OBJECTIVES
We conducted this study to determine the result of prolonged cardiopulmonary resuscitation (CPR) with extracorporeal membrane oxygenation (ECMO) and the predictive factors for hospital discharge and ECMO weaning.

BACKGROUND
Prolonged CPR carries considerable associated mortality and morbidity. As yet, ECMO for prolonged CPR has no definite results. Only small groups of patients and no detailed analysis have been reported.

METHODS
Candidates for ECMO resuscitation were patients in cardiac arrest receiving CPR without return of spontaneous circulation and no absolute contraindication. Venoarterial ECMO was set up during CPR. We reviewed the data of 57 prolonged CPR patients who received ECMO during CPR over a six-year period.

RESULTS
The mean duration of CPR was 47.6 ± 13.4 min and that of ECMO was 96.1 ± 87.9 h. The rate of weaning was 66.7%, and the survival rate was 31.6%. Multiple-organ failure was the major reason for mortality, despite successful weaning. Among survivors, long-term follow-up revealed 88.9% survival, and only 5.6% had a severe neurologic deficit. The results indicate that a shorter CPR duration, postcardiotomy arrest, myocardial indicators, a hepatic indicator, and lactic acid are significantly correlated with both weaning and survival, whereas late damage (level on the third or seventh day of reperfusion) rather than initial damage (level on the first day) was more predictive of the results.

CONCLUSIONS
Prolonged CPR rescue by ECMO provides an acceptable survival rate and outcome in survivors. Our results of the selected cases encourage further investigations of the wider application of ECMO in CPR. (J Am Coll Cardiol 2003;41:197–203) © 2003 by the American College of Cardiology Foundation

Cardiopulmonary resuscitation (CPR) with closed-chest cardiac massage, which was first introduced in 1960 (1), was developed to maintain circulation and ventilation until life-threatening problems could be corrected or reversed. Studies on the effect of CPR have shown that survival to discharge after CPR ranged from 8.2% to 22% among all hospitalized patients and from 6% to 11% among critically ill patients (2–5). Furthermore, the chances of survival decline rapidly if the CPR period lasts >10 to 15 min (6–8).

Because of the low survival rate after prolonged CPR, more aggressive methods have been suggested to increase success. Gibbon introduced cardiopulmonary bypass (CPB) by means of thoracotomy and subsequently extracorporeal venoarterial pumping and oxygenation (9). The use of CPB and its extension to prolong circulatory support without thoracotomy have been reviewed (10). With the advancement of techniques, extracorporeal mechanical support has been applied in conjunction with CPR, with variable results (11–13).

Extensive animal data and preliminary clinical reports suggest that extracorporeal mechanical support might be a superior means of resuscitating some victims of cardiac arrest (11–17). We have developed extracorporeal membrane oxygenation (ECMO) during CPR (in brief, called ECPR) since 1994. This study represents a six-year experience with ECPR at a single institution, in which we tried to analyze risk factors influencing patient survival and weaning from ECPR.

METHODS
Exclusion and inclusion criteria. Because ECPR is an extremely expensive and aggressively invasive intervention in considerable demand and with an unknown effect, we usually selected patients whose condition leading to CPR was thought to be of a cardiac origin. A brief and quick evaluation was performed during CPR to preclude ECMO contraindications, including previous irreversible brain damage, terminal malignancy, and age >75 years. Those who could not be weaned off CPB after surgery due to postcardiotomy shock and were then shifted to ECMO were not included in this study. Patients who experienced progressive deterioration and needed ECMO support urgently without cardiac massage or boluses of epinephrine were excluded, as well.

Briefly, patients were recruited into the ECPR group only if they: 1) were in cardiac arrest that necessitated external or
open-chest cardiac massage and a large amount of epinephrine (>5 mg) during CPR; 2) could not be returned to spontaneous circulation within 10 to 20 min; and 3) subsequently received ECMO in the hospital. Because of the emergency status, oral permission was obtained and formal consent was signed later after the ECMO setup.

**ECMO circuit and equipment.** The circuit and management of ECMO have been described previously (18). The circuit for ECPR is composed of a heparin-bonded Carmeda Bioactive Surface circuit, a Maxima Plus PRF hollow-membrane oxygenator with an integral heat exchanger, and a Biopump centrifugal blood pump (Medtronic Inc., Anaheim, California). We did not have the bridging tube between the arterial and venous lines for conserving manpower. The bridging tube was reconnected to the circuit when weaning was tried.

