# Predicting Outcome in Pediatric Near-drowning

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**Abstract**

**Background :** Near-drowning is common in children and has a high mortality rate. Some survivors remain in a vegetative state after the accident and are a great burden to their family and society.

**Objectives :** To find out whether outcomes on near drowning can be reliably identified early in the course of illness.

**Method :** Medical records of 72 children admitted to Queen Sirikit National Institute of Child Health, Bangkok, Thailand, for treatment of near drowning from January 1993 to December 2001 were retrospectively studied. Stepwise multivariate discriminant analysis was used to identify the power of variables achieving highest overall accuracy in minimizing errors for predicting poor outcome in intact survivors.

**Results :** The patients were identified into three groups: functionally intact, vegetative and dead groups, it was found that a combination of physical examination in the emergency department (ED), the need for cardiopulmonary (CPR) in the ED, amount of adrenaline given during CPR, and high blood sugar achieved an overall accuracy of 83 per cent. When categorizing patients into good outcome *versus* poor outcome (the combination of the vegetative and dead group were the poor outcome group). The variables mentioned above achieved an overall accuracy of 98 per cent. Good outcome survivors could be correctly predicted with no error, but error occurred when poor outcome survivors were predicted to be good outcome in 3 per cent. Glasgow coma score $\geq 5$, the need for CPR in the ED and blood sugar > 300 mg/dl were selected clinical variables found to have optimum predictive abilities with an overall accuracy of 96 per cent, but showed an error of 6 per cent in predicting poor outcome from functional intact survivors (unpredicted good outcome).

**Conclusion :** From the present study discrimination analysis cannot accurately separate all intact survivors from the vegetative groups, but can prospectively differentiate unpredicted good outcome from vegetative or dead groups. When using only simple clinical classification systems, unpredicted

good outcome patients are detected. Since outcome cannot be accurately predicted in the ED, all near drowning victims should receive vigorous and aggressive treatment in the early course of illness and need close monitoring for respiratory complications and neurological signs.

**Key word** : Predicting Outcome, Pediatric Near-Drowning

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**J Med Assoc Thai 2003; 86 (Suppl 3): S501-S509**

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Submersion accidents continue to be a significant cause of morbidity and mortality in children worldwide[1-4]. The drowning rate is highest for children under the age of 5 years and between the age of 15 and 24 years. It is 4 times more frequent in males than in females and low-income group is more susceptible[4]. The mortality rate of near-drowning cases admitted to the hospital varies from 20 to 50 per cent[2,4]. Despite many studies aimed at developing predictors of outcomes, there is limited information that can be used as a prospective tool to guide the physician in limiting the level of interventions[5-10]. Once patients arrive in the ICU, monitoring of cardiopulmonary and neurological status and attention to electrolytes and acid-base status, needs to be continued. Thus, these patients are likely to have long hospital stays, high case fatality rates, a high case sequelae rate, and high hospitalization charges. In addition, after suffering from near drowning some victims survive in vegetative stages and cause a burden to their families[10].

This study reviewed the characteristics, hospital course and outcome of pediatric patients admitted to Queen Sirikit National Institute of Child Health, Bangkok, Thailand with the aim of investigating whether outcomes in near drowning cases can be reliably identified early in the course of illness.

## MATERIAL AND METHOD

The medical records of all children admitted to Queen Sirikit National Institute of Child Health, Bangkok, Thailand, for treatment of near drowning from January 1993 to December 2001 were retrospectively identified. Variables in this study include; age, sex, estimated submersion interval, why it happened, whether drowning was witnessed, condition of the patients on the scene, performance of bystander cardiopulmonary resuscitation, time taken to reach the hospital, condition at the hospital, the need for cardiopulmonary resuscitation in the emergency department (CPR in ED), amount of epinephrine given during CPR, initial temperature, pulse rate, respiratory rate, blood pressure, consciousness, Glasgow coma score (GCS), pH, base excess, $PaO_2$, $PaCO_2$, blood glucose, BUN, creatinine, blood electrolytes, SGOT, SGPT, duration of ventilation support and length of stay.

