Diagnosis of Corticosteroid Insufficiency in Thai Patients with Septic Shock

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Background: *The reported incidence of critical illness-related corticosteroid insufficiency (CIRCI) varies widely, depending on the patient population studied and the diagnostic criteria used. Surviving Sepsis Campaign guidelines suggest that corticosteroid therapy should be considered for adult septic shock when hypotension responds poorly to adequate fluid resuscitation and vasopressors, regardless of any results of diagnostic tests. However, steroid treatment may be associated with an increase risk of infection. This study aims to identify the best diagnostic tool for predicting responsiveness to corticosteroid therapy in Thai septic shock patients with poorly responsive to fluid resuscitation and vasopressors.*

Material and Method: *Twenty-nine septic shock patients who were poorly responsive to fluid therapy and vasopressors were studied. A baseline serum total cortisol was measured in all patients and then 250 mcg corticotropin was injected to patients. Cortisol level was obtained 30 and 60 minutes after injection. All patients were given hydrocortisone (100 mg IV, then 200 mg IV in 24 hrs for at least 5 days). Patients were considered steroid responsive if vasopressor agent could be discontinued within 48 hrs after the first dose of hydrocortisone.*

Results: *Hospital mortality was 62% in which 45% of the patients were steroid responsive. Baseline serum cortisol was 27.6 $\pm$ 11.4 μg/dl in the steroid-responsive patients compared with 40 $\pm$ 16.9 μg/dl in the steroid-nonresponsive patients ($p = 0.03$). The area under the ROC curves for predicting steroid responsiveness was 0.72 for baseline cortisol level. Serum cortisol level of 35 μg/dl or less was the most accurate diagnostic threshold to determine hemodynamic response to hydrocortisone treatment ($p = 0.04$). Using baseline cortisol level of $\leq$ 35 μg/dl to diagnose adrenal insufficiency, the sensitivity was 85%, the specificity was 62% and the accuracy was 72%. A use of (Δ cortisol) showed sensitivity of 50%, specificity of 30% and accuracy of 41%.*

Conclusion: *Baseline cortisol level $\leq$ 35 μg/dl is a useful diagnostic threshold for diagnosis of steroid responsiveness in Thai patients with septic shock and ACTH stimulation test should not be used.*

Keywords: *Septic shock, Steroid, Diagnosis, Corticosteroid, Diagnostic test*

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Septic shock is a major cause of death in Thai patients. It may cause reversible dysfunction of the hypothalamic-pituitary adrenal (HPA) axis[1]. The mechanisms are likely including decreased production of corticotropin-releasing hormone (CRH), adrenocorticotrophic hormone (ACTH), and cortisol and the dysfunction of their receptors[2]. Inadequate corticosteroid activity for the severity of the illness of a patient is described by the term "critical illness-related corticosteroid insufficiency" (CIRCI)[3]. The report incidence of this condition varies widely, depending on the patient population studied and the criteria used to make the diagnosis.

The role of corticosteroid in patients with septic shock remains controversial. Study by Annane et al[4] showed that 7-day treatment with low doses of hydrocortisone and fludrocortisone significantly reduced the risk of death in patients with septic shock

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and relative adrenal insufficiency without increasing adverse events. But recent CORTICUS study[5] only showed a beneficial effect of stress doses of hydrocortisone on the time interval to shock reversal and not on mortality. In addition, treatment with hydrocortisone increased incidence of superinfection and new septic episodes. Based on the two largest randomized, placebo-controlled trials, Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock[6] suggest intravenous hydrocortisone be given to adult septic shock patients only after blood pressure is identified to be poorly responsive to fluid resuscitation and vasopressor therapy (Grade 2C). It is not clear that treatment should be based on the results of adrenal function testing.