**ECMO management.** All circuits were primed with normal saline and heparin (2 U/ml) due to the emergent condition. The warmer was connected to the circuit to rewarm the patients up to 37°C gradually. Femoral cannulation was preferred. For distal limb perfusion, we applied the previously reported salvage method (19,20) of an antegrade reperfusion catheter to the distal artery. Trans-thoracic cannulation was reserved for those necessitating open-chest cardiac massage in postcardiotomy CPR. Heparin (100 U/kg) was given to the patient immediately before cannulation.

The pump flow started initially at 50 to 100 ml/kg per min, with adjustment of vasopressors to maintain a mean blood pressure of around 60 mm Hg. Low-dose heparin was infused to keep the activated clotting time around 160 to 180 s. The high dose of catecholamine was tapered slowly. If the myocardium was found to improve by echocardiography, weaning from ECMO was tried. The activated clotting time was adjusted to 220 s during the period of weaning.

**General management.** Evaluation of consciousness. The consciousness level had to be evaluated every 12 h after CPR. Cessation of ECMO was considered if a severe neurologic insult persisted for more than seven days without signs of recovery. Temporarily dilated pupils after CPR or a bolus of epinephrine are usually found, and it should not be considered an indication for withdrawing ECMO within the first 24 h.

**Further intervention and weaning.** The cause leading to CPR was investigated after spontaneous circulation had returned, and treatment for the underlying cause was started as soon as possible. It is important to perform follow-up echocardiography every day to estimate the recovery of the heart and to detect possible thrombus formation in the left ventricle. A pulsatile arterial waveform should be maintained by adjusting the catecholamine to prevent left ventricular thrombus formation. Weaning should not be tried until 72 h later. If a pulsatile arterial waveform could be detected under dopamine and dobutamine (<10 μg/kg per min) and milrinone (<0.5 μg/kg per min), a trial weaning was performed by gradually decreasing pump flow. If the catecholamine dose had to be increased to more than the aforementioned dose during weaning, the trial weaning was discontinued and then restarted the next day. If weaning was unsuccessful in four to five days, a ventricular assist device or heart transplantation was considered in the absence of contraindications.

**Data collection and statistics.** Our collected data (Table 1) were modified according to the guidelines for reviewing and reporting in-hospital resuscitations (21). The data are shown as the mean value ± SD (standard deviation), unless specified otherwise.

In ECMO–supported patients, two resulting comparisons were of concern: 1) ECMO weaning versus non-weaning and 2) survival–to-discharge versus in-hospital death. Successful weaning was defined as weaning from ECMO followed by survival beyond 48 h. Those who could be weaned from ECMO but who died within 48 h were defined as unsuccessfully weaned. Survival was defined as weaning from ECMO followed by discharge from the hospital. We attempted to identify the risk factors that affected weaning and survival, and we analyzed the effect of ECPR on survival.

Categorical variables were compared by using the Fisher exact test. Continuous variables were compared by the Mann–Whitney U test or Kruskal–Wallis test if there were more than two groups. Spearman correlation was used to pre-select the laboratory variables that correlated significantly with the binomial variables of ECMO weaning or hospital survival. We then applied these variables to the simple logistic regression models on the predicted probability of ECMO weaning and hospital survival. In these regression models with given predicted probabilities of 0.1, 0.5, and 0.9, we then solved for the corresponding variable values. (Logistic regression model: ln[p/(1-p)] = β₀ + β₁ × X₁; for p = 0.1, 0.5, and 0.9, we solved for X₁ = ln[p/(1−p)]−β₀/β₁.)

Standard errors of these corresponding variable values were estimated by the delta method (22). A p value <0.05 was regarded as statistically significant.

Stata 7.0 (Stata Corp., Texas) was used for statistical analyses of this study. Microsoft Excel 2000 spreadsheets...
were used for the calculation of values for predicted probabilities, by solving logistic regression equations, and standard errors by the delta method.

**RESULTS**

**Characteristics of patients.** A total of 57 patients (34 men; 57.1 ± 15.6 years old) were resuscitated by ECMO in conjunction with CPR. All received ECMO during cardiac massage. Six patients (10.5%) had previous CPR before ECPR. Only two patients (3.5%) received transthoracic massage. Twenty-seven patients (47.4%) had previous CPR before conjunction with CPR. All received ECMO during cardiac massage. Twenty-seven patients (47.4%) underwent successful femoral cannulation during ECPR. Three patients (5.3%) received transthoracic massage. Six patients (10.5%) had previous CPR before conjunction with CPR. All received ECMO during cardiac massage.