Outcome was identified into three groups. Patients with functional neurological recovery were classified as good outcome. Patients were classified as the vegetative group if survival occurred without functional recovery and the dead group if death occurred.

### Statistical analysis

Stepwise multivariate discriminant analysis to minimize Wilk's Lambda, calculating prior probabilities based on group size was used to identify the power of each variable and power of the combination of variables which most accurately predicted good, vegetative, or dead patient outcome. Patients were excluded if the variables used were not documented. The most predictive variable was recorded and eliminated from further use in this portion of the analysis. The process was repeated until all variables with the probability of $F < 0.05$ were recorded in order of

predictive ability. An identical procedure was again used to identify the variables, which most accurately categorized patients into good *versus* poor outcome (vegetative and dead group). Final discriminate analysis was performed entering all variables together to find the combination achieving optimal classification. Optimal classification was defined as highest overall accuracy after minimizing errors predicting poor outcome in intact survivors.

### Clinical classification

Using variables identified as most predictive, a simplified clinical classification system was then constructed and applied to the patient database. Variables were selected based on predictive utility in discriminant analysis evaluation, ability to minimize unpredictable good outcome patients (UGO), and the accuracy with which they could be obtained.

## RESULTS

Seventy-two patients were included in this study. Age ranged from 3 months to 14 $^{3}/_{12}$ years (mean 43 months, median 28months) and 70 per cent were males. Seventy-nine per cent of submersion events occurred in Bangkok, 20 per cent in suburban areas including Samut Prakan and Prathum Thani. The drowning was witnessed in only 23 cases. Submersion caused by neglecting the child for a while 66 per cent, accident 28 per cent, and suspected child abuse 5 per cent. Events occurred in a canal or river 44 per cent, swimming pool 25 per cent, waste water 12 per cent, fish pond 10 per cent, and bathtub 8 per cent. Resuscitations on the scene were done in 65 patients, methods used included: holding the child over the shoulder 40 per cent, chest compression 19 per cent, mouth to mouth 8 per cent, and combination of all methods 22 per cent. Data of submersion events were collected in 60 cases. Average submersion time was 11 minutes with a median of 7.5 minutes. After rescuing from submersion, 46 per cent of patients had spontaneous breathing after 5 minutes of resuscitation, while 54 per cent still had cyanosis and no tone after 5 minutes. Average time to reach the hospital was 34 minutes.

Upon arrival in the Emergency Department, 53 children needed emergency management which included; cardiopulmonary resuscitation (CPR) in 25 children, endo-tracheal insertion and respiratory support without cardiac massage in 39 children, airway clearance and gastrointestinal decompression in 14 children. Of twenty-five patients who received CPR, 13 died, 11 survived in a vegetative state and 1 survived with functional intact outcome. Only 10 out of 25 had information about the time spent for CPR. Average time spent for CPR was 17.5 minutes (range from 10 to 30 minutes). Two children with 30 minutes of cardiopulmonary resuscitation died after ICU admission for 2 and 25 days respectively. Of fifty-seven who survived (40 intact, 17 vegetative), 12 received CPR, but only one had good outcome. An initial Glasgow coma score of 3 was recorded in 11 patients, 9 died, and 2 survived in a vegetative stage. Of seventeen children with Glasgow coma score between 4 to 5, 12 survived in a vegetative stage and 5 died. Of 44 patients having a documented Glasgow coma score $\geq 6$, 3 survived in a vegetative state, and 41 survived intact. Outcome of 72 patients included; 41 (57%) functionally intact, 17 (24%) vegetative, and 14 (19%) dead. Mean values for selected variables in the good, vegetative, and dead outcome groups are shown in Table 1.

### Statistical analysis results

The accuracy of each individual variable to predict the outcome of the patient is shown in Table 2. Amount of epinephrine given during CPR and Glasgow coma score showed good predictive ability. Group of variables in physical examination, treatment and history in predicting outcome are shown in Table 3. It was noted that variables in physical examination showed a higher predictive ability. Group of investigation including base excess, blood sugar, SGOT, SGPT showed poor accuracy in predicting outcome. All variables collected but not listed in Table 2 were not predictive.