One major problem intensive care unit (ICU) physicians are faced with is to determine which are the best diagnostic criteria for CIRCI in patients with septic shock. Decisions have been based on the measurement of a random total serum cortisol or the change in the serum cortisol in response to 250 μg of synthetic ACTH (ACTH stimulation test), the so-called delta cortisol (Δ cortisol)[2]. Marik et al[7] concluded that a random serum cortisol concentration of less than 25 μg/dL in patients with septic shock was a better discriminator of adrenal insufficiency than the standard (250 μg) and the low-dose (1 μg) corticotropin stimulation tests as assessed by the hemodynamic response to steroid replacement. Annane et al[8] have reported that adrenal insufficiency determined by metyrapone testing in patients with severe sepsis/septic shock is likely when baseline cortisol levels are less than 10 μg/dl or delta cortisol is less than 9 μg/dl and unlikely when cosyntropin-stimulated cortisol level is 44 μg/dl or greater or delta cortisol is 16.8 μg/dl or greater. However, reference tests including insulin tolerance test and metyrapone stimulation test are both impractical and unsafe in the setting of critical illness[9].

In Thailand, like other Asian countries, where people frequently use herbal medicine which may include steroid components, may have different diagnostic criteria of CIRCI. However, there has not been a study to validate diagnostic tests in Asian countries. This study was conducted to determine the best diagnostic test to detect CIRCI in Thai patients with septic shock as assessed by the hemodynamic response to steroid treatment.

Material and Method

Study Design and Patient Population

The proposed clinical research is a prospective observational study conducted in Siriraj Hospital, a tertiary university hospital, Bangkok, Thailand. Patients were enrolled from June 2008 to December 2008, after providing written informed consent from the patients themselves or their relatives. The study protocol was approved by the hospital ethics committee.

All consecutive patients hospitalized in general medical wards and Medical intensive care unit were prospectively enrolled in the study if they had septic shock. As defined by the American College of Chest Physicians/Society of Critical Care Medicine criteria[10], septic shock was sepsis with hypotension of 90 mmHg or less or a drop of 40 mmHg or more despite adequate fluid resuscitation along with the presence of organ hypoperfusion. Moreover, patients were included only if they had evidence of hypotension which poorly responded to fluid resuscitation and needed vasopressor therapy (Dopamine > 5 μg/kg/min or any dose of Norepinephrine or Epinephrine). Patients with the age of less than 18 years, pregnancy, prior history of adrenal insufficiency, and infection with human immunodeficiency virus were excluded. We also excluded those patients who had received corticosteroid, etomidate or other drugs known to suppress adrenal function within the previous month.

Study protocol

Within 48 hours following the onset of septic shock, a standard (250 μg) corticotropin stimulation test was performed in all patients. For this plasma samples were drawn before (T0), at 30 (T30) and at 60 (T60) min after the administration of 250 μg of corticotropin to analyze cortisol concentration using the electrochemiluminescence immunoassay method. As described in the original study[4], cortisol response to corticotrophin was determined by the difference between T0 and the highest of the T30 and T60 concentrations (Δ cortisol). Responder of ACTH stimulation test was defined as Δ cortisol > 9 μg/dl.

According to Surviving Sepsis Campaign guidelines intravenous hydrocortisone should be given to adult septic shock patients after blood pressure is identified to be poorly responsive to fluid resuscitation and vasopressor therapy. Consequently, after completion of the standard corticotropin stimulation test, all enrolled patients were treated with hydrocortisone 100 mg bolus intravenously then 200 mg intravenous drip in 24 hours for at least 5 days. Hemodynamic effects were monitored by blood pressure monitoring and vasopressor doses until 48 hours later. Steroid responsiveness was defined as when patients could be

weaned off of vasopressor therapy within 48 hours of the first hydrocortisone dose[11]. We calculated the sensitivity and specificity of different diagnostic criteria using the hemodynamic response to steroids (steroid responsiveness) as a marker of CIRCI[12,13].

Data collection

The following variables were recorded; general characteristics including age, sex and preexisting disease; severity of illness as assessed by Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment(SOFA) scores; clinical data including duration of shock before enrollment, need for mechanical ventilation, volume of fluid in first 24 hours, type and initial dose of vasopressors, interval from shock onset to initial dose of antibiotics, type of infection (community-acquired or hospital-acquired) and source of infection. Laboratory variables including serum albumin, lactate, blood cultures, and cultures of specimen drawn from the site of infection were recorded.

