

# Application of Standardized Nursing Procedures Combined with Specialized Management Education in Extracorporeal Membrane Oxygenation in ICU

Min Zhang  
Lingling Wu  
Weihong Shen  
Ying Shen

To analyze the application effect of standardized nursing procedures combined with specialized management education in extracorporeal membrane oxygenation (ECMO) in ICU. 18 patients treated with ECMO in our department from July 1, 2020 to December 30, 2020 were chosen as observation group, and 18 patients receiving ECMO in our department (January 2017-June 2018) were selected as control group. The control group received routine procedures in the implementation of ECMO nursing while the observation group received standardized ECMO nursing procedures combined with specialized management education to analyze the effect of different nursing management methods on ECMO patients by comparing the indexes before and after nursing management. There were no obvious differences in gender ratio, average age, average weight, average BMI, marital status, education and residence between the two groups ( $P > 0.05$ ). Personnel arrival time, start time of rescue, preparation time of items, pipeline prefilling time and catheter completion time in observation group were obviously better compared with control group ( $P < 0.001$ ). The total clinical efficacy rate in observation group was obviously higher compared with control group ( $P < 0.05$ ). There were no significant differences in the  $\text{PaO}_2$ ,  $\text{SPO}_2$  and  $\text{PaCO}_2$  levels between the two groups before nursing management ( $P > 0.05$ ), and the levels in observation group were obviously higher compared with control group after nursing management ( $P < 0.001$ ). The clinical nursing satisfaction in observation group was obviously higher compared with control group ( $P < 0.05$ ). The sequential organ failure assessment (SOFA) score in observation group after nursing management was obviously lower compared with control group ( $P < 0.001$ ). The incidence of complications in observation group was obviously lower compared with control group ( $P < 0.05$ ). The implementation of standardized nursing procedures combined with specialized management education for ECMO patients can effectively shorten rescue time, the preparation time before catheterization and catheter completion time, improve the therapeutic effect, and improve blood gas indicators, safe and effective. At the same time, it can facilitate the doctor-nurse cooperation, worthy of promotion and application.

**Keywords:** standardized nursing procedures; specialized management education; ICU; extracorporeal membrane oxygenation (EXMO); application effect

*Tob Regul Sci.*™ 2021;7(4-1): 647-654

DOI: [doi.org/10.18001/TRS.7.4.1.17](https://doi.org/10.18001/TRS.7.4.1.17)

Min Zhang, nursing department, Jinshan Hospital of Fudan University, Shanghai, 201508, China. Lingling Wu, nursing department, Jinshan Hospital of Fudan University, Shanghai, 201508, China. Weihong Shen, nursing department, Jinshan Hospital of Fudan University, Shanghai, 201508, China. Ying Shen, nursing department, Jinshan Hospital of Fudan University, Shanghai, 201508, China.  
\*Corresponding Author: Ying Shen, Email: 18121288390@126.com

**E**xtracorporeal membrane oxygenation (ECMO) is a treatment technique to provide continuous extracorporeal respiration and circulation for patients with severe

cardiopulmonary failure, aiming to provide cardiopulmonary support and win precious time for rescuing critically ill patients[1-2]. The

technique was initially applied to extracorporeal circulation of open heart surgery, followed by significant progress in treating adult respiratory distress syndrome (ARDS). Besides, this technique has made outstanding contributions to the treatment of fatal hypoxemia, which has greatly triggered the rapid development of ECMO in supporting life[3]. Due to the late application of ECMO in china, there are still many deficiencies in clinical practice. This technique needs to work closely with many disciplines such as extracorporeal circulation, cardiovascular surgery and intensive care unit (ICU), but the current management of ECMO patients in China is decentralized, resulting in a lack of communication mechanism and unclear responsibilities in ECMO, which can easily lead to a "grey area" in patient management[4-6]. ECMO has the characteristics of difficult operation and multi-disciplinary cooperation, with high requirements on the operation of nursing staff. Since the missing of ECMO standardized nursing procedures and nursing quality control standards at home and abroad lead to many problems, it is urgent to establish corresponding procedures and standards[7]. In this study, by analyzing and summarizing the different characteristics of the current ECMO implementation at various stages, standardized nursing procedures were formulated to further improve the clinical effect of ECMO patients, and ECMO patients admitted to our department in different years were selected as the research objects, summarized as below.