The best outcome classifications achieved by discriminant analysis entering all variables together are shown in Table 4. Group of variables that were analyzed to categorize the patients into good, vegetative and dead outcome included; physical examination (pulse rate, respiration rate, systolic BP, diastolic BP, Glasgow coma score), the need for CPR in the ED, amount of adrenaline given during CPR, and high blood sugar, achieved an overall accuracy of 83 per cent. Discriminant analysis showed misclassification of functional intact group in 4.8 per cent, of the vegetative group in 35.3 per cent, of the dead group in 28.6 per cent as shown in Table 4.

Combining the vegetative and dead groups as the poor outcome group made categorization of the outcome into two groups. Stepwise multivariate discriminant analysis was again repeated, physical exami-

**Table 1. Comparison of good outcome group and vegetative/dead groups for study variables.**

| | Variables outcome | Good outcome outcome | Vegetative | P-value |
|---|---|---|---|---|
| Child's age | 4.1085 ± 3.6406 | 3.92 ± 3.58 | 1.79 ± 1.25 | 0.078 |
| Duration of submersion | 5.56 ± 5.72 | 10.47 ± 10.40 | 15.71 ± 12.22 | 0.001 |
| Pre-hospital period | 38.17 ± 31.10 | 20.29 ± 29.70 | 26.14 ± 26.07 | 0.102 |
| CPR duration | 00 ± 00 | 0.65 ± 0.49 | 7.86 ± 11.04 | < 0.0001 |
| Amount of adrenaline given during CPR | 00 ± 00 | 1.06 ± 1.6 | 2.07 ± 1.27 | < 0.0001 |
| Level of consciousness | 1.46 ± 0.67 | 2.94 ± 0.24 | 3 ± 00 | < 0.0001 |
| Glasgow coma score | 12.17 ± 2.71 | 4.76 ± 1.44 | 3.43 ± 0.65 | < 0.0001 |
| Systolic BP | 101.46 ± 15.62 | 42.82 ± 47.58 | 5.36 ± 20.04 | < 0.0001 |
| Diastolic BP | 61.41 ± 10.12 | 24.76 ± 27.92 | 3.57 ± 13.6 | < 0.0001 |
| Pulse rate | 121.17 ± 29.44 | 43.53 ± 53.84 | 14.29 ± 53.45 | < 0.0001 |
| Respiration rate | 35.95 ± 15.99 | 11.53 ± 19.10 | 00 ± 00 | < 0.0001 |
| Temperature | 37.08 ± 0.76 | 36.41 ± 2.76 | 35.85 ± 1.17 | 0.031 |
| Blood pH | 7.36 ± 0.2 | 7.42 ± 0.12 | 7.34 ± 0.17 | 0.001 |
| Base excess | -2.17 ± 3.2635 | -4.58 ± 4.92 | -12.72 ± 8.4 | < 0.0001 |
| $CO_2$tension | 35.03 ± 6.99 | 30.54 ± 9.78 | 31.66 ± 14.26 | 0.202 |
| $O_2$ tension | 135.11 ± 128.53 | 241.28 ± 206.28 | 156.2 ± 153.1 | 0.064 |
| Blood sugar | 138.77 ± 99.53 | 197.31 ± 76.6 | 221.5 ± 227.9 | < 0.0001 |
| BUN | 11.49 ± 3.7 | 16.69 ± 13.25 | 15.7 ± 6.63 | 0.033 |
| Blood creatinine | 0.497 ± 0.15 | 0.60 ± 0.35 | 15.7 ± 6.63 | 0.155 |
| SGOT | 83.75 ± 95.57 | 124.75 ± 104.4 | 494 ± 396 | 0.005 |
| SGPT | 51.62 ± 78.5 | 79 ± 74.89 | 236.5 ± 208.7 | 0.022 |
| Sodium | 135.36 ± 3.66 | 134.14 ± 4.04 | 132.07 ± 7.14 | 0.073 |
| Potassium | 3.95 ± 0.619 | 3.89 ± 0.51 | 4.02 ± 1.08 | 0.881 |
| Length of stay | 5.46 ± 4.59 | 30.12 ± 19.8 | 9.29 ± 10.17 | < 0.0001 |
| Duration of Ventilation support | 0.37 ± 0.99 | 8.59 ± 5.53 | 3.72 ± 5.96 | < 0.0001 |

