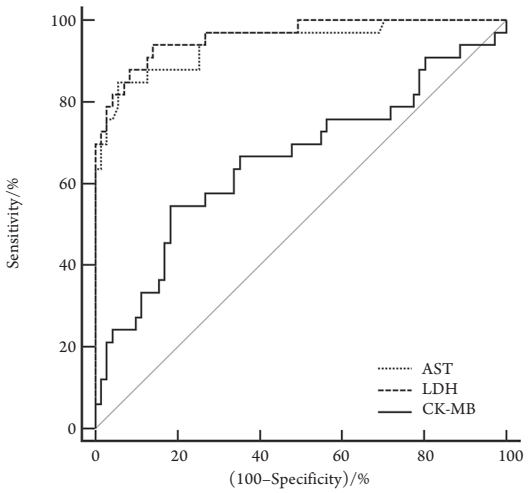


**图1 血清AST、LDH、CK-MB诊断重症MPP的ROC曲线**

**Figure 1 ROC curve of serum AST, LDH, and CK-MB in diagnosis of severe MPP**

AST: Aspartate aminotransferase; LDH: Lactate dehydrogenase; CK-MB: Creatine kinase-myocardial band; MPP: Mycoplasma pneumoniae pneumonia; ROC: Receiver operating characteristic.

**表7 血清AST、LDH、CK-MB对MPP预后的预测价值**

**Table 7 Predictive value of serum AST, LDH, and CK-MB for prognosis of MPP**

| 指标 | 最佳截断值 | AUC | *P* | 95% CI | 敏感度/% | 特异度/% |
|---|---|---|---|---|---|---|
| AST | >73.53* | 0.935 | <0.001 | 0.869~0.974 | 88.89 | 88.42 |
| LDH | >667.16* | 0.961 | <0.001 | 0.904~0.989 | 88.89 | 92.63 |
| CK-MB | >20.29* | 0.851 | <0.001 | 0.768~0.914 | 88.89 | 81.05 |

*单位为U/L。AST：谷草转氨酶；LDH：乳酸脱氢酶；CK-MB：肌酸激酶同工酶；MPP：肺炎支原体肺炎；AUC：曲线下面积。

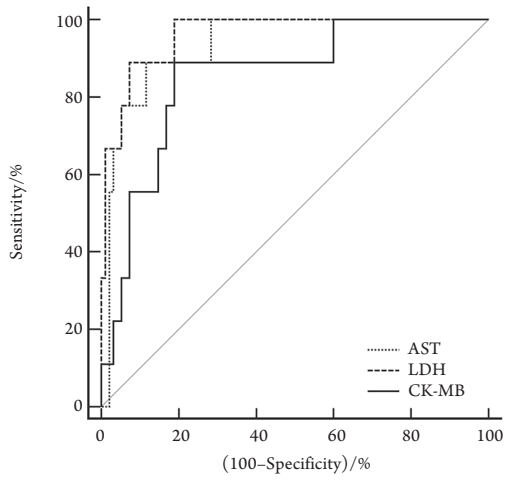


**图2 血清AST、LDH、CK-MB预测MPP预后的ROC曲线**

**Figure 2 ROC curve of serum AST, LDH, and CK-MB in predicting prognosis of MPP**

AST: Aspartate aminotransferase; LDH: Lactate dehydrogenase; CK-MB: Creatinine kinase-myocardial band; MPP: Mycoplasma pneumoniae pneumonia; ROC: Receiver operating characteristic.

## 3 讨 论

MPP是社区获得性肺炎常见类型，其流行具有明显的季节性、群体性，儿童因免疫力弱、机体发育不成熟，更易感染MP，以学龄前儿童最为多见，且近年MPP发生呈现低龄化趋势[8]。发热、咳嗽等是MPP主要临床表现，早期经抗生素治疗可有效缓解症状，但仍有部分患儿存在病程迁延难愈，出现一系列肺内、肺外症状[9]。有研究[10-11]发现6.6%~22.84%的MPP患儿有肺部后遗症表现。因此，尽早准确识别MPP患儿病情程度及预测预后以指导临床诊疗，具有重要临床意义。

在判断肺炎病情程度时不仅依据临床表现，还会结合影像学检查、实验室指标进行综合评估。由于MP和机体肺、脑、心及平滑肌上皮中均有部分共同抗原存在，因而MP感染后会产生相应抗体并结合成免疫复合物，导致心血管等肺外器官出现免疫损伤[12]。心肌损伤是MPP肺外合并症之一，研究[13]发现：MPP患儿常出现心肌酶谱增高，且在治疗后心