## MATERIALS AND METHODS

### General Information

18 patients treated with ECMO in our department from July 1, 2018 to December 30, 2020 were chosen as observation group, and 18 patients receiving ECMO (January 2017-June 2018) were selected as control group.

#### Inclusion Criteria

① The patients were in the severe stage of lung diseases, and the ventilator can not meet the clinical needs; ② The patients had severe myocarditis, myocardial infarction and major heart surgery; ③ The patients had cardiac or respiratory arrest; ④ The study got the approval of the hospital ethics committee, and all patients signed the informed consent.

#### Exclusion Criteria

① The patients were complicated with malignant tumors; ② The patients had irreversible brain injury and irreversible multiple organ damage; ③ The cardiopulmonary resuscitation time of patients was more than 30 minutes.

## Methods

### Implementation methods

The control group received routine ECMO nursing procedures, which meant that the nursing staff carried out ECMO nursing directed by the doctors based on the doctors' clinical experience[8-9]. Patients in the observation group received standardized ECMO nursing procedures combined with specialized management education, and the ECMO nursing was divided into 5 phases, including staff preparation, material preparation, pipeline prefilling, intraoperative cooperation for tube placement and postoperative monitoring. The nursing operating procedures at each stage were reasonably arranged and combined, and phased and time quantitative management was conducted. Multi-site and multi-project operations could be carried out at the same time.

### Formulation of standardized nursing procedures

A special nursing team for ECMO standardization was established. Based on the analysis and summary of related literature at home and abroad and in combination with clinical practice, the team analyzed the post requirements for nursing procedures and working content in the implementation of ECMO technique, formulated standardized nursing procedures for ECMO technique according the ECMO implementation in our hospital, assigned jobs according to the team members' position, qualification and work ability, and distributed responsibilities to individuals. In addition, some documents were formulated, including ECMO Material Preparation Checklist, ECMO Pipeline Prefilling Standard Procedure, Division and Responsibilities of ECMO nursing staff and ECMO Professional Nurse Training and Assessment Content. ECMO Routine Nursing was also completed.

### Training and assessment content

① Theoretical teaching (a total of 22 class hours) was given to the team members, including ECMO basic principles, and establishment and special nursing of ECMO; ② Watching the video of ECMO establishment process, with a total of 4 class hours; ③ Operational training was conducted, including preparation and placement of items, tubing prefilling, and aseptic operation techniques, with a total of 4 class hours. Once the ECMO nursing team members received the notification appropriate cases, they should be in place immediately while initiating the standardized ECMO nursing procedures, and carried out the operation based on the procedures in the implementation of ECMO; ④ Simulation test. Operating experience was summarized through the implementation of complete nursing

procedures after the establishment of ECMO simulation process. ⑤ The ECMO nursing staff were organized to learn related courses about ECMO specialized management education, and to get familiar with the ECMO Material Preparation Checklist, ECMO Pipeline Prefilling Standard Procedure, Division and Responsibilities of ECMO nursing staff and other documents, with a total of 2 class hours. The electronic learning materials were shared in the group for learning. Assessment was performed after training. Due to less application of ECMO, at least two times of further education and training on related content were carried out every year to consolidate and improve the ECMO standardized specialized nursing management ability of the team members,

### Observation Indexes

The rescue operation time of patients in the two groups was recorded and compared, including personnel arrival time, start time of rescue, preparation time of items, pipeline prefilling time and catheter completion time.

Evaluation of clinical efficacy. ① Markedly effective. The relevant clinical symptoms of the patients were completely relieved after treatment; ② Effective. The patients' clinical symptoms and condition were significantly improved; ③ Ineffective. Clinical symptoms did not improve, or even were aggravated. Treatment efficiency = Markedly effective rate + effective rate.

