EFFECT OF DEXMEDETOMIDINE ON CIRCULATORY STABILITY DURING ESCHARECTOMY IN PATIENTS WITH EXTENSIVE BURNS

Yixin Guo[1#], Zhigang Chen[2#], Dengguo Xiang[3*]
[1]Department of Anesthesiology, Fifth Hospital in Wuhan, Wuhan, 430050, China - [2]Department of Anesthesia and Pain, Wuhan Xinzhou District People's Hospital, Wuhan, 431400, China - [3]Department of Anesthesiology, The Central Hospital of Enshi Tujia and Miao Autonomous Prefecture, Enshi, 445000, China
[#]These authors contributed equally to this work as co-first author

ABSTRACT

Objective*: To investigate the effect of dexmedetomidine (Dex) on cyclical stability during escharectomy in patients with extensive burns.*

Methods*: The clinical data of 60 patients with extensive burns in the Fifth Hospital in Wuhan from May 2019 to June 2021were retrospectively analyzed. The patients were divided into an observation group and a control group, with 30 cases in each group. The observation group was pumped with 1 μg/kg Dex 15 minutes before anesthesia induction, then was pumped with 0.5μg·kg-1·h-1, the control group was pumped with the same dose of normal saline; both groups were given the same anesthesia scheme. The operation related indexes of the two groups were compared; hemodynamic indexes [mean arterial pressure (MAP), heart rate (HR)] were measured before dexmedetomidine infusion (T0), 10 minutes after anesthesia induction (T1), at the end of operation (T2) and 5 minutes after extubation (T3) and compared between the two groups; sedation and recovery were compared between the two groups; the adverse reactions were counted.*

Results*: There was no statistically significant difference in comparison of operation time and blood loss in both groups (P>0.05); there was no statistically significant difference in comparison of HR and MAP in both groups at T0 (P>0.05); the HR and MAP levels at T1, T2 and T3 of the observation group were lower when compared with the control group (P<0.05); HR and MAP were compared in both groups at each time point (P<0.05); compared with the control group, the time of eye-opening, stimulus-response recovery, and orientation recovery in the observation group was shorter, and the Sedation Rating Scale (Ramsay) score was higher (P<0.05); the incidence of adverse reactions in the observation group was lower when compared with the control group (P<0.05).*

Conclusion*: Dex can stabilize blood pressure and HR, improve sedation and recovery, reduce the adverse excessive stress, and is beneficial to circulation stability during escharectomy in patients with extensive burns.*

Keywords: *severe large area burn, escharectomy, dexmedetomidine, cyclical stability.*

DOI: 10.19193/0393-6384_2022_3_291

Received *March 15, 2021;* ***Accepted*** *January 20, 2022*

Introduction

Escharectomy is an important treatment method for patients with large area burn, it can preserve the normal dermis of patients, remove the necrotic tissue, and promote the regeneration and repair of the wound[(1)]. However, patients with large area burn, especially critically ill patients, have relatively large wounds, relatively large microvascular bleeding volume, and insufficient effective circulation capacity, in escharectomy, the circulation stability is insufficient, and agitation and shivering are easy to occur[(2)]. Therefore, it is important to find an ideal anesthesia method to ensure circulation stability in escharectomy for patients with severe large area burns. Dexmedetomidine (DEX) as an α2 receptor agonist with high selectivity can effectively inhibit the human sympathetic nerve and has strong analgesic and sedative effects, moreover, it will not significantly inhibit the circulatory function and has fewer adverse reactions[(3)].

Studies have shown that DEX can reduce the inflammatory response of patients with severe burns, protect the nervous system and reduce the occurrence

of postoperative delirium[4]. However, there are few studies on the effect of DEX on circulatory stability during escharectomy in patients with severe large area burns; therefore, this study performs an analysis on this and provides a reference for the follow-up improvement of anesthesia scheme for escharectomy in patients with severe large area burn.