Follow-up

All patients were followed up for 28 days from the study enrollment. The records of the following data were collected daily: vital signs, vasopressor dose, adverse events including hyperglycemia (capillary blood glucose $\geq$ 200 mg/dl), hypernatremia (serum sodium $\geq$ 150 mmol/l) and evidence of superinfection. Hospital death and 28-day mortality were also recorded.

Statistical Analysis

Numerical variables were expressed as mean $\pm$ SD and categorical variables were showed as number of patients (percentages). Sensitivity, specificity and diagnostic accuracy of different baseline cortisol levels and Δ cortisol values measured after ACTH stimulaton test in predicting the hemodynamic response to corticosteroid treatment were calculated. Receiver operating characteristic (ROC) curves were constructed to determine the cut-off value of baseline serum cortisol concentration that was the most accurate predictor of the hemodynamic response to corticosteroids. For comparison between groups, we conducted univariate analyses using Chi-square analysis with Fisher's Exact test for categorical data and t test for Numerical data. Multivariate analyses were performed by Forward Stepwise Logistic regression model to evaluate variables differencing between groups. All statistics were computed using the SPSS software, version 16.0 (SPSS, Chicago, IL). Probability value of less than 0.05 indicated statistical significance.

Results

Twenty-nine patients were included. Twenty were male and 9 were female. The average age of the patients was 65.2 $\pm$ 14.7 yrs. Table 1 summarizes baseline demographic and physiologic parameters regarding hemodynamic response to hydrocortisone therapy. There were no significant differences between steroid-responsive groups and steroid-nonresponsive patients with respect to age, gender, pre-existing diseases, source and type of infection, and need of mechanical ventilator. Hospital mortality was 62.1%. Interestingly, mean baseline cortisol level of non-survivors trends toward higher levels than that of survivors; however, it is not significant (36.5 $\pm$ 15.1 vs. 31.0 $\pm$ 17.0; p = 0.37).

According to Surviving Sepsis Campaign guidelines, all enrolled patients received hydrocortisone 300 mg/day. Among all patients, hemodynamic responsiveness to corticosteroid treatment (steroid responsive) was observed in 13 patients (44%). Baseline or stress cortisol level was 27.6 $\pm$ 11.4 µg/dl in the steroid-responsive patients compared with 40 $\pm$ 16.9 µg/dl in the steroid-nonresponsive patients (p = 0.03). Univariate analysis demonstrated that steroid-responsive patients had significantly lower APACHE II scores, needed a lower norepinephrine dose and had a lower baseline cortisol level than steroid-nonresponsive patients did (p = 0.03, 0.04 and 0.03, respectively). However, using multivariate analysis, baseline cortisol level was the only significantly different variable between groups (p = 0.02).

The area under the ROC curve of baseline cortisol level for diagnosis of CIRCI was 0.72 (p = 0.04). Baseline cortisol level of $\leq$ 35.06 µg/dl was the best cut-off value for predicting hemodynamic responsiveness to corticosteroid therapy, which was associated with a sensitivity of 85%, a specificity of 62%, a positive predictive value of 65%, a negative predictive value of 83% and an accuracy of 72%. Eighty-five percent (11/13) of steroid-responsive patients had stress cortisol level $\leq$ 35 µg/dl. Table 2 shows diagnostic accuracy of different cut-off points of cortisol level.

Sensitivity and specificity of ACTH stimulation test using Δ cortisold $\leq$ 9 µg/dl for discriminating steroid responsiveness was 50% and 30%, respectively (p = 0.41). Even if we used different levels of Δ cortisol as diagnostic criteria of ACTH stimulation test, all threshold values were not significantly associated with hemodynamic response to corticosteroid treatment (Table 3).