The Blood-gas analyzer (manufacturer: Wuhan Easy Diagnosis Biomedicine Co., Ltd) was used to determine the blood gas indicators before and after nursing management in the two

groups, including PaO<sub>2</sub>, SpO<sub>2</sub> and PaCO<sub>2</sub>.

The Clinical Nursing Satisfaction of ECMO patients questionnaire made by our department was used to evaluate the satisfaction of the two groups with the medical team after nursing. The total score of the scale was 100 points, and the score  $\geq 85$  was fully satisfied, 70-84 was satisfied, 55-69 was generally satisfied and  $< 54$  was dissatisfied. Total satisfaction = fully satisfied rate + satisfied rate;

SOFA score[10] was applied for evaluating degree of organ failure and dysfunction after nursing management in the two groups. The total score of the scale was 10 points, and the higher the score was, the more serious the degree of organ failure and dysfunction was.

The incidence of clinical complications was recorded and compared.

### Statistical Treatment

All the experimental data were statistically analyzed and processed by SPSS21.0 software, and the data were graphed by GraphPad Prism 7 (GraphPad Software, San Diego, USA). The count data were tested by  $\chi^2$ , expressed by [n(%)], and the measurement data were measured by t test, expressed by ( $\bar{x} \pm s$ ). The difference was statistically significant when  $p < 0.05$ .

## RESULTS

### Comparison of Clinical Data

There were no obvious differences in gender ratio, average age, average weight, average BMI, marital status, education and residence between the two groups ( $P > 0.05$ ), as shown in Table 1.

**Table 1 Comparison of clinical data**

Items	Observation group (n=18)	Control group(n=18)	$\chi^2/t$	P
Gender			0.114	0.735
Male	11(61.11%)	10(55.56%)		
Female	7(38.89%)	8(44.44%)		
<b>Average age</b> (years old)	65.31 $\pm$ 4.25	65.26 $\pm$ 4.17	0.036	0.972
<b>Average BMI</b> (kg/m <sup>2</sup> )	21.52 $\pm$ 1.26	21.46 $\pm$ 1.17	0.148	0.883
<b>Average weight</b> (kg)	69.32 $\pm$ 5.28	70.21 $\pm$ 5.18	0.510	0.613
Marital status				
Unmarried	2(11.11%)	0(0.00%)	2.118	0.146
Married	13(72.22%)	17(94.44%)	3.200	0.074
Divorced	3(16.67%)	1(5.56%)	1.125	0.289
<b>Education</b>				
University	3(16.67%)	2(11.11%)	0.232	0.630
Middle school	12(66.67%)	11(61.11%)	0.120	0.729
Primary school	3(16.67%)	5(27.78%)	0.643	0.423
Residence			0.131	0.717
Urban area	6(33.33%)	5(27.78%)		
Rural area	12(66.67%)	13(72.22%)		

**Comparison of Rescue Operation Time**

The personnel arrival time, start time of rescue, preparation time of items, pipeline prefilling time and catheter completion time in

observation group were obviously better than compared with control group ( $P < 0.05$ ), as shown in Table 2.

**Table 2 Comparison of rescue operation time ( $\bar{x} \pm s$ , min)**

Group	n	Personnel arrival time	Start time of rescue	Preparation time of items	Pipeline prefilling time	Catheter completion time
Observation group	18	3.26±0.62	3.46±1.35	2.81±0.25	10.23±1.72	31.24±7.25
Control group	18	6.21±0.53	7.62±1.24	10.25±0.32	17.32±1.65	43.42±7.28
t		15.344	9.628	77.732	12.620	5.030
P		0.000	0.000	0.000	0.000	0.000

**Comparison of Clinical Efficacy**

The total clinical efficacy rate in observation

group was obviously higher compared with control group ( $P < 0.05$ ), as shown in Table 3.