One patient failed to be cannulated; this patient developed a massive retroperitoneal hematoma when percutaneous femoral cannulation was attempted. Three patients (5.3%) were unable to return to spontaneous rhythm, despite successful execution of ECMO.

**ECPR in postcardiotomy arrest.** Patients with postcardiotomy ECPR (n = 14) had a significantly better survival rate than those without postcardiotomy ECPR (57.14% vs. 23.26%, p = 0.025). However, the postcardiotomy group did not have a significantly higher weaning rate than the non-postcardiotomy group (60.47% vs. 66.67%, p = 0.109).

**Duration of CPR.** No patient received ECMO within 15 min after arrest and CPR occurred. The rates of weaning and survival at different CPR durations are shown in Table 2. The data revealed that patients who were successfully weaned experienced a shorter CPR duration (45.0 ± 13.4 min in weaned patients vs. 52.9 ± 11.6 min in non-weaned patients, p = 0.027). Survivors also had a much shorter CPR duration (39.2 ± 13.7 min in survivors vs. 51.5 ± 11.3 min in non-survivors, p = 0.0014). As seen in Table 2, the survival rate was higher for CPR lasting <60 min than for CPR lasting >60 min (p = 0.004), and similarly, a higher weaning rate was associated with a duration <60 min (80.7% vs. 50%, p = 0.023). The survival rate for CPR lasting <45 min was also noted to be better than that for CPR lasting >45 min (57.1% vs. 23.3%, p = 0.025), but not the weaning rate (78.6% vs. 62.8%, p = 0.343). We also could not demonstrate the statistic difference in both survival and weaning rate between those with CPR lasting <60 min and those with CPR lasting >60 min. Therefore, we could conclude that CPR <60 min followed by ECMO rescue could predict a survival rate of around 50% and a successful weaning rate of 80%, and the shorter the duration, the better the survival.

**Subsequent interventions.** A total of 32 subsequent intervention procedures were performed in 28 patients receiving ECPR in this study, including 12 coronary artery bypass graft surgeries, two coronary angioplasties, three repairs of ventricular rupture, two pulmonary embolectomies, one creation of a fenestrated atrial septal defect, one replacement of a thrombosed mechanical valve, one reconstructed stenotic aorta, six conversions to a ventricular assist device, and four heart transplantations. Both the weaning rate (77.8% vs. 56.7% with vs. without intervention) and the survival...
rate (37.0% vs. 26.7%) were higher in patients with subsequent interventions, but the differences did not reach statistical significance (p = 0.159 for weaning, and p = 0.569 for survival). The CPR duration was still an important factor influencing survival in the subgroup with subsequent interventions (36.0 ± 12.6 min in survivors vs. 48.3 ± 12.2 min in non-survivors, p < 0.05). In patients with non-postcardiotomy ECPR (n = 43), the weaning rates did not differ significantly between those with and those without subsequent procedures (72.73% vs. 47.62%, p = 0.124). Also, there was a borderline difference in survival rates (33.36% vs. 9.52%, p = 0.069) in those with and those without subsequent procedures.

**Initial rhythm, defibrillation, and witnessed and monitored cardiac arrest.** Almost all patients (96.5%) received initial CPR in the hospital; a witnessed arrest occurred in 96.5% of patients; and 84.2% of patients were monitored during CPR. Ventricular fibrillation (VF) was noted in 27 patients (47.4%), ventricular tachycardia (VT) in eight patients (14.0%), and arrest and pulseless electrical activity in 22 patients (38.6%). In all patients, defibrillation had been tried before ECMO. These four factors did not affect the outcome in terms of weaning and survival (p > 0.05). However, we discovered that the use of ECMO in prolonged CPR resulted in a very high incidence of return to spontaneous rhythm (94.7%).

**Previous CPR.** Six patients (10.5%) had a previous CPR before the episode of ECPR, but the previous CPR did not influence the weaning or survival rate for either the whole group or the non-postcardiotomy group (p > 0.05).

**Duration of ECMO.** There was no significant difference in ECMO duration either in weaning (105.6 ± 87.8 h in weaning vs. 77.2 ± 87.2 h in non-weaning, p = 0.092) or in survival (104.9 ± 103.7 h in survivors vs. 92.0 ± 80.8 h in non-survivors, p = 0.76). When focusing on the non-postcardiotomy or postcardiotomy patients, ECMO duration did not affect weaning or survival in the subgroups (p > 0.05).

