

## EFFECTS OF DEXMEDETOMIDINE ON HEMODYNAMICS, STRESS RESPONSE, LUNG COMPLIANCE, AND OXYGENATION INDEX IN LAPAROSCOPIC PATIENTS WITH CERVICAL CANCER

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### ABSTRACT

**Objective:** This study aimed at exploring the effects of dexmedetomidine on hemodynamics, stress response, lung compliance, and oxygenation index (OI) in patients with cervical cancer undergoing laparoscopy.

**Methods:** 86 cases of cervical cancer patients treated in our hospital from May 2019 to March 2020 were randomly divided into study and control groups according to the random number table method, 43 cases in each group. Both groups were treated with total laparoscopic hysterectomy or double adnexectomy. The study group was given dexmedetomidine intravenous infusion, while the control group was given 0.9% sodium chloride injection at the same speed. The clinical data of the two groups were compared. Hemodynamic indexes were measured before anesthesia, 5 min after intubation, 30 min after establishing pneumoperitoneum, 5 min after extubation, and 2 h after the operation. The changes in stress reaction factors before anesthesia, 5 minutes after intubation, and 30 minutes after pneumoperitoneum establishment were compared between the two groups. The changes in peak airway pressure, lung compliance, and oi were measured at 5 min after intubation, 30 min after establishing pneumoperitoneum, and 5 min after extubation.

**Results:** There was no significant difference in HR, DBP, and SBP between the two groups before anesthesia and 2 hours after the operation ( $P>0.05$ ); at 5 minutes after intubation, 30 minutes after establishing pneumoperitoneum, and 5 minutes after extubation, the above indexes in the study group were significantly lower than those in the control group ( $P<0.05$ ). There was no significant difference in Na, cor, ACTH, and Ang II between the two groups before anesthesia ( $P>0.05$ ); the above indexes in the study group were significantly lower than those in the control group at 5 minutes after intubation and 30 minutes after the establishment of pneumoperitoneum ( $P<0.05$ ). Compared with 5min after intubation, peak airway pressure and lung compliance were significantly increased, OI was significantly decreased at 30min after pneumoperitoneum establishment ( $P<0.05$ ). Compared with 30min after pneumoperitoneum, peak airway pressure and lung compliance were significantly decreased; OI was significantly increased ( $P<0.05$ ).

**Conclusion:** Dexmedetomidine can maintain hemodynamic stability, reduce stress response, and improve lung compliance and oxygenation function of patients with cervical cancer under laparoscopy, which can play a certain role in lung protection.

**Keywords:** Dexmedetomidine, cervical cancer, laparoscopy, hemodynamics, stress response, lung compliance, oxygenation index.

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### Introduction

Cervical cancer is the most common gynecological malignant tumor clinically. According to statistics, there are more than 500,000 new cases of cervical cancer every year, accounting for about 5% of all new cancer cases, and more than 80% of the patients come from developing countries. With the gradual development of science and technology and the continuous improvement of medical equipment, the early diagnosis of cervical cancer is significantly

improved, and the mortality rate is significantly reduced. However, the therapeutic effect of cervical cancer still varies greatly in different regions and ranges<sup>(1)</sup>. Surgery combined with radiotherapy and chemotherapy is the main treatment for cervical cancer. Laparoscopy is a minimally invasive surgery with the advantages of less trauma, less blood loss, quick recovery, and short hospital stay; it has become the first choice for the treatment of cervical cancer<sup>(2)</sup>. However, studies have found that laparoscopic surgery will significantly impact

patients' hemodynamics. Furthermore, laparoscopic surgery will increase intra-abdominal pressure, decrease diaphragm offset, significantly increase pulmonary vascular resistance and airway pressure, and decrease respiratory compliance, thus further causing the imbalance of ventilation/blood flow ratio and the decrease of Oxygenation index (OI)<sup>(3-4)</sup>. Dexmedetomidine is a novel, highly selective  $\alpha_2$  adrenergic receptor agonist with sedative, analgesic, and anti-anxiety effects and mild respiratory inhibition.

