Relative Adrenal Insufficiency in Burn Patients

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**Abstract**

Cortisol is essential in maintaining normal physiology and it becomes particularly important in preserving homeostasis during stressful conditions. In critically stressed patients, the hypothalamic-pituitary-adrenal axis (HPA axis) may change to increase cortisol production depending on the demand of the body. It is intuitive that during critical stress, cortisol levels would be proportional to the severity of the illness. In some critically ill patients, cortisol levels and/or production are actually lower than predicted. This adrenal insufficiency has been referred to as relative adrenal insufficiency (RAI). RAI is a syndrome in which the HPA axis has no known damage but serum cortisol is observed to be inappropriately low, and/or does not respond appropriately to ATCH stimulation. RAI has been recognized in a variety of clinical illnesses; studies have suggested that as many as 60% of critically ill patients suffer from RAI at some point in time during their intensive care stay. RAI should be suspected in any hypotensive patient who responds poorly to fluids and/or medications to support blood pressure. Currently, RAI diagnosis is based on the above clinical findings. Some researchers advocate diagnosis based on a random total serum cortisol of less than 9μg/dL or by an ACTH stimulation testing showing total serum cortisol response of less than 9μg/dL over baseline after the administration of low dose (250μg) exogenous ACTH. RAI confers increased morbidity and mortality in those patients in whom it develops. RAI in burn patients is a relatively poorly described and characterized entity. The purpose of this prospective observational study was to evaluate RAI in sixty critically ill burn patients utilizing serum cortisol levels and the Cosyntropin stimulation test.

**Introduction**

Relative adrenal insufficiency (RAI) is defined as an inadequate production of cortisol with increase demand due to stress, or in this case, severe burn injuries. RAI is a syndrome in which the hypothalamic-pituitary-adrenal axis (HPA axis) has no known damage but serum cortisol is inappropriately low, and does not respond to ATCH stimulation. RAI has been recognized in patients with critical illnesses.

**Results**

Sixty patients were enrolled. Sixty-two percent were male, the mean total body surface area burned was 38%, and the mean age was 41 years. Mean bidirec cortisol level over the entire study period was 15.6. This did not vary significantly as a function of time, with a range of 12.3 to 20.2 over a maximum of 19 weeks. The number of patients with one or more cortisol levels below 30 was 60 (100%). The number of patients with one or more cortisol levels below 20 was 50 (83%). Twenty-one patients (35%) had consyntropin stimulation tests. 15 patients (71%) failed to stimulate, with a rise in cortisol level of less than 9 at 15 or 30 minutes following stimulation.

**Materials and Methods**

A prospective observational study of critically ill burn patients over a two year period was performed. Inclusion criteria included adult burn patients admitted to the burn ICU. Basic demographic data were recorded. Early morning cortisol levels were drawn Monday and Thursday on all patients while in the ICU. Cosyntropin stimulation tests were performed on patients based on cortisol levels and clinical status. Descriptive statistics were performed.

**Discussion**

Palmieri, et al., studied cortisol and ACTH levels and the results of ACTH stimulation testing in 25 pediatric burn patients. Over the course of the study, 56% of ACTH stimulation tests were abnormal, and this rate increased as length of stay increased. No patients were treated with cortisol and the mortality was 0.04%. The authors concluded that random cortisol measurements did not accurately predict adrenal dysfunction and that ACTH stimulation testing should be used to diagnose RAI in pediatric burn patients.

**Conclusions**

Critically injured burn patients demonstrated relatively low cortisol levels throughout their ICU stay. Most of these patients subsequently failed cosyntropin stimulation testing. Relative adrenal insufficiency characterized by cortisol level and stimulation test is common in burn patients in the ICU. The clinical relevance of this finding remains unknown and further study is warranted.

**References**


**Figure 1:** Adrenal stimulation in the critically ill patient (1) Diagnosed Adrenal Failure in critically ill patients

**Figure 2:** Serum cortisol levels as a function of time

**Figure 3:** Initial Diagnosis of RAI