nation (pulse rate, respiration rate, systolic BP, diastolic BP, Glasgow coma score), the need for CPR in the ED, amount of adrenaline given during CPR, and high blood sugar, achieved an overall accuracy of 98 per cent. Good outcome survivors could be correctly predicted with no error, but error occurred when poor outcome survivors were predicted to be good outcome in 3 per cent as shown in Table 4.

Variables from physical examination, emergency treatment, and laboratory investigation as shown in Table 2 were selected to classify the patients into good and poor outcome groups to try to minimize unpredicted good outcome patients. Three variables including: initial Glasgow coma score ≥ 5, the need for CPR in the ED and blood sugar > 300 mg/dl, were found to have optimum predictive abilities. Patients meeting all 3 criteria were predicted to have a poor outcome and all others were predicted to have a good outcome. Classification using this method resulted in an overall accuracy of 96 per cent, but predicting a poor outcome in 2 functionally intact survivors (UGO) resulted in error of 6 per cent as shown in Table 5.

The actual outcome of patients classified by the clinical criteria into good and poor outcome categories is shown in Table 6. Of thirty-seven cases who were correctly classified as good outcome, no one required CPR in the ED, 6 had apnea and needed endotracheal tube (E-T) tube with respiratory support within 48 hours, 36 had Glasgow coma score of more than 6, 1 had Glasgow Coma Score of 6, 32 had blood sugar less than 200 mg/dl, 5 had blood sugar between 200-250 mg/dl.

One patient who was predicted to have good outcome but actually became vegetative had an estimated submersion time of 10 minutes, Glasgow coma score of 6, needed E-T tube with respiratory support within 24 hours. She developed decorticate posture during admission and had blood sugar of 211 mg/dl. Of twenty-nine whose outcome was accurately predicted to be poor, 24 required CPR in the ED, 5 had apnea and needed E-T tube with respiratory support, 26 had Glasgow coma score less than 6, 2 had Glasgow coma score of 6, 1 had Glasgow coma score of 8. Fifteen patients had blood sugar less than 200 mg/dl, 5 had blood sugar between 200-300 mg/dl, 5

**Table 2. Discriminant analysis classification of predictive ability in each variable.**

| Variables | Predictive ability (%) |
|---|---|
| Duration of submersion | 61.1 |
| Drowning was witnessed | 54.2 |
| On the scene condition | 63.9 |
| Level of consciousness | 70.8 |
| Glasgow coma score | 79.2 |
| Pulse rate | 73.6 |
| Respiratory rate | 69.4 |
| Systolic blood pressure | 72.2 |
| Diastolic blood pressure | 76.4 |
| Decorticate or decerebrate posture | 69.4 |
| Cardiopulmonary resuscitation in the ED | 73.6 |
| CPR duration in ED | 65.3 |
| Adrenaline received during CPR | 80.6 |
| Duration of ventilation support | 69.4 |
| Length of stay | 66.7 |
| Base excess | 63.9 |
| Blood sugar | 66.7 |
| SGOT | 55.6 |
| SGPT | 59.3 |

had blood sugar between 300-400 mg/dl, 4 had blood sugar more than 400 mg/dl.

The two patients predicted to have poor outcome but survived intact (unpredicted good outcome or UGO patients) represented 6.4 per cent of all patients predicted to have a poor outcome (Table 6). One of the UGO patients was a $3\ ^{9}/_{12}$ year old girl. She was submerged in the canal for 5 minutes and rescued with neither pulse nor heart rate and needed CPR in the ED. She had initial blood sugar of 682 mg/dl. By 12 hours after submersion, she developed purposeful movements and was successfully extubated. The second UGO patient was $2\ ^{6}/_{12}$ years old. She developed convulsion and apnea on arrival at the ER, and an E-T tube was immediately inserted without the need for CPR. She developed purposeful movements by 48 hours and was also extubated successfully.