**Correlation of biochemistry with weaning or survival.** Table 3 shows the correlation between biochemical factors in weaning and survival. The weaned and non-weaned groups differed significantly (p < 0.05) by Spearman’s method with respect to creatinine on the third and seventh days (Cre3, Cre7), aspartate aminotransferase (AST) on the third day (AST3), creatine kinase (CK) on the third day (CK3), creatine kinase MB fraction (CK-MB) on the third and seventh days (CK-MB3, CK-MB7), and lactic acid (LA) on the third and seventh days (LA3, LA7). When comparing survival and non-survival, Cre7, AST3, AST7, CK1, CK3, CK7, CK-MB3, CK-MB7, LA1, LA3, and LA7 showed a significant correlation with survival (Table 3). From the analysis, the biochemical data, including Cre7, AST3, CK3, CK-MB3, CK-MB7, LA3, and LA7, had correlations with both weaning and survival. They could be regarded as predictive indicators for the ECPR result.

**Long-term follow-up.** Eighteen patients survived to discharge after ECPR. The mean duration of follow-up was 48.5 ± 12.2 months (range 6 to 68). Only one patient became vegetative with a severe neurologic deficit due to prolonged CPR (>60 min). Another patient, who was a victim of postcardiotomy left ventricular rupture and received 65 min CPR, had to have a limb amputated because of ischemia due to ECMO cannulation and was discharged

Table 3. Analysis of the Factors in Weaning and Survival by the Spearman Method

<table>
<thead>
<tr>
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<td>-0.3119</td>
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<td>-0.7521*</td>
<td>0.0008</td>
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<td>-0.3122*</td>
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<tr>
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<td>0.0104</td>
<td>-0.4203*</td>
<td>0.0133</td>
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<td>CK7</td>
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<td>0.0647</td>
<td>-0.5669*</td>
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<td>CK-MB1</td>
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<td>-0.1038</td>
<td>0.4685</td>
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<td>0.0590</td>
</tr>
<tr>
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<td>-0.4628*</td>
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<td>LA7</td>
<td>16</td>
<td>-0.6585*</td>
<td>0.0055</td>
<td>-0.7253*</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

*p < 0.05. The p values are two-tailed. The number after the factor abbreviations is the number of days of ECMO (e.g., BUN1 means the BUN level on the first day of ECMO).

Corr. Cf. = correlation coefficient; CPRD = cardiopulmonary resuscitation duration; Cre = creatinine; LA = lactic acid; other abbreviations as in Table 1.
with a clear consciousness. One patient with a pulmonary embolism died two years later due to the underlying ovarian malignancy, and the other patient receiving a heart transplant had a sudden death four years later; chronic rejection was suspected. Long-term follow-up of survivors was 88.9% (16/18) in the discharge group and 28.1% in the ECPR group.

DISCUSSION

Cardiopulmonary resuscitation has been widely used for cardiac arrest since the introduction of closed-chest cardiac massage. Several reports revealed only a 16% to 45% rate of initial response to CPR, a lower survival-to-discharge rate for in-hospital cardiac arrests (10% to 15%) (3,4,23,24), and an even worse outcome for prolonged resuscitation (8,25).

Multi-institutional trials of emergency CPB also revealed better survival than conventional CPR in the early 1990s (12,16). However, no single study in the last 10 years has analyzed the factors influencing weaning from ECPR and the survival of ECPR patients.

Previous studies of CPR showed that a witnessed arrest was associated with a favorable outcome in in-hospital resuscitation (3,23). We examined the pre-CPR status, such as witnessed or monitored arrests and different arrhythmias, and our conclusion differed from the conclusion of previous studies. The majority of the patients in this study received initial CPR (96.5%) in the hospital, and most of them (96.5%) had cardiac arrests that were witnessed. This might be the reason that the statistic could not show a difference. Unwitnessed arrests could have been excluded from the study because of the relatively uncertain arrest time, but we still included them (n = 2) to complete the data for patients treated with ECMO to rescue them from CPR.

Despite the fact that some reports revealed CPR in the VT/VF group was associated with better survival than in the non-VT/VF group (26), we could not draw a similar conclusion from our ECPR data. We believe it was ECMO that made the different result. The previously reported incidence of sustained return of spontaneous rhythm due to advanced cardiopulmonary life support (ACLS) (20.2% to 33.5%) (24,25) was considerably lower than that found in this study (94.7%). Early return of spontaneous rhythm in our group might contribute to active decompression of the heart by ECMO and provide immediate circulatory support to decrease progressive acidosis. Also, ECMO could protect and preserve the myocardium through increased tissue perfusion and provide better survival, regardless of different initial rhythms.