Table 1. Patients characteristics regarding hemodynamic response to hydrocortisone therapy

	steroid-responsive (n = 13)	steroid-nonresponsive (n = 16)	total (n = 29)
Age (yr)	67.4 ± 14.9	63.4 ± 14.8	65.2 ± 14.7
Sex : male	11 (84.6)	9 (56.2)	20 (68.9)
Preexisting disease			
hypertension	3 (23)	7 (44)	10 (22.7)
diabetes mellitus	3 (23)	4 (25)	7 (15.9)
liver disease	4 (31)	3 (19)	7 (15.9)
neurological disease	2 (15)	3 (19)	5 (11.4)
CKD or ESRD	0	4 (25)	4 (9.1)
Others	2 (15)	6 (37)	8 (27.6)
Use of mechanical ventilation	10 (76.9)	12 (75)	22 (75.9)
Shock onset (hrs)	12.6 ± 12.2	16.2 ± 12.9	14.6 ± 12.5
APACHE II	21.2 ± 5.6	26.9 ± 7.1	24.3 ± 7*
SOFA	11.4 ± 3.6	12.9 ± 3.8	12.2 ± 3.7
Albumin (mg/dl)	2.7 ± 0.9	2.5 ± 0.8	2.6 ± 0.8
Lactate (mg/dl)	5.8 ± 6.9	8.7 ± 8.4	7.4 ± 7.7
Total fluid received in 1st day(cc)	4,276 ± 1,619	5,485 ± 2,461	4,943 ± 2,178
Dopamine dose (□g/kg/min)	4.57 ± 1.76	13.4 ± 7.73	9.61 ± 7.29
Norepinephrine dose (□g/kg/min)	0.14 ± 0.09	0.26 ± 0.19	0.21 ± 0.17*
Time to antibiotic start (hr)	4.0 ± 6.6	2.4 ± 4.1	3.1 ± 5.4
Type of infection			
community-acquired	8 (61.5)	8 (50)	16 (55.2)
hospital-acquired	5 (38.5)	8 (50)	13 (44.8)
Source of infection			
Lung	7 (53.8)	5 (31.2)	12 (41.4)
urinary tract	2 (15.4)	4 (25)	6 (20.7)
Intra-abdominal	2 (15.4)	1 (6.2)	3 (10.3)
skin and soft tissue	0	1 (6.2)	1 (3.4)
culture from site of infection: positive	5 (38.4)	8 (50)	13 (52.9)
hemoculture : positive	6 (46.2)	6 (37.5)	12 (41.4)
Appropriateness of antibiotic			
appropriate	12 (92.3)	15 (93.8)	27 (93.1)
Baseline cortisol level(T0)	27.6 ± 11.4	40.0 ± 16.9	34.5 ± 15.8*
ACTH stimulation test			
non-responders	6 (50)	7 (70)	13 (59)
responders	6 (50)	3 (30)	9 (41)
Hospital death	5 (38.5)	13 (81.2)	18 (62.1)*
Adverse events			
hyperglycemia	11 (78.6)	8 (61.5)	19 (54)
superinfection	2 (14.3)	3 (23.1)	5 (14)
hypernatremia	1 (7.1)	2 (15.4)	3 (8)

Values are presented as mean (SD) or n (%), * $p < 0.05$ for comparison. Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; SOFA, Sequential Organ Failure Assessment; CKD, chronic kidney disease; ESRD, end stage renal disease; ACTH, Adrenocorticotropic hormone.

Discussion

Critical illness-related corticosteroid insufficiency (CIRCI) is defined as inadequate cellular corticosteroid activity for the severity of the patient's illness[2]. It occurs as a result of a decrease in adrenal steroid production (adrenal insufficiency) or tissue resistance to glucocorticoids[2]. The reported incidence of this condition varies widely, depending on the pa-

Table 2. Diagnostic accuracy of different cut-off points of baseline cortisol level for diagnosis of adrenal insufficiency

cortisol level	Sensitivity (%)	Specificity (%)	PPV	NPV	Accuracy	p
≤ 45 µg/dl	84.6	37.5	52.4	75	59	0.24
≤ 35 µg/dl	84.6	62.5	64.7	83.3	72	0.02
≤ 25 µg/dl	30.8	81.2	57.1	59.1	59	0.67
≤ 18 µg/dl	23.1	87.5	60	58.3	59	0.63

