

Application and Nursing Procedure of Double Filtration Thermo (DFT) in the Treatment of a Critically Ill COVID-19 Patient

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Abstract

Objective: To explore the application, nursing procedure, complications and outcome of heat cycle double plasma filtration in critically ill COVID-19 patients.

Methods: A critical ill COVID-19 patient who underwent double filtration thermos (DFT) was selected as the study object. Psychological counseling and health education were given before treatment. The changes of vital signs, finger blood oxygen saturation, inflammatory factors and dialysis complications were observed and recorded before and after treatment. The patient fully understood and accepted the operation methods and treatment risks of double filtration thermo (DFT).

Results: In the process of DFT therapy, the patient had no therapy-resistance behavior, and actively cooperated with medical staff. The whole process was smooth and the vital signs of the patient were stable. There were no complications related to blood purification. Interleukin-6 (IL-6) as 9.81 pg/ml was significantly lower than that of 50.23pg/ml pre-DFT, C-reactive protein (CRP) as 34.3mg/l was significantly lower than that of 82.3mg/l pre-DFT, and blood oxygen saturation (95%-100%) was significantly higher than that before DFT (90%-92%).

Conclusion: DFT can effectively remove inflammatory factors and provide more opportunities for the treatment of critically ill COVID-19 patients.

Keywords: Double filtration thermo (DFT); COVID-19; nursing; Dialysis

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Introduction

Since December 2019, a bunch of cases of COVID-19 patients (Coronavirus Disease 2019, COVID-19) have been found in Wuhan, Hubei Province. At present, COVID-19 have been found in more than 100 countries all over the world. COVID-19 has strong infectivity and general susceptibility to human and the main clinical manifestations are fever, fatigue and dry cough. Severe patients with COVID-19 often have dyspnea and/or hypoxemia after one week [1, 2]. It is found that most critically ill COVID-19 patients are accompanied by "cytokine storm" [3, 4]. A variety of blood purification treatments can effectively remove the excessive inflammatory mediators and toxins in patients, block the occurrence of cytokine storm, and reduce the mortality of patients [5, 6]. However, so far, it is still difficult to remove inflammatory factors from critically ill patients. At present, one critically ill COVID-19 patient has been treated with double filtration thermo (DFT) in our hospital. Considering that COVID-19 is a new infectious and explosive disease, DFT is different from conventional bedside blood purification in terms of clinical nursing. Therefore, the application effect and nursing procedure of the special patient are reported as follows in order to provide reference for clinical application of DFT in critically ill COVID-19 patients treatment.

1 Clinical Characteristics

1.1 Basic clinical information

Patient, 70 years old, female, had history of breast cancer and cerebral infarction, without hypertension, diabetes, chronic bronchitis, heart disease and other basic diseases. Admission physical examination: body temperature 36.8°C, pulse, 72/min, respiratory frequency 19/min, blood pressure 141/82 mmHg; finger pulse oxygen saturation 96% (without oxygen inhalation). The patient confirmed COVID-19 was admitted to hospital on Feb. 6, 2020.

Admission auxiliary examination: Blood routine examination: WBC $12.56 \times 10^9/L$ (reference: $3.5-9.5 \times 10^9/L$), neutrophils 88.7% (reference: 40%-75%), lymphocyte 5.7%, lymphocyte count $0.72 \times 10^9/L$, C-reactive protein (CRP) 56.0 mg/l (reference: 0, 10 mg/L), Procalcitonin (PCT) 0.049 ng/ml (reference: < 0.1 ng/ml). The function of liver and kidney was normal, the electrolyte examination: potassium 3.49 mmol, calcium 1.90 mmol, with the others normal. Three items of myocardial infarction are normal. Other pathogens of respiratory tract were negative. In terms of symptoms, chest tightness and wheezing symptoms worsened day by

day, and there was still cough, wheezing, chest tightness and no fever on February 15th, but they could not deoxidize and could not go out for chest CT examination. Physical examination: vital signs are stable, there is no obvious change in heart and lung; auxiliary examination: leukocytes $14.61 \times 10^9/L$, neutrophils 88.7%, neutrophils 88.7%, CRP 82.3mg/ml (reference: $<10\text{pg/ml}$); blood oxygen saturation 90%-92% with mask high flow rate (10L/min). The right femoral vein was temporarily dialysed and intubated, and the first DFT treatment was performed for 2 hours. The second DFT treatment was given every other day for 2 hours, the blood oxygen saturation was maintained at 95%-100 % , with CRP 34.3mg/l and IL-69.81pg/ml.

1.2 Nursing process

1.2.1 The nursing before DFT treatment

Throughout the treatment, the patient did not know about the new COVID-19 disease, and were not accompanied by their family during the treatment, resulting in negative emotions such as tension, loss, fear and so on. Therefore, attention should be paid to the psychological counseling of patients. The main results are as follows: (1) Before the beginning of DFT treatment, doctors and nurses should communicate with patients to understand their psychological state. (2) Explaining the purpose, method and therapeutic effect of blood purification to patients, so that they can fully understand the knowledge related to treatment and eliminate the bad mood during the treatment. (3) Paying attention to the expression of the patients in the communication with the patients, releasing the bad emotions of the patients, relieving the psychological pressure, and make them cooperate with the DFT. (4) To inform patients that a positive attitude is very important, and keep peace of mind and emotional stability will help to improve their immunity. It is necessary to stimulate patients' desire for survival and establish confidence in overcoming the disease. (5) Positive psychology such as mindfulness decompression and other means can be used to communicate in a mild, relaxed and positive tone to create a relaxed and comfortable treatment.