**Table 3 Comparison of clinical efficacy [n(%)]**

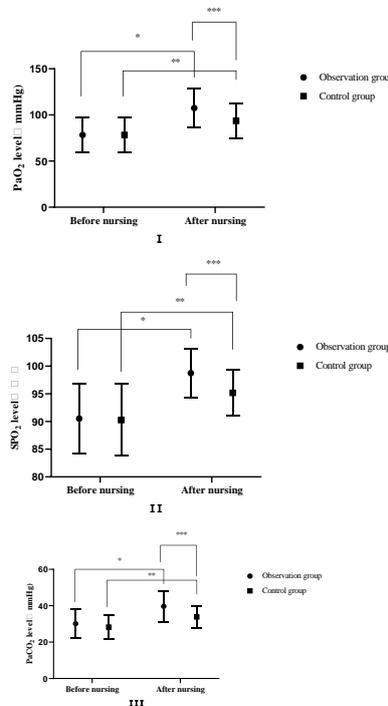
Group	n	Markedly effective	Effective	Ineffective	total Effective rate
Observation group	18	9(50.00%)	8(44.44%)	1(5.56%)	94.44%(17/18)
Control group	18	5(27.78%)	7(38.89%)	6(33.33%)	66.67%(12/18)
X <sup>2</sup>					4.118
P					0.042

**Comparison of Blood Gas Indicators Before and After Nursing**

The PaO<sub>2</sub>, SPO<sub>2</sub> and PaCO<sub>2</sub> levels in both groups after nursing were obviously higher ( $P <$

0.05), and the levels in observation group after nursing were obviously higher compared with control group ( $P < 0.05$ ), as shown in Figure 1.

**Figure 1 Comparison of blood gas indicators before and after nursing ( $\bar{x} \pm s$ )**



Note: Figure I Comparison of PaO<sub>2</sub> levels

The abscissa represents the groups, and the ordinate represents the PaO<sub>2</sub> level (mmHg).

The PaO<sub>2</sub> levels in the observation group before and after nursing were (78.34±19.23) mmHg and (107.49±21.32) mmHg, respectively while those in the control group were (78.29±18.94) mmHg and (93.56±19.38) mmHg, respectively.

\* indicated a significant difference in the PaO<sub>2</sub> levels in the observation group before and after nursing (t=4.307, P=0.000);

\*\* indicated a significant difference in the PaO<sub>2</sub> levels in the control group before and after nursing (t=2.391, P=0.023).

\*\*\* indicated an obvious difference in PaO<sub>2</sub> levels between the two groups after nursing (t=2.051, P=0.048).

Figure II Comparison of SPO<sub>2</sub> levels

The abscissa represents the groups, and the ordinate represents the SPO<sub>2</sub> level (%).

The SPO<sub>2</sub> levels in the observation group before and after nursing were (90.53±6.35)% and (98.73±4.35)%, respectively while those in the control group were (90.27±6.49)% and (95.17±4.16)%, respectively.

\* indicated a significant difference in the SPO<sub>2</sub> levels in the observation group before and after nursing (t=4.520, P=0.000);

\*\* indicated a significant difference in the SPO<sub>2</sub> levels in the control group before and after nursing (t=2.697, P=0.011).

\*\*\* indicated an obvious difference in SPO<sub>2</sub> levels between the two groups after nursing (t=2.509, P=0.017).

Figure III Comparison of PaCO<sub>2</sub> levels

The abscissa represents the groups, and the ordinate represents the PaCO<sub>2</sub> level (mmHg).

The PaCO<sub>2</sub> levels in the observation group before and after nursing were (30.15±7.82)mmHg and (39.64±8.35)mmHg, respectively while those in the control group were (28.26±6.45)mmHg and (33.83±6.17)mmHg, respectively.

\* indicated a significant difference in the PaCO<sub>2</sub> levels in the observation group before and after nursing (t=3.519, P=0.001);

\*\* indicated an obvious difference in PaCO<sub>2</sub> levels in control group before and after nursing (t=2.648, P=0.012).

\*\*\* indicated an obvious difference in the PaCO<sub>2</sub> levels between the two groups after nursing (t=2.374, P=0.023).

Comparison of Clinical Nursing Satisfaction

The clinical nursing satisfaction in observation

group was obviously higher compared with control group (P < 0.05), as shown in Table 4.