Table 3. Diagnostic accuracy of different Acortisol levels as criteria of ACTH stimulation test for diagnosis of adrenal insufficiency

□ cortisol (maximal increment)	Sensitivity (%)	Specificity (%)	PPV	NPV	Accuracy	p
≤ 21 µg/dl	75	0	47.4	0	41	0.22
≤ 19 µg/dl	75	10	50	25	45	0.59
≤ 17 µg/dl	58.3	20	46.7	28.6	41	0.38
≤ 15 µg/dl	58.3	30	50	37.5	45	0.67
≤ 13 µg/dl	58.3	30	50	37.5	45	0.67
≤ 11 µg/dl	58.3	30	50	37.5	45	0.67
≤ 9 µg/dl	50	30	46.2	33.3	41	0.41
≤ 7 µg/dl	16.7	40	25	28.6	27	0.07
≤ 5 µg/dl	16.7	70	40	41.2	41	0.62

tient population studied and diagnostic criteria used (table 4). The variation in expected cortisol levels according to type and severity of disease hampers the standardization of definition of normal biochemical response to illness. Our study demonstrates that the most reliable marker of hemodynamic response to treatment with corticosteroids in Thai patients with septic shock is a baseline cortisol level of < 35 µg/dl. The other important finding of this study is that the different diagnostic criteria should be looked for and applied in different populations, *i.e.* in different ethnic groups and countries.

To diagnose adrenal insufficiency in critical illness, proposed cut-off levels of baseline total cortisol level and Δ cortisol after ACTH stimulation test almost all emerged from empirical studies of factor associated with mortality[7,14,15]. However, whether or not corticosteroid therapy in the treatment of septic shock improves survival remains debated and controversial. The international task force assembled by the American College of Critical Care Medicine has conducted a meta-analysis and showed that moderate dose of hydrocortisone had no benefit on mortality in patients with septic shock[2]. In contrast, a meta-analysis conducted by Annane at al has recently shown survival benefit in subgroup with prolonged use of low-dose corticosteroid therapy[16]. In spite of this, the benefit of corticosticoids therapy on shock reversal was commonly found in all studies, and we have no other end organ or biochemical marker of acute adrenal insufficiency at this time. We therefore utilized the most accepted and common clinical feature associated with CIRCI in critical illness, hemodynamic response to steroids in septic shock patients with hypotension refractory to fluid resuscitation and requiring vasopressors, as the main outcome in this study.

Annane et al[8] proposed that a baseline cortisol of less than 10 µg/dl or a delta cortisol of less than 9 µg/dl after 250 µg ACTH stimulation test should consider that adrenal insufficiency is likely. Although the specificity of the test was high, the sensitivity was low. The study used the overnight single-dose metyrapone stimulation test to investigate the diagnostic value of baseline cortisol and 250 µg ACTH stimulation test but the metyrapone stimulation test is cumbersome and impractical in Thailand.

Table 4. Serum total cortisol levels in patients with septic shock

Reference	Year	Number of patients	Criteria used to define CIRCI	Incidence of CIRCI (%)
Annane et al 13	2000	189	Increment of < 9 μg/dl	54
Marik and Zaloga 7	2003	59	Baseline of < 25 μg/dl	61
Annane et al 8	2006	101	Baseline of < 10 μg/dl or increment of < 9 μg/dl	55

The present study shows that the incidence of steroid responsiveness in Thai patients with septic shock is 44.8%. Baseline cortisol level of ≤ 35 μg/dl is the best tool for discriminating responsiveness to moderate dose of hydrocortisone and the ACTH stimulation test is not suitable to be a diagnostic tool. As shown in our study, not all septic shock patients have adrenal insufficiency and respond to hydrocortisone. This corresponds to the studies of Marik and Zaloga[7], Oppert et al[12] and River et al[17] These studies demonstrated that steroid responsive patients with rapid hemodynamic improvement have lower baseline cortisol levels than steroid nonresponsive patients.