Materials and methods

General data

This study was in line with the principles of the medical ethics committee, the clinical data of 60 patients with excision of eschar for the first time in the Fifth Hospital in Wuhan from January 2019 to June 2021 were analyzed retrospectively. The patients were divided into an observation group and a control group, with 30 cases in each. Both the patients and their families signed the consent form. There were 17 males and 13 females in the observation group; aged 20-68 years old, the average age was (41.13±4.24) years; the burn area was 54.52-83.46%, and the average burn area was (65.43±6.47) %; acute physiology and chronic health evaluation II (APACHE II) (5) scored 12-36 points, with an average APACHE II score of (21.31±4.17) points. There were 16 males and 14 females in the control group; aged 20-70 years old, the average age was (41.44±4.63) years; the burn area was 52.89-81.63%, and the average burn area was (66.06±6.33) %; APACHE II score was 12-36 points, and the average APACHE II score was (20.89±3.78) points. The general data of the two groups were statistically compared, with (P>0.05) indicating comparability.

Inclusion and Exclusion criteria

Inclusion criteria: 1) admission within 4 hours after burn which conformed to the Guidelines for Burn Rehabilitation Treatment (2013 Edition)[6]; 2) total burn area >= 30% or III degree burn area >= 15% total body surface area (TBSA); 3) aged 18-65 years old; 4) preoperative American Society of Anesthesiologists (ASA) grade[7] II-III; 5) excision of eschar was performed on the 3rd-5th day after the injury, and the shock period was flat.

Exclusion criteria: 1) patients with chemical and electrical burns, severe crush injury, combined with inhalation injury and compound injury; 2) complicated with infection, preoperative and intraoperative application of vasoactive drugs; 3) combined with cardiovascular disease, hypertension, diabetes, and immune system diseases before the injury; 4) pregnant women; 5) history of severe allergy and allergy to drugs involved in the study; 6) took immunosuppressive drugs; 7) patients included in clinical study or clinical drug trial 3 months before injury; 8) patients considered unsuitable for inclusion by other researchers.

Method

The observation group was pumped with 1μg/kg Dex pumping 15 minutes before anesthesia induction (Hunan Kelun pharmaceutical, permission code of State Food and Drug Administration H20183149, specification: 2ml:200 μg), followed by 0.5 μg·kg-1·h-1 pumping, the control group was pumped with the same dose of normal saline, both groups were given the same anesthesia regimen. Rehydration during induction period: rapid volume expansion of 500ml Ringer's lactate solution (about 1 hour). Anesthesia induction: intravenous injection of 2mg/kg propofol (Fresenius Kabi Deutschland GmbH, HJ20181145, specification: 50ml: 1.0g), 0.6mg/kg rocuronium (Zhejiang Huahai pharmaceutical, H20183265, specification: 10ml: 100mg), 0.3 μg/kg sufentanil (Sufentanil Citrate Injection, H20150126, specification: 1ml: 75 μg). Endotracheal intubation or tracheotomy, connected the anesthesia machine for mechanical ventilation, the end expiratory carbon dioxide partial pressure was about 30-40mmhg. Anesthesia maintenance: inhaled 2% sevoflurane (Shanghai Hengrui medicine, H20070172, specification: 120ml), the monitored anesthesia care (MAC) value was maintained at 0.8-1. After resuscitation and extubation, 0.1mg atropine (Anhui Changjiang pharmaceutical, H34023134, specification: 1ml: 1mg) and 2mg neostigmine (Shanghai Xinyi Jinzhu pharmaceutical, H31021570, specification: 1ml: 0.5mg) were injected intravenously. Intraoperative rehydration: supplied blood loss with lactate Ringer's solution 1-3ml/kg/hr+ blood products.