Table 4 Comparison of clinical nursing satisfaction [n(%)]

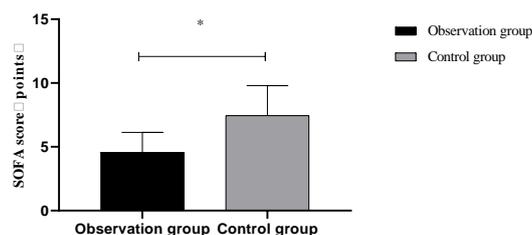
Group	n	Fully satisfied	Satisfied	Generally satisfied	Dissatisfied	Total satisfaction
Observation group	18	9(50.00%)	8(44.44%)	1(5.56%)	0(0.00)	94.44%
Control group	18	6(33.33%)	6(33.33%)	4(22.22%)	2(11.11%)	66.67%
X <sup>2</sup>						4.434
P						0.035

Comparison of SOFA Scores after Nursing Management

The SOFA score in observation group after

nursing management was obviously lower compared with control group (P < 0.05), as shown in Figure 2.

Figure 2 Comparison of SOFA scores after nursing management (  $\bar{x} \pm s$  )



Note: The abscissa represents the groups, and the ordinate represents the SOFA score (points).

The SOFA scores in the two groups were (4.57±1.56) points and (7.45±2.34) points, respectively.

\* indicated an obvious difference in the SOFA scores between the two groups ( $t=4.345$ ,  $P=0.000$ ).

### Comparison of the Incidence of Complications

The incidence of complications in observation

group was obviously lower compared with control group ( $P < 0.05$ ), as shown in Table 5.

**Table 5 Comparison of the incidence of complications[n(%)]**

Group	n	External organ failure	Infection	Thrombus	Total Incidence
<b>Observation group</b>	18	0(0.00%)	0(0.00%)	1(5.56%)	5.56%(1/18)
<b>Control group</b>	18	2(11.11%)	1(5.56%)	3(16.67%)	33.33%(6/18)
<b>X<sup>2</sup></b>					4.434
<b>P</b>					0.035

## DISCUSSION

ECMO is split into venous-venous (V-V) ECMO and venous-arterial ECMO based on o treatment purposes and blood circulation patterns, in which the latter is generally carried out in the operating room, and the former is suitable for patients who need respiratory support. Since V-V ECMO is mostly established in ICU, higher requirements are put forward for nursing cooperation in the use of ECMO<sup>[11-13]</sup>. The lack of standardized ECMO nursing procedures will lead to lots of disadvantages. It increases training cost of ECMO nursing personnel, resulting in insufficient supply of ECMO professional nursing staff, uneven ability distribution and difficult training of reserve forces, which to some extent hinders the application and development of ECMO technique. Besides, the lack of standardized nursing management mechanism is also an important factor affecting the success of treatment for patients<sup>[14-16]</sup>. Therefore, through the analysis and summary of relevant literature at home and abroad, combined with clinical practice, this study developed standardized nursing procedures and specialized management education model suitable for ECMO patients in China. Some scholars believe that communication, cooperation and optimal layout management among ECMO team members are key factors affecting the establishment of ECMO<sup>[17]</sup>. In this study, ECMO cases treated in different years were chosen as research objects. After summary of the current ECMO nursing staff and facilities, ECMO standardized nursing procedures combined with the specialized nursing management education were formulated, and the routine procedures and standardized nursing procedures were implemented for the research objects respectively. Through the analysis and summary of the implementation process, the quality control was implemented, and the nursing rocedures were improved. Finally, a feasible implementation plan was formulated to reduce ECMO-related complications, enhance the success rate of treatment and ensure the life safety of patients.