肌酶水平明显下降。因而，近年来临床越来越重视MPP患儿心肌损害的防治。心肌酶谱包括AST、LDH、CK-MB、肌红蛋白、肌酸激酶，以前三者关注度最高，均是心肌或其他组织器官受损后释放入血的生物标志物，通常在判断患者心肌受损情况时使用。AST在心脏中的含量最多，肾和肝次之，在机体的氨基酸代谢过程中发挥重要作用[14]；LDH在机体各器官组织中均有广泛分布，是糖酵解反应的关键酶[15]；CK-MB则是心肌细胞的特异性同工酶，通常情况下在血清中含量低，而在心肌受损后被大量释放，血清水平明显升高，因而对辅助判断心肌受损程度的敏感性相对较高[16]。目前，MPP损害心肌的作用机制并不完全明晰，可能为MP感染诱发过度免疫反应损伤心肌，也可能为MP感染对心脏的直接损伤作用[17]。本研究发现，重症组血清AST、LDH、CK-MB水平均明显高于轻症组。这表明MPP患儿的心肌酶水平与其病情程度相关，病情越重，患儿的血清心肌酶水平越高。值得注意的是，并不能仅依靠心肌酶谱增高就判定MPP患儿存在心肌炎或心肌损伤。有学者[18]认为，MP感染虽然可直接或间接损伤心脏，但实际上较少发生，因其严重受损者则更为少见，明确诊断为MPP合并心肌损伤者仅占2.3%。由于MPP不仅累及心肌，AST、LDH在心肌外的多个脏器组织中均有分布，其较差的组织特异性在一定程度上也是其准确评估MPP病情的优势。本研究结果显示：血清AST、LDH、CK-MB诊断儿童重症MPP的AUC分别为0.944、0.961、0.657，表明AST、LDH诊断重症MPP的诊断效能明显高于CK-MB，且以LDH的诊断效能最佳。与周忠霞等[19]研究结果相似，这可能是因为LDH对肺组织受损更为敏感，肺组织的病变将引起血清LDH水平的明显改变，加之重症MPP常累及其他器官系统，而LDH在机体组织中的分布最广，因而对MPP病情变化的反映更准确。

已有研究[20]将心肌酶谱用于肺炎患者预后的预测中，该研究指出LDH、CK-MB及α-羟丁酸脱氢酶水平与新型冠状病毒肺炎患者的临床分级及预后均呈正相关。本研究也将AST、LDH、CK-MB用于MPP患儿预后的早期评估中，结果显示：血清AST、LDH、CK-MB预测儿童MPP预后不良的AUC分别为0.935、0.961、0.851。这表明心肌酶谱三项对MPP预后均有较高评估价值，提示心肌酶谱水平可能对MPP患儿肺部病灶组织的恢复、后遗症的风险具有一定提示意义，且以LDH的评估效能最高，敏感度、特异度分别为88.89%、92.63%。

综上所述，血清AST、LDH、CK-MB水平可有效评估MPP患儿病情程度及预后，血清AST、LDH、CK-MB水平越高的患儿病情越重，越易有肺部后遗症表现，预后不良风险越高。但本研究仍存在一定不足：其一，预后良好组和预后不良组患儿病例数相差较大，可能会导致统计结果偏倚；其二，并未对患儿血清AST、LDH、CK-MB水平进行动态监测，可能会存在部分病例分组偏倚。未来仍需进行前瞻性、大样本量研究进一步验证和完善结论。

**利益冲突声明：**作者声称无任何利益冲突。

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**本文引用：**李双剑, 田杰, 张建明. 心肌酶谱三项对儿童肺炎支原体肺炎病情和预后的评估价值[J]. 临床与病理杂志, 2023, 43(1): 62-68. DOI:10.3978/j.issn.2095-6959.2023.221265

***Cite this article as:*** LI Shuangjian, TIAN Jie, ZHANG Jianming. Value of three items myocardial enzyme spectrum in evaluating the disease severity and prognosis of mycoplasma pneumoniae pneumonia in children[J]. Journal of Clinical and Pathological Research, 2023, 43(1): 62-68. DOI:10.3978/j.issn.2095-6959.2023.221265