Moreover, dexmedetomidine can maintain hemodynamic stability and reduce the dosage of sedatives, thus being increasingly used in anesthesia<sup>(5)</sup>. This study mainly investigated the effects of dexmedetomidine on hemodynamics, stress response, lung compliance, and OI in laparoscopic cervical cancer patients.

## Data and methods

### Basic information

A total of 86 patients with cervical cancer treated in our hospital from May 2019 to March 2020 were randomly selected and divided into study and control groups according to the random number table method, with 43 patients in each group.

#### Inclusion criteria:

- All patients met the diagnosis and treatment criteria of cervical cancer<sup>(6)</sup>;
- The classification of the American College of Anesthesiologists was I~II;
- The patient's mental symptoms are normal and can cooperate with treatment;
- The patients had not used opioids 3 months before the study;
- All the studies were approved by the hospital ethics Committee; All conform to medical ethics;
- Both patients and their families gave informed consent and signed informed consent.

#### Exclusion criteria:

- Combined with serious liver and kidney function or heart function insufficiency;
- The patient's medical records are not complete or quit halfway;
- With emphysema, lung cancer, and other lung diseases;
- Have a history of severe drug allergy.

### Experimental methods

Laparoscopic total hysterectomy or bilateral adnexectomy was performed in both groups.

Patients in the study group received an intravenous infusion of dexmedetomidine (Jiangsu Hengrui Pharmaceutical Co., LTD., Batch Number: 20190248, specification: 2ml: 200 $\mu$ g), 1 $\mu$ g/kg for 10min, and 0.5 $\mu$ g/kg·h for 30min before the end of surgery. The control group was injected with 0.9% sodium chloride injection at a constant speed.

### Observation indicators

The basic clinical data of age, body mass index, operation time, anesthesia time, American College of Anesthesiologists classification, and infusion volume were compared between the two groups. All patients were examined before anesthesia, 5min after intubation, 30min after pneumoperitoneum establishment, 5min after extubation, and 2h after surgery. Hemodynamic indexes [heart rate (HR), Diastolic pressure (DBP), and systolic pressure (SBP)] were measured by PICCO cardiopulmonary volume monitor in 2 groups. 3mL blood was collected at each time point, and Norepinephrine (NA) and cortisol (CORTISOL, Cor, ACTH, and Angiotensin II (Ang II) levels. The changes in airway peak pressure and lung compliance were measured 5min after intubation, 30min after pneumoperitoneum establishment, and 5min after extubation by anesthesia monitor.

An arterial blood gas analyzer was used to measure the arterial partial pressure of oxygen (PaO<sub>2</sub>) 5min after intubation, 30min after pneumoperitoneum establishment, and 5min after extubation. Oxygen uptake volume fraction (FiO<sub>2</sub>). Calculate OI (OI= PaO<sub>2</sub>/ FiO<sub>2</sub>).

### Statistical methods

SPSS22.0 software package was used for statistical data analysis in this study. The statistical data of the American College of Anesthesiologists' classification of the study group and the control group were expressed as a percentage, and the  $\chi^2$  test was used. Age, hemodynamic parameters, stress response, lung compliance, and OI were compared between groups using an independent sample T-test. Results were compared with data when P<0.05 was statistically significant.

## Results

### Comparison of basic clinical data between the two groups

There was no significant difference in age, operation time, anesthesia time, and other basic information between the two groups (P<0.05); see Table 1.

Group	Research group (n=43)	Control group (n=43)	$\chi^2/t$	P
Age (year)	52.77±6.08	53.41±6.13	0.486	0.628
Body mass index (kg/m <sup>2</sup> )	23.57±2.58	23.42±2.57	0.270	0.788
Operation time(min)	226.95±15.94	227.93±13.12	0.311	0.756
Anesthesia time (min)	331.34±56.42	318.54±98.14	0.742	0.461
American College of Anesthesiologists classification				
I	23 (53.49)	18 (41.86)	1.165	0.280
II	20 (46.51)	25 (58.14)		
Infusion quantity (mL)	3247.68±529.35	3234.34±479.80	0.122	0.903

**Table 1:** Comparison of basic clinical data between the two groups.

**Comparison of hemodynamic indexes between the two groups**

There were no significant differences in HR, DBP, and SBP between 2 groups before anesthesia and 2 hours after surgery (P<0.05). At 5min after intubation, 30min after pneumoperitoneum establishment, and 5min after extubation, the above indexes in the study group were significantly lower than those in the control group (P<0.05), as presented in Table 2.