## DISCUSSION

Studies on the prognostic factors of near-drowning showed that the factors which correlated with outcome included historic variables such as duration of submersion[8], types of water, patients' temperature[11,12], and intervention on the scene[13], treatment variables such as the need for CPR in the ED [13-15], apnea[16], depth of coma[17], neurological response to therapy[18], and laboratory variables such as blood sugar[19]. In the present study variables such as duration of submersion, the need for CPR in ED, physical examination in ED, the initial Glasgow coma score, blood pH, base excess and blood sugar correlated significantly with the outcome.

Once CPR was needed in the ER, the outcome was considered to portend death or vegetative

**Table 3. Discriminant analysis classification of predictive ability in group variables.**

| Group variables | Predictive ability (%) |
|---|---|
| History (Duration of submersion; Drowning was witnessed; On the scene condition) | 68.1 |
| Physical examination (Glasgow coma score; Pulse rate; Respiration rate; Blood pressure) | 81.9 |
| Treatment (CPR in ED; adrenaline received during CPR in ED; E-T tube insertion in ED) | 80.6 |

**Tabel 4. Classification results using discriminant analysis.**

| Actual outcome | Outcome categories predicted outcome | | | | Actual outcome | Outcome categories predicted outcome | | |
|---|---|---|---|---|---|---|---|---|
| | Intact | Vegetative | Dead | % Error | | Good | Poor | % Error |
| Intact | 39 | 2 | 0 | 4.9 | Good | 39 | 0 | 0 |
| Vegetative | 1 | 11 | 5 | 35.3 | Poor | 1 | 29 | 3.3 |
| Dead | 0 | 4 | 10 | 28.6 | | | | |

Categorization into intact, vegetative and dead outcome is shown on the left and categorization into good and poor outcome is shown on the right. Three cases were excluded due to missing values.

**Table 5. Classification results using clinical classification method.**

| Actual outcome | Predicted outcome | | |
|---|---|---|---|
| | Good | Poor | % Error |
| Good | 37 | 2 | 5.1 |
| Poor | 1 | 29 | 3.3 |

state. In the present study of 25 patients who received CPR, 13 died, 11 survived in a vegetative state and only one survived functionally intact (4%). However, 5 studies reported functional recovery in 0 per cent (14), 12 per cent(13), 15 per cent(12), 18 per cent(17), and 21 per cent(8), (about 14% overall average) of drowning victims who required CPR in the ED.

A previous study by Christensen et al to identify combinations of variables most reliable to predict good and poor outcome by using discriminant analysis was employed in 274 near drowning patients. A combination of physical findings in the ED, performance of CPR in the ED, and initial pH achieved 95 per cent accuracy. There was an error predicting death in 6 intact survivors. It was shown that no combination of variables could accurately separate all intact survivors from the vegetative and dead groups. Clinical classification method using need for CPR in the ED, apnea and coma in the ED and initial pH < 7.00 achieved 93 per cent overall accuracy, and among the patients predicted to have a poor outcome, 5 (6.3%) survived functionally intact (UGO)(20).

The results of the present study are different from the previous one since using discriminant analysis gives more advantage than the simple clinical system in minimizing unpredictable good outcome patient (error of 0%). However, of patients predicted to have good outcome, 29 (98%) survived intact, 1 (3%) survived in a vegetative state. Clinical classification in the present study is different from Christensen's study, a combination of 3 variables including Glasgow coma score ≥ 5, the need for CPR in the ED and blood sugar > 300 mg/dL showed good predictive ability to categorize the patients into intact group but did not accurately separate all intact patients from vegetative patients. In addition, using these three simple variables could not categorize the unpredicted good outcome (UGO) patients that represented 6 per cent of all patients who were predicted to have a poor outcome. It implies that a decision based on clinical classification alone, 6 per cent of the patents who were predicted to have a vegetative or dead outcome will have no chance to survive intact if withdrawal or withholding aggressive treatment was done early in the course of treatment.

