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Intraoperative target-controlled infusion anesthesia application using remifentanil hydrochloride with etomidate in patients with severe burn as monitored using Narcotrend

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ABSTRACT

Objective: This study aims to evaluate the feasibility of intraoperative composite target-controlled infusion (TCI) anesthesia application using remifentanil hydrochloride with etomidate in patients with severe burns, as monitored by Narcotrend.

Methods: A total of 40 patients with severe burns with eschar excisions and skin grafts were randomly and equally grouped into the etomidate (E) and the propofol groups (P). Anesthesia was induced and maintained by a remifentanil hydrochloride TCI combined with etomidate or propofol. The depth of anesthesia and other relevant indicators were recorded through intraoperative electroencephalogram monitoring using a Narcotrend monitor.

Results: No statistically significant differences were observed between the drug withdrawal times, eye opening requirements, or orientation recoveries of the two groups ($P > 0.05$). The cortisol and aldosterone levels in group E were significantly lower than those in group P 24 h post operation ($P < 0.05$). No significant differences between the number of operations, hospitalization duration, mean arterial pressure, heart rate, and postoperative adverse reaction incidence of the two groups were observed at each time point ($P > 0.05$).

Conclusion: The application of a composite remifentanil hydrochloride combined with etomidate TCI is feasible for the early eschar excision in patients with severe burns.

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1. Introduction

In addition to body injuries, patients with early burns exhibit neuroendocrine changes, which include hypothalamic–pituitary–adrenal (HPA) excitement. The degree of neuroendocrine change is closely related to the burn area and injury depth. Excessive HPA axis activation causes serious secondary injuries, such as systemic inflammatory response syndrome and multiple-organ failure syndrome, which affect patient prognoses [1–3]. Several clinical anesthesia methods have been used to prevent and treat severe burns after stress reaction, including the utilization of local anesthesia, analgesics, and sedatives. However, prevention and treatment exhibit modest effects because of the effects of surgery and the condition of the patient. HPA-induced secondary damage prevention is thus a key issue that must be addressed in clinical anesthesia of patients with severe burns.

Etomidate, an imidazole derivative, is a short-acting intravenous anesthetic characterized by rapid action, hemodynamic stability, and the absence of histamine release. This anesthetic does not affect sympathetic nerve tension or the autonomic reflex. Etomidate can thus induce general anesthesia in critical patients. A single etomidate dose can temporarily suppress adrenal function without triggering adverse postoperative events [4]. Continuous sedation in ICU patients also suppresses adrenal function, which increases patient mortality [5–7]. Thus, etomidate application for anesthetic maintenance in a clinical setting remains controversial. Moreover, the effect of etomidate on excessive HPA axis activation in patients with severe burns also remains unclear.

The emergence of an advanced metabolic state, increased cardiac output, and increased liver and renal blood flow improves the drug clearance rate in patients with severe burns in the acute phase. These effects significantly vary with individuals; thus, the corresponding treatment must be patient specific [8].

Target-controlled infusion (TCI) and Narcotrend are widely used individualized anesthetic technologies for clinical anesthesia in various surgeries [9,10]. Narcotrend (MonitorTechnik, Bad Bramstedt, Germany) is an electroencephalographic (EEG) monitor, and the algorithm of which has been developed based on the visual assessment of an EEG with increasing burst suppression in 15 substages [9]. Clinical data on etomidate TCI application are unclear in patients with severe burns; only few studies have focused on the depth of anesthesia guided by Narcotrend. Therefore, etomidate TCI was used in the present study to induce and maintain anesthesia, the depth of which was guided using Narcotrend. The effect of etomidate TCI on the adrenal function of patients with severe burns was observed. Moreover, perioperative complications were monitored to evaluate the feasibility of etomidate TCI for the eschar excision of patients with severe burns.

2. Patients and methods

2.1. General information

A total of 40 patients with severe burns (classes II to III from the American Society of Anesthesiologists classification) who underwent eschar excision in our hospital <1 week after incurring injuries between January and October 2013 were included in this study. The patients were divided into an etomidate group (E) and a propofol group (P) (20 cases in each group) based on the surgery sequence using the random-number table method. The ages of the patients ranged from 18 to 65 years, with weights ranging from 40 to 90 kg. The total burn areas (total body surface area (TBSA)) ranged from 31% to 50%, with third-degree burns covering 11–20% of the area. Patients with any drug allergy, observable preoperative heart, lung, liver, or renal dysfunction, or a body mass index (BMI) > 30 were excluded from the study. The differences in gender, age, BMI, height, TBSA, full-thickness burn surface area, days from injury to surgery, and operation times of the two groups are not statistically significant ($P > 0.05$, Table 1). Some patients were consulted when conscious if they could not sign or verbally communicate before operation. The signatures of the patients or their legal representative were also obtained. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of First Affiliated Hospital of General Hospital of PLA. Written informed consent was obtained from all participants.

2.2. Anesthesia protocol

Anesthesia was administered to the two groups between 8:00 AM and 10:00 AM. An intravenous line was placed on the patients upon arrival to the operating room. Ringer's solution (10 mL/kg) was administered until noninvasive blood pressure and invasive arterial pressure measurements were started.

Table 1 – Comparisons of general information of patients in the two groups (mean ± standard deviation).

Group	Gender (cases)		Age (yr)	Weight (kg)	Height (cm)	ST (min)	TBSA	FTBSA	Days (d)
	Male	Female							
E group	13	7	43.10 ± 13.33	65.65 ± 9.29	166.80 ± 6.11	181.00 ± 36.40	0.41 ± 0.08	0.15 ± 0.03	2.75 ± 0.64
P group	14	6	38.95 ± 14.70	66.90 ± 10.80	168.55 ± 6.50	188.00 ± 33.97	0.42 ± 0.07	0.15 ± 0.02	2.95 ± 0.69
χ^2 value	0.114		–	–	–	–	–	–	–
t Value	–		0.935	−0.392	−0.877	−0.629	−0.421	0.000	−0.950
P value	0.7357		0.3556	0.6969	0.3858	0.5333	0.6763	0.9995	0.3479

Note: –, no statistical value; E, etomidate; P, propofol; ST, surgery time; TBSA, total burn surface area; FTBSA, full thickness burn surface area; Days, days from injury to surgery.