Group	n	Time	HR (times/min)	DBP (tmmHg)	SBP (tmmHg)
Research group	43	Before anesthesia	72.73±4.89	69.89±3.54	116.41±7.36
		5 min after intubation	75.89±3.90	70.47±2.34	122.41±6.98
		30 min after Pneumoperitoneum	64.27±1.19	66.0±3.54	106.23±5.85
		5 min after extubation	67.37±2.38	69.21±3.26	116.17±4.63
		2h 2h after operation	67.41±3.40	67.59±3.29	112.83±4.77
Control group	43	Before anesthesia	72.35±4.03	70.11±3.36	117.33±8.51
		5 min after intubation	77.73±2.11	74.91±3.78	126.27±7.74
		30 min after Pneumoperitoneum	63.61±1.11	66.19±3.05	102.99±5.93
		5 min after extubation	71.19±3.83	72.39±3.04	121.65±5.48
		2h 2h after operation	67.11±3.43	69.35±3.27	113.65±4.47

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

**Comparison of stress response factors between the two groups**

There were no significant differences in NA, Cor, ACTH, and Ang II between 2 groups before anesthesia (P<0.05); At 5min after intubation and 30min after pneumoperitoneum establishment, the above indexes in the study group were significantly lower than those in the control group (P<0.05); see Table 3.

Group	n	Time	NA (pg/mL) <sup>3</sup>	Cor (mmol/L)	ACTH (pg/mL)	AngII (p/μg·L)
Research group	43	Before anesthesia	218.86±24.87	211.41±44.16	11.52±2.24	34.26±2.47
		5 min after intubation	308.46±24.32	402.15±65.25	24.52±5.85	36.84±2.53
		30min after Pneumoperitoneum	322.20±26.53	500.21±47.88	35.37±4.85	40.68±3.65
Control group	43	Before anesthesia	228.86±20.73	216.13±17.52	12.41±2.63	34.22±2.33
		5 min after intubation	345.73±30.46	499.63±66.57	46.54±7.19	39.58±3.74
		30min after Pneumoperitoneum	372.88±31.58	538.92±42.29	62.42±5.16	47.47±3.75

**Table 3:** Comparison of stress response factors between the two groups ( $\bar{x}\pm s$ ).

**Comparison of changes in airway peak pressure and lung compliance between the two groups**

Compared with 5min after intubation, peak airway pressure and lung compliance increased significantly 30min after pneumoperitoneum establishment (P<0.05). Compared to 30min after pneumoperitoneum, the peak airway pressure and lung compliance significantly decreased 5min after extubation (P<0.05); see Table 4.

Group	n	Time	Peak airway pressure (cmH <sub>2</sub> O)	Lung compliance (cmH <sub>2</sub> O)
Research group	43	5 min after intubation	12.55±1.47	45.81±4.07
		30min after Pneumoperitoneum	19.63±1.17	33.83±3.05
		5 min after extubation	17.03±1.46	40.85±3.05
Control group	43	5 min after intubation	12.51±1.37	47.55±5.51
		30min after Pneumoperitoneum	25.22±1.71	27.51±3.30
		5 min after extubation	21.41±1.54	33.41±2.35

**Table 4:** Comparison of changes in airway peak pressure and lung compliance between the two groups ( $\bar{x}\pm s$ ).

**Comparison of OI levels between the two groups**

OI was significantly reduced 30min after pneumoperitoneum establishment compared with 5min after intubation (P<0.05). Compared with 30min after pneumoperitoneum, OI increased significantly 5min after extubation (P<0.05), as presented in Table 5.