Evaluation index

(1) Operation related indicators: the total area, time and intraoperative bleeding of escharectomy; total intraoperative infusion volume and urine volume were compared between the two groups (2) Hemodynamics: hemodynamic changes, including heart rate (HR) and mean arterial pressure (MSP), were obtained by vital signs monitor (GE™: ADU, Aespire/100/7100, AVANCE) before pumping dexmedetomidine (T0), 10 min after anesthesia induction (T1), at the end of operation (T2) and 5 min

after extubation (T3); (3) Sedation and recovery: the time of eye-opening, stimulus-response recovery and orientation recovery were counted and compared. Ramsay Sedation score (Ramsay)[8-9] was used to assess sedation, patients with anxiety, uneasiness, or irritability were 1 point, cooperation and wakefulness were 2 points, lethargy, quick response to instructions were 3 points, quick response to calls were 4 points, slow response to calls were 5 points, and no response to calls were 6 points; (4) Adverse reactions: the occurrence of choking, agitation and delayed awakening were counted.

Statistical methods

SPSS24.0 software was used for data processing, and the counting data were expressed in percentage, $\chi^2$was used for the test; the measurement data received Shapiro-Wilk normality test, and the measurement data of normal distribution were expressed in , independent sample t-test was used between groups, and paired t-test was used at two time points in the group, compared single index among groups at multiple time points, the general linear repeated measurement was used for the test, P<0.05 was statistically significant difference.

Results

Operation related indicators

There was no statistically significant difference in operation time and intraoperative bleeding between the two groups (P>0.05) (Table 1).

Groups	Operation time (min)	Intraoperative bleeding volume (mL/%)
Observation group (n=30)	161.29±13.65	35.55±3.41
Control group (n=30)	157.45±15.24	36.17±3.12
t	1.028	0.735
P	0.308	0.466

Table 1: Comparison of operation related indexes between the two groups ($\bar{x}\pm s$).

Hemodynamics

There was no statistically significant difference in the comparison of HR and MAP between the two groups at T0 (P>0.05); the levels of HR and MAP at T1, T2, and T3 in the observation groups were lower than those in the control group (P<0.05); the levels of HR and MAP were compared between the two groups at each time point (P<0.05). (Table 2).

Time points	Groups	HR (times/min)	MAP (mmHg)
T_0	Observation group (n=30)	115.17±10.52	78.33±8.36
	Control group (n=30)	115.80±11.79	77.57±7.97
T_1	Observation group (n=30)	106.27±10.36^{ad}	72.12±6.22^{ad}
	Control group (n=30)	109.98±11.65^{a}	74.79±7.53^{a}
T_2	Observation group (n=30)	105.74±9.88^{ad}	67.48±7.06^{abd}
	Control group (n=30)	109.86±10.57^{a}	69.99±6.38^{ab}
T_3	Observation group (n=30)	107.41±10.66^{ad}	71.34±7.19^{acd}
	Control group (n=30)	112.57±12.41^{ab}	75.56±6.65^{ac}
F_{groups} P_{groups}		95.364 <0.001	110.637 <0.001
$F_{\text{time points}}$ $P_{\text{time points}}$		12389.637 <0.001	14126.771 <0.001
$F_{\text{interaction between groups and time points}}$ $P_{\text{interaction between groups and time points}}$		10563.264 <0.001	10458.473 <0.001

Table 2: Comparison of hemodynamics between the two groups ($\bar{x}\pm s$).

Note: a. compared with the same group at T0, P<0.05; b. compared with the same group at T1, P<0.05; c. compared with the same group at T_2, P<0.05; d. compared with the control group at the same time point, P<0.05.

Comparison of sedation and recovery

The time of eye-opening, stimulus-response recovery, and orientation recovery were shorter and the Ramsay score was higher in the observation group than those in the control group (P<0.05). (Table 3).

Groups	Time of eye opening (min)	Recovery time of stimulus response (min)	Recovery time of orientation (min)	Ramsay score (min)
Observation group (n=30)	9.53±1.96	10.93±2.07	20.44±3.30	2.42±0.68
Control group (n=30)	11.52±2.38	12.88±2.23	24.31±3.65	1.53±0.45
t	3.535	3.10	4.308	5.978
P	0.001	0.001	<0.001	<0.001

Table 3: Comparison of sedation and recovery between the two groups ($\bar{x}\pm s$).