In our study, no one started ECMO support within the first 15 min of ACLS. This was because ACLS was tried first to sustain a return of spontaneous circulation before deciding to use ECMO, and it usually took more than 20 min to try ACLS and set up ECMO. Therefore, the duration between CPR and ECMO in this ECPR study was longer than that in any other previously reported series with conventional CPR. The CPR duration in survivors was 39.2 ± 13.7 min, which was significantly shorter than that of non-survivors (51.5 ± 11.3 min, p = 0.0014). A similar difference with less significance was found between weaned and non-weaned patients (p = 0.027). Our study confirmed again that a shorter CPR duration correlated with shorter weaning and better survival (Table 2). A recent study even found that CPR >10 min correlated with a very high mortality (>80%) (8,27). In our study, 100% of those whose CPR duration was <30 min were weaned from ECPR and survived; in those receiving CPR <60 min, the survival rate was acceptable, and the incidence of weaning was high. From this study, we conclude that ECMO can extend the CPR time to 60 min with an acceptable survival rate and an acceptable neurologic result, which is the great benefit of applying ECMO in CPR.

Our data revealed a significantly higher survival rate in the postcardiomyotomy group (p < 0.05). This was not related to the different CPR duration between the two groups, because the CPR duration of these two groups did not show a significant difference (47.4 min in the postcardiomyotomy group vs. 48.9 min in the non-postcardiomyotomy group, p > 0.05). Despite the fact that two patients in the postcardiomyotomy group had ventricular rupture with massive bleeding, the postcardiomyotomy ECPR group still showed better rates of weaning and survival. It might be argued that the postcardiomyotomy group should not have been taken into the study group, because it might represent a different group of patients. However, the postcardiomyotomy patients included in the study were not extending CPB after the operation due to difficulty of weaning from CPB, but they were patients who were weaned from CPB and collapsed later suddenly, followed by ECPR. We therefore still took them into the ECPR group.

Several possibilities for better survival in the postcardiomyotomy group might be speculated about: 1) they were pre-selected by virtue of their preoperative screening and expected to survive their original surgery in postcardiomyotomy ECPR; 2) the detection of arrest in the postcardiomyotomy ECPR patients was earlier because all the arrests happened within 24 h postoperatively; and 3) the possible detrimental factors or underlying anatomic factors had been corrected before ECMO, so that the patients could be weaned from CPB initially after surgery.

To our surprise, the subsequent interventional procedure did not increase weaning or survival rates. Even in the non-postcardiomyotomy group, subsequent interventional procedures did not reach statistical difference in weaning rates (p = 0.124), but they approached a statistical difference in survival rates (p = 0.069). This might be because the study group included patients with various etiologies leading to CPR and the sample size may not have been large enough to show the difference. When focusing on subgroups with an initial acute coronary syndrome (n = 22), subsequent intervention still did not play an important role in survival, which was due to a limited patient volume.
We tried to identify the factors correlated with weaning or survival by comparing biochemical data before and during ECMO support. Interestingly, myocardial function indicators (e.g., CK-MB) still played a significant part in both weaning and survival (p < 0.05). The renal function indicator (Cre) was also correlated to weaning (p < 0.05 for Cre3 and Cre7) and survival (p < 0.05). The finding confirmed the previous analysis study concerning the survival of patients in the postcardiomyotomy group who received ECMO (28, 29). However, with the advancement of supporting technology, injured myocardium and kidneys can be easily supported by ECMO and hemofiltration. Some selected patients could be converted from ECMO to ventricular assist devices for long-term support and transplantation.

Aspartate aminotransferase and LA had a good correlation with weaning (p < 0.05 for AST3, LA3, and LA7) and survival (p < 0.05 for AST3, AST7, LA1, and LA7). This correlation reflects the fact that persistent hepatic damage and slow reversibility of lactic acidosis are important in weaning and survival. Initial indicators (Cre, CK, and CK-MB on the first day) failed to show a good correlation and predict the outcome, but the factors by the third and seventh days of ECPR showed good correlation with outcome. Those who are interested in the efficacy of ECPR should take this finding into consideration. Not the initial damage, but that occurring during reperfusion several days later—especially on the third day—can predict survival. This finding deserved further investigation to prevent reperfusion injury by ECMO after CPR.