This study showed that rescue time in observation group was obviously lower ( $P < 0.05$ ). The narrow internal space of ICU and the need for more clinical auxiliary equipment bring difficulties to the surgery and cooperation<sup>[18-19]</sup>. To solve this problem, a standardized item placement checklist was written to guide the nursing staff to place all kinds of items and equipment reasonably, reduce the movement of equipment or instruments, and avoid cross infection. Besides, the layout optimization greatly improved the cooperation of the team members and effectively reduced the rescue time. In addition, the prevention and treatment of ECMO-related complications is still the focus. Due to the extremely unstable hemodynamic parameters of patients at this stage, early nursing management will have a decisive impact on the overall situation<sup>[20-22]</sup>. This study found that incidence of clinical complications in observation group was obviously lower. Ayyildiz et al.<sup>[23]</sup> pointed out in their study that after the implementation of standardized nursing procedures for ECMO patients in the emergency department, the total incidence of clinical complications was obviously lower compared with reference group, indicating that standardized nursing procedures obviously reduce complications in patients with ECMO and ensure treatment effect.<sup>[24]</sup>

In conclusion, the implementation of standardized nursing procedures combined with specialized management education for ECMO patients can effectively shorten the rescue time, enhance the clinical rescue effect, improve blood gas indicators and facilitate the doctor-nurse cooperation, worthy of application and promotion.<sup>[25]</sup>

### DECLARATION OF CONFLICTING INTERESTS

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**FUNDING**

This research work is supported by Application of Standardized Nursing Procedures Combined with Specialized Management Education in Extracorporeal Membrane Oxygenation in ICU(Jyhz2013).