Groups	Choking	Agitation	Delayed awakening	Adverse reactions
Observation group (n=30)	1 (3.33)	0	0	1 (3.33)
Control group (n=30)	3 (10.00)	4 (13.33)	1 (3.33)	8 (26.67)
χ^2	-	-	-	4.964
P	-	-	-	0.026

Table 4: Comparison of adverse reactions between the two groups n (%).

Occurrence of adverse reactions

The incidence of adverse reactions in the observation group was lower than that in the control group (P<0.05) (Table 4).

Conclusion

Escharectomy is still an important treatment for patients with severe large area burn, it can reduce inflammation and edema, remove necrotic tissue, and plays a positive role in the wound recovery of patients[10]. However, patients with severe large area burns have relatively large wound areas, large fluid loss, and relatively low circulatory stability, which increases the difficulty of anesthesia during escharectomy, and is easy to cause complications[11]). Moreover, patients with severe large area burn who undergo escharectomy have great difficulty in intraoperative anesthesia due to electrolyte disorder, coagulation disorder, and other reasons[12,13]). Therefore, it is more important to find an ideal anesthesia method beneficial to the circulatory stability of patients in order to improve the safety of escharectomy in patients with severe large area burns.

DEX is a common anesthetic adjuvant and highly selective α 2 adrenoceptor agonist, moreover, it has fewer adverse reactions and high safety, can effectively inhibit the stress response during perioperative anesthesia and improve the circulatory stability of surgical patients, which may be beneficial to the circulation stability during escharectomy in patients with severe large area burn[14,15]. The results of this study showed that there was no significant difference in operation time and intraoperative bleeding between the two groups, it showed that DEX would not increase the amount of bleeding or prolong the operation time, and would not affect the operation.

This study analyzed the effect of DEX on circulatory stability during escharectomy in patients with severe large area burn, the HR and MAP levels at T1, T2 and T3of the observation group were lower than those of the control group, this shows that the use of DEX will stabilize the blood pressure and HR of patients with severe large area burn after escharectomy, and maintain the stability of body circulation. The analysis of reason: the selection of anesthetic drugs plays an important role in the stability of circulation in escharectomy, Dex has ideal sedative and analgesic effects, which can reduce stress response, stabilize blood pressure and HR, ensure the stability of hemodynamics during operation, and benefit patients[16]. Dex can act on the locus coeruleus α 2 receptor, which activates the nervous system of the body α 2 receptor, inhibits sympathetic nerve excitation and reduces the release of catecholamine in children, so as to stabilize map and HR[17,18]. At the same time, Dex can down regulate the level of adrenaline and reduce the excitability of postsynaptic membrane, so as to stabilize MAP and HR and improve the stability of circulation[19].

Studies have shown that Dex can promote hemodynamic stability and respiratory system stability in burn patients, and is conducive to circulatory stability, which is consistent with this study[20]. The results of this study showed that the time of eye opening, stimulus response recovery and orientation recovery in the observation group was shorter than that in the control group, and the Ramsay score was higher than that in the control group. This shows that the use of Dex can improve the sedation and recovery of patients with severe large area burn after escharectomy. The analysis of reason: Dex can act on the peripheral or central nervous system of the body, inhibit sympathetic activity, reduce injury and reduce the irritation of intraoperative operation, so as to improve the sedation and recovery, and shorten the time of eye opening, stimulus response recovery and directional force recovery[21,22]. At the same time, there are certain inflammatory reactions in the nervous system of burn patients, Dex has been proved to have certain anti-inflammatory effects[23,24]). Dex improves the sedative effect and waking quality by reducing norepinephrine, exciting the vagus nerve and reducing nerve cell inflammation(25). In addition, there were fewer adverse reactions in the observation group, which may be because the use of DEX can improve the sedative effect and reduce the occurrence of adverse reactions such as choking and agitation[26-29].