1.2.2 Protection of therapists

In the whole process of treatment, the protection of personnel is also particularly important. First, before entering the isolation ward, the therapists are prepared to enter the clean area through the special passageway for the staff, and wear protective equipment in the clean area. The process of wearing protective items is as follows: change clothes, change work shoes, wash hands or hand disinfection, wear medical protective mask (check mask tightness), wear disposable round medical hat, wear gloves, wear goggles, wear gloves, wear gloves (over the cuffs of protective clothing), wear shoe covers and wear face masks. Hand sterilization is carried out before entering the contaminated area.

Next, the therapists should wash their hands before leaving the isolation area or the contaminated area. The order of removing protective equipment in buffer zone is: take off the mask, remove the shoe cover, remove the zipper of protective clothing, Loosening the coat is easy to remove, remove gloves, remove protective clothing, hand disinfection into the buffer

zone, wash hands, close your eyes, take off goggles, hand disinfection, close your eyes, take off your goggles, remove your hands, take off your hat (hands do not touch the inside of the hat and yourself), wash your hands, take off gloves, close your eyes, take off the mask, wash your hands and enter the clean area.

Personal hygiene disposal of medical staff before leaving the department: personal hygiene treatment should be carried out before leaving work, and attention should be paid to the protection of respiratory tract and mucous membrane. The specific process is: wash hands, change clean masks, take off overalls, change shoes, bathe, change clothes and leave.

1.2.3 DFT treatment procedure

The DFT treatment used Japan Kawasumi KM-9000 blood purification device, selected double filtration thermo (DFT) mode, blood loop mode K-PD-90DT, membrane plasma separator Plasma cure PE-08 and membrane plasma component separator Evaflux-5A20 were used for blood purification. According to the operation instructions, the cardiopulmonary bypass system was installed, and the cardiopulmonary bypass pipeline was preflushed after the automatic test was passed. 1L heparin saline of 5mg/ml concentration was used first, and then 3L saline was used. Anticoagulant regimen is 20~30min intravenous injection of low molecular weight heparin before treatment, the dose is 60~80IU/Kg [7]. After the establishment of extracorporeal circulation, the flow rate of blood pump was adjusted to 80ml-150ml/min, the separation pump was 20ml-45ml/min, the circulating pump was automatically set at 80ml/min, and the heater was set at 42°C. The preset target volume of plasma purification was 3000 ~ 4000ml and the duration of treatment was 1 ~ 2.5 hours.

1.2.4 Nursing in the DFT treatment

1.2.4.1 Nursing during DFT treatment

The whole process is managed by experienced blood purification specialist nurses, no longer caring for other patients. (1) Record vital signs every half an hour and notify the doctor in time if any abnormalities are found. If there is dyspnea or decrease of blood oxygen saturation, you should immediately finish the treatment, and immediately perform endotracheal intubation and rescue if necessary. (2) Closely monitor the numerical indicators displayed by the machine, such as inlet pressure, return blood pressure, filtration pressure, purifier pressure, separator transmembrane pressure and other abnormal alarm, accurately determine the cause, timely and effectively eliminate the problem, and restore the treatment state. (3) Closely observe the condition of extracorporeal blood circulation device, such as blood flow rate, plasma separation speed, circulating pump speed, heating temperature, circulatory system and so on. If abnormal changes such as red outside the plasma separator, blood clots in the arteriovenous ampulla and dark color of the filter are found, deal with them in time and report to the doctor. (4) Paying close attention to the oxygen supply situation of the patients, grasp the changes of finger pulse oxygen saturation and consciousness, avoid the complications related to oxygen therapy, check the connection between the oxygen supply pipeline and the patient, and remove the stagnant water in the pipeline immediately. When the oxygen supply pipe is damaged, broken and visible

pollution, it should be replaced immediately[8]. (5) Paying close attention to the transmembrane pressure of the purifier. If the pressure rises to more than 250mmHg, it indicates that the filtration efficiency of the membrane plasma separator reaches saturation and the blood can be returned to the machine to end the treatment. (6) fill in the disposal operation in time so that the doctor can grasp the changes of the disease during the treatment.

1.2.4.2 Nursing after DFT treatment

After the blood is returned, the consumables of cardiopulmonary bypass are removed, the blood circuit and the separator are placed in the medical waste bin with a double-layer yellow garbage bag, and the sharp instruments are placed in the sharp bucket. The main results are as follows: (1) Strict aseptic operation, follow the procedure of changing dressing of dialysis catheter, disinfect, bandage and fix. (2) Patients should be advised to reduce the rest in the right lying position so as not to oppress the indwelling catheter and reduce the bending movement of the right lower extremities. (3) Observe whether the indwelling catheter has bleeding, whether the dressing is crimped, whether the surrounding skin is dry and uncontaminated, and if necessary, change the dressing immediately to prevent secondary infection[9].