The goal in the treatment of near-drowning victims are to preserve life and to minimize sequelae. Attempts to prolong life regardless of functional outcome require all possible therapies being given to all patients, hence, prediction of outcome is unnecessary. On the contrary, when intact outcome is needed, prediction of good or poor outcome is the most important characteristic; misclassification between vegetative and dead groups is not of much concern because both vegetative survival and death are unwanted. Hence, accurate prediction of good and poor outcome is essential for guiding clinical decisions, while preoccupation with prediction of vegetative or dead outcome has little clinical use.

Many studies tried to develop criteria to differentiate the patients into good and poor outcome. Criteria such as failure to respond to advanced life support within 25 minutes(8) which indicate poor prognosis is not widely used because of anecdotal experience with victim recoveries. Graf et al suggested that outcome for pediatric near-drowning victims can be predicted with four simple variables: coma, absence of papillary light reflex, initial blood glucose and sex(7). Again those criteria could not apply to other studies as well as the present study. The

**Table 6. Predicted good and poor outcome using clinical classification system and actual outcome.**

| Near drowning cases (n = 69) | | | | | |
|---|---|---|---|---|---|
| Predicted intact (n = 38) | | | Predicted vegetative/dead (n = 31) | | |
| Actual intact | Actual vegetative | Actual dead | Actual intact | Actual vegetative | Actual dead |
| 37 | 1 | 0 | 2 | 17 | 13 |

present findings and the other opinions[20] suggest that no index or score applied in the ED will predict outcome with complete accuracy. However, an important thing to keep in mind is that the primary mechanism of near-drowning neurological injury is caused by hypoxic-ischemic insult. Serial neurological examinations over time can provide additional prognostic information and rapid recovery within 48 hours is a reasonable observation period for patients with predicted poor outcome[7,20]. It is evident that the limits beyond which intact survival is excluded cannot be established until other measures of neuronal injury become available[7]. The present study supports this finding since two of the authors' unpredicted good outcome patients were in serious condition at the beginning but neurological improvement occurred at 12 and 48 hours respectively after injuries and finally both patients recovered intact.

In conclusion the present findings suggest that physical findings, the need for CPR in the ED, the amount of epinehrine given during CPR, and high blood sugar, cannot accurately separate all intact survivors from the vegetative group, but can differentiate unpredicted good outcome from the vegetative or dead groups. However, using clinical classification systems including Glasgow coma score $\geq 5$, the need for CPR in the ED and blood sugar > 300 mg/dL will misclassify unpredicted good outcome in 6 per cent. Although evidence from the present study and another study also shows that observation and therapy for 48 hours improves certainty, it does not eliminate the possibility of error[19]. Hence, it is suggested that all pediatric submersion patients should receive aggressive treatment at the beginning, then search for undermining factors to prognosticate the patients, but support termination of therapy may have to be considered before absolute prognostic certainty is established. Withdrawal and withholding therapy may be considered together with the victim's parents if the patients could not recover functionally. Finally, pediatricians should emphasize the preventive measures during health supervision visits in well-child care and community campaigns for prevention as well as education.

## ACKNOWLEDGEMENTS

The authors wish to thank Dr. Sorasak Lochindarat, Dr. Suwanna Roungkanchanasate, Dr. Boonchian Pansatiankul for their helpful advice and also Dr. Surapee Roansuwan, Director of Queen Sirikit National Institute of Child Health for her permission to carry out this study.

(Received for publication on May 14, 2003)

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# การทำนายผลลัพธ์ของภาวะเด็กจมน้ำ

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**ความเป็นมา** : ภาวะจมน้ำในเด็กเป็นอุบัติเหตุที่พบได้บ่อย มีอัตราตายสูง และผู้ที่รอดชีวิตมักเกิดความพิการทางสมองตามมาทำให้ครอบครัวและสังคมต้องรับภาระในการดูแลเด็กกลุ่มนี้