From the data, we tried to identify the levels at which different biochemical indicators might be used to predict weaning and survival. Table 4 describes the predictive levels of significant factors derived from Table 3 in different probabilities of survival and weaning. The predictive level of different factors shown in Table 4 was carefully calculated only for those factors with both significant correlation coefficients (p < 0.05) (Table 3) and significant logistic coefficients (β1) (p < 0.05) after logistic regression. There might be an overlap between the 95% confidence interval in some factors, and it may not be precise in predicting the outcome; but these data still could help physicians make rough predictions about survival or weaning from ECPR.

Only one surviving patient (5%) had a severe neurologic deficit after prolonged CPR followed by ECMO rescue. Although the neurologic outcome after conventional CPR usually carries an acceptable incidence of neurologic insult (23), the CPR duration of survivors was much less than that of those receiving ECPR in our study; this difference must be considered when comparing the results of our study with results from others. We speculate that a rapid return of circulation, immediate adequate support, and highly oxygenated blood to the brain by ECMO may be the key to achieving good cerebral resuscitation results, even after prolonged CPR. This is an important benefit supporting the application of ECMO in selected CPR cases.

**Study limitations.** Our study of ECPR efficacy is not a randomized, controlled study; and the pre-selection criteria for ECPR usually considers only those without previous cerebral injury who have had prolonged CPR and for whom a better outcome may be expected. The case number is not large, as well, so that only a few factors can be identified with significant associations to weaning or survival. The do-not-resuscitate policy may pre-select patients with a better outcome for continuous CPR.

Moreover, ECPR is more expensive than conventional CPR. The cost-effectiveness of ECPR deserves consideration before application is instituted. From our data, less neurologic defect was noted in survivors, which may be related to the withdrawal of treatment if a significant neurologic defect was found during ECPR.

**Conclusions.** Despite these limitations, our results reveal that ECMO can be used with prolonged CPR and renders acceptable survival with minimal neurologic insult in survivors. This surgically aggressive ECPR is proven effective in either the surgical or non-surgical group of patients. The ECPR result deserves further, randomized study in some groups of patients before a generalized application can be formulated.

**Acknowledgments**

We thank Dr. Matthew Huei-Ming Ma and Dr. Wen-Jone Chen for their assistance and referral of patients from the emergency department.

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**Table 4. Predictive Levels for Different Probabilities of Weaning and Survival**

<table>
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<th>Factors</th>
<th>Weaning</th>
<th>Survival</th>
<th>Weaning</th>
<th>Survival</th>
<th>Weaning</th>
<th>Survival</th>
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<td>CPRD</td>
<td>104 ± 52</td>
<td>65 ± 18</td>
<td>62 ± 35</td>
<td>36 ± 11</td>
<td>27 ± 20</td>
<td>13 ± 6</td>
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<td>Cre3</td>
<td>7.4 ± 3.7</td>
<td>—</td>
<td>5.0 ± 2.8</td>
<td>—</td>
<td>2.6 ± 2.1</td>
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</tr>
<tr>
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<td>—</td>
<td>381 ± 188</td>
<td>—</td>
<td>177 ± 116</td>
<td>—</td>
<td>&lt;30 ± 87</td>
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<tr>
<td>CK1</td>
<td>—</td>
<td>6,978 ± 3,591</td>
<td>—</td>
<td>609 ± 1,165</td>
<td>—</td>
<td>&lt;160 ± 3,032</td>
</tr>
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<td>—</td>
<td>20.8 ± 9.0</td>
<td>—</td>
<td>7.6 ± 5.3</td>
<td>—</td>
<td>0.3 ± 5.0</td>
</tr>
<tr>
<td>LA3</td>
<td>13.7 ± 6.6</td>
<td>6.6 ± 3.1</td>
<td>9.2 ± 4.9</td>
<td>3.0 ± 2.0</td>
<td>4.8 ± 3.6</td>
<td>0.2 ± 1.6</td>
</tr>
</tbody>
</table>

Data are presented as the mean value ± SE.

AST = aspartate aminotransferase (U/l); CK = creatinine kinase (U/l); CPRD = cardiopulmonary resuscitation duration (min); Cre = creatinine (mg/dl); LA = lactic acid (mM/l); Pp = predictive probability, as the probability p used in the ln(p/[1 − p]) of logistic regression.
REFERENCES