Our data demonstrated that the best cut-off value of baseline cortisol level to detect CIRCI with steroid responsive in septic shock Thai patients is the value of < 35 μg/dl, with a sensitivity of 85%, and a specificity of 62%. This cut-off value is considerably higher than the suggested criteria of 25 μg/dl from the Merik study[7]. Interestingly, baseline cortisol levels, especially in the steroid-responsive group (27.6 ± 11.4 μg/dl) in our study, was noticeably higher than those in other studies[7,17]. There are some explanations for this phenomenon. First, adrenal insufficiency in critical illness determined by means of a baseline cortisol of less than10 μg/dl or a delta cortisol of less than9 μg/dl after 250 μg ACTH stimulation test occurs in only small amount of septic shock patients. Most CIRCI in this population might occur as a result of tissue resistance to glucocorticoids, in which elevated levels of circulating cortisol levels are commonly found. This condition has recently been defined as "systemic inflammation-associated glucocorticoid resistance[18]". The second explanation is that patients in our study were enrolled in the study and performed the diagnostic tests earlier than other studies[5,7]. The mediators released in sepsis patients may stimulate or impair the synthesis and action of cortisol via actions on the HPA axis and glucocorticoid receptors. These opposition actions on the HPA axis may be time dependent. In the early phases of critical illness cortisol levels frequently rise, either in response to increased release of CRH and ACTH, or via resistance to, or inhibition of, negative-feedback control[19,20]. The third explanation is that our patient population is Asian, which is dissimilar from others in terms of ethnic origin. The polymorphisms of glucocorticoid receptors and other pivotal genes in the different populations studied may influence the downstream effects of glucocorticoid-glucocorticoid receptors interactions leading to different degree of glucocorticoid resistance[21,22]. Lastly, we employed the electrochemiluminescence immunoassay method to analyze cortisol concentration. The specificity, sensitivity, and performance of the commercially available cortisol assays are not uniform because they show wide variations in immunoassay characteristics[23]. The variation of these assay characteristics might be more significant in critically ill subjects, especially those with septic shock. It is evident that some septic patients have heterophile antibodies in their sera that interfere in immunoassay systems, resulting in overestimation of the actual cortisol value[24].

ACTH stimulation test (Δ cortisol ≤ 9 μg/dl) should not be used for diagnosis of steroid responsiveness in patients with CIRCI because its sensitivity and specificity are poor. It does not assess the integrity of the HPA axis and may be poorly reproducible, especially in patients with septic shock[25]. The change in cortisol concentration following ACTH stimulation test is a measure of adrenal reserve, but not adrenal function. Since basal cortisol levels of our patients were already high, this indicates that the adrenals of our septic shock patients might already be maximally stimulated at baseline, thus diagnostic criteria based on a minimal rise in cortisol after ACTH are probably invalid. Our results agree with the Consensus statements from an international task force by the American College of Critical Care Medicine[2] which recommend that the ACTH stimulation test should not be used to identify those patients with septic shock who should receive glucocorticoids. However, the routine administration of a moderate dose of hydrocortisone to all pa-

tients with septic shock who have responded poorly to fluid resuscitation and vasopressors may be placed in doubt because hydrocortisone supplementation increased the incidence of septic shock relapse, hyperglycemia, and hypernatremia in the CORTICUS study[5]. We recommend a three-step approach: first, performing the test only in cases with clinical suspicion of adrenal insufficiency; second, basal cortisol testing, then hydrocortisone administrating; and finally, decision making about whether to continue steroid or not based on the result of basal cortisol. The study determining the best cut-off value of basal cortisol to discriminate steroid responsiveness in specific population should be conducted using their own cortisol assay.

The present study is limited by the fact that the population was relatively small, and reflective of only a single center. Commercially available cortisol assays measure the total hormone concentration rather than the biologically active, free cortisol concentration. This dissociation between the total and free cortisol level is most marked in patients with a serum albumin of < 2.5 mg/dL[9], which commonly found in patient with septic shock.