Group	n	Time	OI
Research group	43	5 min after intubation	456.33±12.85
		30min after Pneumoperitoneum	411.77±6.14
		5 min after extubation	428.32±6.38
Control group	43	5 min after intubation	456.32±12.75
		30min after Pneumoperitoneum	308.17±12.82
		5 min after extubation	362.90±11.22

**Table 5:** Comparison of OI levels between the two groups ( $\bar{x}\pm s$ ).

## Discussion

Cervical cancer is the most common gynecological tumor in women. Its incidence ranks first among gynecological malignant tumors as one of the main causes of death in female patients. Operation is the main method for treating cervical cancer, and laparoscopic surgery has become the preferred surgical method. It is a minimally invasive surgery; laparoscopic surgery can be used for the diagnosis and treatment of abdominal and pelvic surgery, has quick postoperative recovery time, fewer complications, and the advantages of small skin scar. However, the laparoscopic operation is more complicated and sophisticated than traditional laparotomy surgery with a longer time, thereby increasing the risk of surgery and anesthesia in patients<sup>(7)</sup>. Therefore, it is important to search for appropriate anesthetic drugs. Dexmedetomidine is an  $\alpha_2$  adrenergic receptor agonist, which has the advantages of sedation, hypnosis, analgesia, inhibition of nerve release, reduction of nerve excitability, and inhibition of renin release without obvious respiratory inhibition<sup>(8)</sup>. This study aimed to investigate the effects of dexmedetomidine on hemodynamics, stress response, lung compliance, and oxygenation index in laparoscopic patients with cervical cancer. Some studies have found that the hemodynamics of patients with cervical cancer under laparoscopy show significant changes<sup>(9)</sup>.

Hemodynamics is an important index reflecting the functional status of the body's circulatory system. In addition, hemodynamics can also indirectly reflect the body's stress response. Once harmful stimuli stimulate the body, the sympathetic nervous system is excited, and the release of norepinephrine and catecholamine in the blood increases significantly, which makes the hemodynamics fluctuate violently, and further increases the risk of cardiovascular and cerebrovascular accidents<sup>(10)</sup>. This study showed that dexmedetomidine was of great significance in improving the hemodynamics of laparoscopic cervical cancer patients.

Some scholars believe that perioperative stress response affects patients' postoperative outcomes<sup>(11)</sup>. Stress response refers to a series of nerve and humoral regulations caused by the stimulation of the sympathetic system, which increases the release of catecholamine. Physiological stress is an important defense and adaptation ability of the body and plays a vital role in mobilizing the body's potential<sup>(11)</sup>. However, pathological stress will destroy the body's

normal homeostasis and promote the occurrence and development of diseases, resulting in body failure and even the death of patients. Studies have found that stress response is closely related to the occurrence and development of the digestive system, cardiovascular system, neuropsychiatric system, tumor, and other diseases<sup>(13)</sup>. NA, Cor, ACTH, and Ang II are all important factors that reflect the stress response of the body and play an important role in reflecting the changes in the stress state of the body caused by anesthesia<sup>(14)</sup>. This study showed that dexmedetomidine could significantly inhibit the release of NA, Cor, ACTH, Ang II, and other factors and reduce the stress response of patients.

Due to the long time required for cervical cancer surgery, pneumoperitoneum is often appropriately prolonged, and the increase of intra-abdominal pressure caused by carbon dioxide pneumoperitoneum will significantly reduce lung compliance and residual capacity of lung function and lead to the obvious imbalance of atelectasis/blood flow ratio, resulting in the occurrence of hypoxemia<sup>(15)</sup>. Peak airway pressure and lung compliance are both important indicators of patients' lung function. Duration of pneumoperitoneum and patient position have a serious impact on lung function. This study indicates that dexmedetomidine is of great significance in improving non-male organ function and reducing impaired arterial oxygenation in patients.

In conclusion, dexmedetomidine can maintain hemodynamic stability in laparoscopic cervical cancer patients, reduce stress response, improve lung compliance and oxygenation function, and play a certain role in lung protection.

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