**วัตถุประสงค์** : เพื่อศึกษาว่าการทำนายผลลัพธ์ของภาวะจมน้ำในเด็กตั้งแต่ระยะแรกรับไว้ในโรงพยาบาลเชื่อถือได้เพียงใด

**วิธีการศึกษา** : ศึกษาจากรายงานของผู้ป่วยที่ได้รับการวินิจฉัยว่าจมน้ำ ณ สถาบันสุขภาพเด็กแห่งชาติมหาราชินี ระหว่างเดือนมกราคม 2536 ถึงเดือนธันวาคม 2544 จำนวน 72 ราย โดยแบ่งผู้ป่วยออกตามผลลัพธ์ จากนั้นใช้สถิติวิเคราะห์จำแนกกลุ่ม วิเคราะห์ว่ากลุ่มปัจจัยใดที่ให้ค่าความสามารถในการทำนายผลลัพธ์ได้สูงสุดและเหมาะสมที่สุด

**ผลการศึกษา** : เมื่อแบ่งผู้ป่วยเป็น 3 กลุ่ม ได้แก่ กลุ่มรอดชีวิตปกติ กลุ่มรอดชีวิตที่พิการทางสมอง และกลุ่มเสียชีวิต พบว่าตัวแปรจาก การตรวจร่างกายแรกรับ ความต้องการในการฟื้นคืนชีพขณะมาถึงห้องฉุกเฉิน จำนวนครั้งที่ให้ Epinephrine ขณะฟื้นคืนชีพ และระดับน้ำตาลในกระแสเลือดสูง สามารถทำนายผลลัพธ์ถูกต้อง 83% แต่ถ้าแยกกลุ่มผลลัพธ์ของผู้ป่วยออกเป็น 2 กลุ่ม คือกลุ่มดี และกลุ่มไม่ดี (โดยรวมกลุ่มที่รอดชีวิตโดยพิการทางสมองหรือเสียชีวิตเข้าด้วยกัน) แล้วใช้สถิติวิเคราะห์จำแนกกลุ่มด้วยปัจจัยข้างต้น พบว่าสามารถทำนายถูกต้อง 98% โดยไม่มีความผิดพลาดของการจำแนกเด็กไปอยู่ในกลุ่มพิการหรือเสียชีวิตโดยผลลัพธ์จริงเป็นเด็กปกติเลย แต่เกิดความผิดพลาด 3% จากการจำแนกผู้ป่วยไปอยู่ในกลุ่มปกติแต่ผลลัพธ์จริงมีความพิการทางสมอง หลังจากนำปัจจัยทางคลินิกที่ประเมินได้ง่าย ๆ 3 อย่างมาใช้จำแนกเด็กได้แก่ Glasgow coma score ≥ 5 ความต้องการในการกู้ชีพขณะมาถึงห้องฉุกเฉิน และระดับน้ำตาลในเลือดสูง > 300 mg/dL พบว่าสามารถจำแนกผลลัพธ์ได้ถูกต้อง 96% แต่เกิดความผิดพลาดในการจำแนกเด็กไปอยู่ในกลุ่มพิการหรือเสียชีวิตโดยผลลัพธ์จริงเป็นเด็กปกติถึง 6%

**สรุป** : การนำวิธีการทางสถิติในการจำแนกกลุ่มมาใช้ในการศึกษาครั้งนี้ช่วยเป็นแนวทางในการทำนายผลลัพธ์ของผู้ป่วยได้แต่ยังมีความผิดพลาดของการทำนายอยู่ ส่วนการนำอาการทางคลินิกง่าย ๆ มาจำแนกผู้ป่วยมีความผิดพลาดในการจำแนกเด็กไปอยู่ในกลุ่มผลลัพธ์ไม่ดีทั้ง ๆ ที่ผลลัพธ์จริงดี เนื่องจากยังไม่สามารถทำนายผลลัพธ์ของผู้ป่วยได้ถูกต้องทั้งหมด ในการดูแลผู้ป่วยระยะแรกจึงต้องให้การรักษาเต็มที่และเฝ้าระวังปัญหาทางระบบหายใจและการเปลี่ยนแปลงทางระบบประสาทของผู้ป่วยอย่างใกล้ชิด

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