In conclusion, Dex can stabilize blood pressure and HR, improve sedation and recovery, reduce adverse reactions and facilitate circulatory stability in escharectomy of patients with severe large area burn.

References

1) Xu CX, Zhang C, Chen L. Effect of excision of eschar and skin grafting on scar appearance and healing time in patients with deep burn wounds (J). J Clin Surg, 2018, 26 (7): 550-552
2) Jia YY, Yan Q, Ma SW, et al. Clinical observation on preemptive analgesia of flurbiprofen axetil combined with ketamine in excision of eschar and skin grafting for burn patients (J). Shandong Med, 2020, 60 (6): 81-83
3) Barends CRAbsalom A, van Minnen B, et al. Dexmedetomidine versus Midazolam in Procedural

Sedation.A Systematic Review of Efficacy and Safety(J). PLoS One, 2017, 12(1): e0169525.

4) Zhang L, Wang L, Tian CZ, et al. Effects of dexmedetomidine on plasma IL-1β, IL-6, serum S-100β levels and postoperative delirium in patients with severe burns (J). J Hebei Med Univers, 2020, 41 (11): 1344-1348

5) Zimmerman J E, Kramer A A, McNair D S Et al. Acute Physiology and Chronic Health Evaluation (APACHE) IV: hospital mortality assessment for today's critically ill patients(J). Crit Care Med. 2006, 34(5):1297-1310.

6) Chen J, Peng YZ, Luo GX, et al. Guidelines for burn rehabilitation treatment (2013 Edition) (J). Chin J Burn, 2013, 29 (6): 497-504

7) Practice Guidelines for Moderate Procedural Sedation and Analgesia 2018: A Report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists and Society of Interventional Radiology(J). Anesthesiology, 2018, 128(3): 437-479.

8) Li YH, Shi CB, Li WL. Reliability and validity of Ramsay score in electronic bronchoscopy sedation (J). Chin J Prac Diag & Trea, 2013, 27 (10): 1000-1001

9) Rezai M, Mahmoodi M, Kaeidi A, Noroozi Karimabad M, Khoshdel A, Hajizadeh MR. Effect of crocin carotenoid on BDNF and CREB gene expression in brain ventral tegmental area of morphine treated rats. Asian Pac J Trop Biomed 2018; 8(8): 387-393.

10) Wang H, Peng J, Mou SW. Retrospective analysis and clinical feasibility study of excision of eschar and skin grafting combined with negative pressure wound treatment for deep second to third degree burn patients (J). J Inner Mongolia Med University, 2018, 40 (4): 397-400

11) Toft-Petersen AP, Ferrando-Vivas P, Harrison DA, et al. The organisation of critical care for burn patients in the UK: epidemiology and comparison of mortality prediction models(J). Anaesthesia, 2018, 73(9): 1131-1140.

12) Wang ZH, Zhao PD, Wu YP, et al. Effect of excision of eschar and skin grafting on repair and microcirculation in patients with severe joint burn (J). Chin J Clinici, 2020, 48 (1): 85-88

13) Ravari A, Mirzaei T, Bahremand R, Raeisi M, Kamiab Z. The effect of Pilates exercise on the happiness and depression of elderly women: a clinical trial study. J Sports Med Phys Fitness. 2021 Jan; 61(1): 131-139. doi: 10.23736/S0022-4707.20.10730-8. Epub 2020 Jul 28. PMID: 32734750.

14) Yang ZB, Shen JY, Mi KD, et al. Application of dexmedetomidine combined with remifentanil in dressing change of conscious non intubated patients in burn intensive care unit (J). Chin J Burns, 2018, 34 (10): 707-713

15) Murphy CV, Coffey R, Moore K, et al. Safety-feasibility,and acceptability of patient-controlled anxiolysis with dexmedetomidine for burn-care dressing changes: an open-label,single-arm-pilot study(J). Int J Burns Trauma. 2020, 10(5): 269-278.