Conclusion

The different diagnostic criteria should be looked for and applied in different populations. Prevalence of CIRCI in septic shock Thai patients is 44.8% as defined by hemodynamic response to steroid treatment. Baseline total cortisol level $\leq$ 35 µg/dl is a useful diagnostic threshold for diagnosis of CIRCI in septic shock Thai patients. The ACTH stimulation test should not be used to identify those patients with septic shock who should receive glucocorticoids.

Competing interests

The authors declare that they have no competing interests.

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การวินิจฉัยภาวะขาดฮอร์โมนคอร์ติโคสเตียรอยด์ในผู้ป่วยไทยที่มีภาวะช็อกจากการติดเชื้อ

รณิษฐา รัตนะรัต, ภาณุวัฒน์ พรหมสิน, อภิรดี ศรีวิจิตรกมล, ฉันทนิจ ลี้มิ่งสวัสดิ์, ไชยรัตน์ เพิ่มพิกุล

ภูมิหลัง: *อุบัติการณ์การเกิดภาวะขาดฮอร์โมนคอร์ติโคสเตียรอยด์ ในผู้ป่วยภาวะช็อกจากการติดเชื้อมีความแตกต่างกันมาก ส่วนหนึ่งเนื่องจากเกณฑ์ในการวินิจฉัยภาวะดังกล่าวยังแตกต่างกัน คณะทำงาน surviving sepsis campaign แนะนำให้รักษาผู้ป่วยซึ่งสงสัยว่ามีภาวะนี้ด้วย hydrocortisone ในผู้ป่วยซึ่งมีภาวะช็อกจากการติดเชื้อที่ยังคงมีความดันโลหิตต่ำหลังจากได้สารน้ำอย่างเพียงพอและได้รับยากลุ่ม vasopressor แล้ว โดยการรักษาดังกล่าวมีความเสี่ยงต่อการติดเชื้อเพิ่มขึ้น*

วัสดุและวิธีการ: *คณะผู้นิพนธ์ศึกษาผู้ป่วยผู้ป่วยภาวะช็อกจากการติดเชื้อ 29 คนซึ่งไม่ตอบสนองต่อการให้สารน้ำและ vasopressor โดยการวัดระดับ cortisol ก่อนและหลังทำ ACTH stimulation test หลังจากนั้นให้ยา hydrocortisone ในผู้ป่วยทุกราย*

ผลการศึกษา: *ผู้ป่วยมีอัตราเสียชีวิตในหออภิบาล 62% โดย 45% ของผู้ป่วยทั้งหมดตอบสนองต่อการรักษาด้วย hydrocortisone โดยกลุ่มที่ตอบสนองต่อการรักษามีระดับ baseline cortisol 27.6 ± 11.4 μg/dl เปรียบเทียบกับ 40.0 ± 16.9 μg/dl ในกลุ่มที่ไม่ตอบสนองต่อการรักษาด้วย hydrocortisone การวินิจฉัยภาวะขาดฮอร์โมนคอร์ติโคสเตียรอยด์ ในผู้ป่วยภาวะช็อกจากการติดเชื้อโดยใช้ระดับ baseline cortisol มีความแม่นยำมากกว่าการใช้ระดับ coritsol หลังการทำ ACTH stimulation test โดยมีพื้นที่ใต้กราฟ ROC อยู่ที่ 0.72 ค่า baseline cortisol ที่น้อยกว่าหรือเท่ากับ 35 μg/dl เป็นระดับที่ทำนายการตอบสนองต่อการรักษาด้วย hydrocortisone ดีที่สุด โดยมี sensitivity 85% specificity 62% และ accuracy 72%*

สรุป: *ค่า baseline cortisol ที่น้อยกว่าหรือเท่ากับ 35- μg/dl เป็นเกณฑ์ดีที่สุดในการวินิจฉัยการตอบสนองต่อการรักษาด้วยฮอร์โมนฮอร์โมน คอร์ติโคสเตียรอยด์ในผู้ป่วยไทยที่มีภาวะช็อกจากการติดเชื้อ*