**REFERENCES**

- Jean-Marc Baste, Laura Haddad, Guillaume Philouze. A combined technique using a muscular flap and endobronchial stent to repair complex broncho-oesophageal fistulae supported by ECMO[J]. *Acta Chirurgica Belgica*, 2018, 118(1):52-55.
- Alessandro Galazzi, Alessandra Brambilla, Giacomo Grasselli, et al. Quality of Life of Adult Survivors After Extra Corporeal Membrane Oxygenation (ECMO)[J]. *Dimensions of Critical Care Nursing*, 2018, 37(1):12-17.
- Alessandro Galazzi, Alessandra Brambilla, Giacomo Grasselli, et al. Quality of Life of Adult Survivors After Extra Corporeal Membrane Oxygenation (ECMO)[J]. *Dimensions of critical care nursing: DCCN*, 2018, 37(1):12-17.
- Kahloon, Rehan, Mangi, Muhammad Asif, Moukarbel, George V.. Migrated Avalon Elite Venovenous ECMO Cannula Novel Technique to Reposition Without Disrupting the Circuit[J]. *JACC. Cardiovascular interventions*, 2019, 12(18):E161-E162.
- Jing Liu, Yusu Han, Wenda Hua, et al. Improved flowing behaviour and gas exchange of stored red blood cells by a compound porous structure[J]. *Artificial Cells, Nanomedicine, and Biotechnology*, 2019, 47(1):1888-1897.
- De Waele, Elisabeth, Jonckheer, Joop, Pen, Joeri J., et al. Energy expenditure of patients on ECMO: A prospective pilot study[J]. *Acta Anaesthesiologica Scandinavica*, 2019, 63(3):360-364.
- Lorusso Roberto, Bidar Elham, Natour Ehsan, et al. Minimally invasive management of central ECMO after ascending aortic surgery[J]. *Journal of cardiac surgery*, 2019, 34(3):131-133.
- Tyler, Michelle D., Singh, Neetu, McNally, Matthew J., et al. Improved Outcomes With Standardized Convalescent Preterm Respiratory Care Practices[J]. *Respiratory care*, 2019, 64(9):1109-1115.
- Van Calster, Joachim, Willekens, Koen, Seys, Deborah, et al. Standardized care by redesign of an intravitreal injection pathway[J]. *European journal of ophthalmology*, 2019, 29(1):92-99.
- Leu Grace R., Scott Andrew R.. A Standardized Care Pathway following Mandibular Distraction in Infants Less Than 3 Months of Age[J]. *Otolaryngology-Head and Neck Surgery*, 2019, 161(5):870-876.
- McNicol, Megan, Kuhn, Catherine, Sebastian, Sonya. Standardized documentation workflow within an electronic health record to track pharmacists' interventions in pediatric ambulatory care clinics[J]. *Journal of the American Pharmacists Association: JAPhA*, 2019, 59(3):410-415.
- Iba Toshiaki, Arakawa Makoto, Mochizuki Katsunori, et al. Usefulness of Measuring Changes in SOFA Score for the Prediction of 28-Day Mortality in Patients With Sepsis-Associated Disseminated Intravascular Coagulation[J]. *Clinical and Applied Thrombosis/Hemostasis*, 2019, 25.
- Wang, Xiao-Wen, Niu, Xing-Guo, Li, Jin-Xiu, et al. SOFA Score Can Effectively Predict the Incidence of Sepsis and 30-Day Mortality in Liver Transplant Patients: A Retrospective Study[J]. *Advances in therapy*, 2019, 36(3):645-651.
- Choi, Ji Ho, Lee, Bora, Hwang, Se-Hwan. Association of Respiratory Mechanic Instability and Respiratory Parameters among Adults with Obstructive Sleep Apnea[J]. *Otolaryngology-head and neck surgery: official journal of American Academy of Otolaryngology-Head and Neck Surgery*, 2019, 160(5):928-934.
- Aanchal. Arora, Manasa. Mudalagiri, Deepali. Sharma, et al. Myocarditis with sinus exit block: A rare presentation of Plasmodium vivax malaria[J]. *Indian Journal of Medical Specialities*, 2019, 10(1):39-41.
- Choi Ji Ho, Lee Bora, Hwang Se-Hwan. Association of Respiratory Mechanic Instability and Respiratory Parameters among Adults with Obstructive Sleep Apnea[J]. *Otolaryngology-Head and Neck Surgery*, 2019, 160(5):928-934.
- Kuo, Chia-Chun, Chuang, Ho-Chiao, Yu, Hsiao-Wei, et al. Adaptive control of phase leading compensator parameters applied to respiratory motion compensation system[J]. *Journal of X-ray science and technology*, 2019, 27(4):715-729.
- Carubbi, Cecilia, Masselli, Elena, Calabro, Elisa, et al. Sulphurous thermal water inhalation impacts respiratory metabolic parameters in heavy smokers[J]. *International Journal of Biometeorology: Journal of the International Society of Biometeorology*, 2019, 63(9):1209-1216.
- Salem, Joe-Elie, Allenbach, Yves, Kerneis, Mathieu. Abatacept for Severe Immune Checkpoint Inhibitor-Associated Myocarditis[J]. *The New England journal of medicine*, 2019, 380(24):2377-2379.
- Tschoepe, Carsten, Cooper, Leslie T., Torre-Amione, Guillermo, et al. Management of Myocarditis-Related Cardiomyopathy in Adults[J]. *Circulation research: a journal of the American Heart Association*, 2019, 124(11):1568-1583.
- D Olychnikov, A Letunovskaya, S Battaia, et al. In vivo diagnosis of Toxoplasma gondii myocarditis in a cat[J]. *Australian Veterinary Practitioner*, 2019, 49(2):31-35.
- Higgins, Julia M., San, Cindy, Lagnado, Gillian, et al. Incidence and Management of Clozapine-Induced Myocarditis in a Large Tertiary Hospital[J]. *Canadian journal of psychiatry*, 2019, 64(8):561-567.
- Ayyildiz, Ayse, Pamuk, Gulsun A., Uzumcugil, Filiz, et al. The Effects of BMI on Respiratory and Hemodynamic Parameters in Laparoscopic Bariatric

- Surgery: An Observational Study[J].Bariatric Surgical Patient Care,2019,14(1):34-40.
24. Hao Wang , Xiao-Meng Zhang , Go Tomiyoshi, et al. Association of serum levels of antibodies against MMP1, CBX1, and CBX5 with cerebral infarction. *Oncotarget*, 2017, 9(5): 5600-5613. Doi: 10.18632/oncotarget.23789
25. Jiafeng Yao, Li Wang, Kai Liu, Hongtao Wu, Hao Wang, Jingshi Huang, Jianping Li. Evaluation of electrical characteristics of biological tissue with electrical impedance spectroscopy. *Electrophoresis* , 2020, 41(16-17): 1425-1432. doi: 10.1002/elps.201900420.