16) Liu MX, Liu LY, Song ZX, et al. Comparison of anesthetic effects of different doses of dexmedetomidine combined with remifentanil and propofol in burn patients without endotracheal intubation (J). Chin J Anesthes, 2019, 39 (4): 459-461.

17) Jiang M, Sun Q, Liu G, et al. Efficacy of dexmedetomidine in reducing post-operative pain and improving the quality of recovery in patients with burn wounds undergoing tangential excision skin grafting(J). Exp Ther Med. 2019, 17(3): 1776-1782.

18) Xu FR, Li Y, Yang F, et al. Role of dexmedetomidine and fentanyl in reducing stress response in burn patients (J). Mod Med, 2018, 46 (7): 758-761

19) Schuler BR, Kovacevic MP, Dube KM, et al. Evaluation of Sedation Outcomes Following Increased Dexmedetomidine Use in the ICU(J). Crit Care Explor. 2020, 2(4): e0100.

20) Zhu T, Chen LY. Sedative effect of dexmedetomidine during excision of eschar and skin grafting in burn patients with hypertension (J). Chin Gener Med, 2019, 17 (3): 388-391454

21) Zhang ZJ, Hua HF, Zou J, et al. Effect of dexmedetomidine on the number of Th17 cells and Treg cells in peripheral blood of patients with severe burn (J). Pharmaceut & Clin Resea, 2018, 26 (6): 409-412

22) Kawazoe Y, Miyamoto K, Morimoto T, et al. Effect of Dexmedetomidine on Mortality and Ventilator-Free Days in Patients Requiring Mechanical Ventilation with Sepsis: A Randomized Clinical Trial(J). JAMA, 2017. 317(13): 1321-1328.

23) Ying HF, Zhang WP, Li J, et al. Effect of dexmedetomidine combined with sufentanil on burn pain patients [J]. Chin Gener Med, 2019, 17 (11): 1837-1840.

24) Zhang L, Wang L, Tian CZ, et al. Effects of dexmedetomidine on plasma IL-1β, IL-6, serum S-100β levels and postoperative delirium in patients with severe burns [J]. J Hebei Med Univers, 2020, 41 (11): 1344-1348.

25) Zhang K, Xia JG, Yuan XH, et al. Effects of different doses of dexmedetomidine on agitation and inflammatory cytokines in patients undergoing excision of eschar and skin grafting under general anesthesia [J]. Guangdong Med J, 2018, 39 (22): 3415-3418.

26) Asadi F, Paydar S. Presenting an evaluation model of the trauma registry software. Int J Med Inform. 2018 Apr; 112: 99-103. doi: 10.1016/j.ijmedinf.2018.01.013. Epub 2018 Jan 31. PMID: 29500028.

27) Fan W, Yang H, Sun Y, et al. Comparison of the pro-postoperative analgesia of intraoperative dexmedetomidine with and without loading dose following general anesthesia: A prospective, randomized, controlled clinical trial[J]. Medicine (Baltimore), 2017, 96(7): e6106.

28) Erfannia L, Amraei M, Arji G, Yazdani A, Sabzehgar M, Yaghoobi L. Reviewing and Content Analysis of Persian Language Mobile Health Apps for COVID-19 Management. Stud Health Technol Inform. 2022 Jan 14; 289: 106-109. doi: 10.3233/SHTI210870. PMID: 35062103.

29) Zhang YF, Zhou WG, Yang JZ. Effect of dexmedetomidine combined with remifentanil on fiberoptic bronchoscopic intubation in patients with difficult airway after burn [J]. Western Med, 2019, 31 (7): 1088-1092

Corresponding Author:
DENGGUO XIANG
Email: anmeiao51554034715@163.com
(China)