1.3 Clinical observation indicators

Observe whether there are adverse reactions in the course of DFT, whether there are emergency complications related to blood purification, such as air embolism, allergy, hemolysis, etc., and compare the vital signs, finger pulse oxygen saturation, IL-6, CRP, serum creatinine and albumin before and after DFT treatment.

2 results

2.1 Observation of side effects in the DFT treatment

The DFT treatment process was smooth, there were no complications related to blood purification, no side effects and bleeding. There was no significant change in body temperature before and after DFT treatment (mean 36.7 °C before treatment, 36.5 °C after treatment), heart rate (74/min before treatment, 75/min after treatment), respiratory rate (17/min before and 17/min after off-machine), and blood pressure (106-138/72-82mmHg, 115~153/67~95mmHg after off-machine). There was no significant change in serum creatinine (67 μ mol/L before treatment and 74 μ mol/L after treatment), albumin (29.9 g/L before treatment and 30.9 g/L after treatment), and ALT/AST (1.66 before treatment and 1.68 after treatment).

2.2 Therapeutic effect and outcome of the DFT treatment

The treatment time lasted for 2 hours, and when the oxygen supply scheme was unchanged, the finger pulse oxygen saturation increased significantly after DFT treatment, and the blood oxygen saturation increased from 90%-92% to 95%-100%. The IL-6 (9.81pg/ml) was lower than that before treatment (50.23pg/ml), and the CRP(34.3mg/l) was lower than that of 82.3mg/l before DFT treatment. The results indicated that the degree of dyspnea was alleviated after DFT treatment.

3 Discussion

In terms of the characteristics of the disease, COVID-19 is lack of effective drugs, with relatively long onset time, and most of the patients have anxiety and panic. The operation of blood purification technology will aggravate the negative emotions of patients, and good quality nursing can effectively improve the cooperation and prognosis of patients[10, 11]. Therefore, during DFT treatment, senior blood purification specialist nurses give patients sufficient psychological counseling before treatment, skilled operation and specialized nursing during DFT treatment, take the initiative to carry out specialist guidance, interrogate early psychological problems, build up confidence, and reduce their resistance to therapy.

In terms of the principle of DFT therapy, after the plasma was separated twice by the modified double plasma exchange (DFPP), the DFT technique warmed the plasma circulation (from 38 °C to 42 °C), which decreased the plasma albumin viscosity and improved the adsorption efficiency of the separation membrane for protein toxin, eventually, the separator membrane absorbed the inflammatory factors in the plasma without change of blood volume, reduced the incidence of volumetric hypotension during dialysis, and could efficiently clear inflammatory factors. All the beneficial substances such as albumin in circulating plasma were infused back into the patients, which reduced the input of exogenous substances and reduced the care intensity of nurses. Crucially, there is no need to supplement plasma or albumin and other liquids during the DFT treatment, which avoids a series of problems caused by fluid infusion and reduces the incidence of complication. Due to the closed circulatory pathway of the whole system, the removal of waste does not come into the outside, which can effectively prevent infection and unsanitary environment.

Noteworthy, the plasma volume in DFT circulation treatment is 1.4 times than that of traditional plasma exchange, plasma adsorption and other plasma treatments, which improves the efficiency of removing harmful solutes in plasma and ensures the therapeutic effect[12]. Compared with traditional plasma exchange, plasma adsorption, continuous renal replacement therapy (CRRT) and other methods to remove inflammatory factors, DFT method does not use plasma products and exchange fluid, has low care intensity, short treatment time, reduces dialysis complications and interference to blood coagulation function, and has better treatment compliance. Meanwhile, DFT greatly reduces the risk of exposure of nursers to COVID-19 in the treatment process.

In addition, the traditional bedside dialysis therapy takes a long time, usually lasts 8 hours or more, and requires at least 32 L dialysate and replacement fluid for 8 hours, which is heavy and requires more nurses. Under the three-level protective measures, nurses' visual field is blocked, breathing is difficult, operation is inflexible, activity is restricted, and physical exertion is fast, which tests the physical quality and psychological endurance of nurses. Under the special background of the epidemic, nursing staff are extremely short of human resources, which requires more manpower expenditure than traditional treatment. Therefore, we need a treatment

with good effect, short time and convenient operation, and the DFT method just meets these conditions.

To sum, in the special period with COVID-19 outbreak, under the background of tertiary protection, the shortage of human resources and blood products, the advantage of DFT is more obvious, which is suitable for large-scale promotion of DFT technology to remove cytokines from critically ill COVID-19 patients.

4. Conclusion

A great deal of clinical experience and facts have proved that many critically ill patients have been saved from the clinical application of blood purification technology. When applied to the nursing experience that the clinical nursing of COVID-19 is different from that of blood purification of common diseases, there are still some improvements in dialysis nursing of COVID-19. Our research shows that DFT is effective and safe in the treatment of critically ill COVID-19 patients. The present study indicates that DFT technology will continue to be popularized and studied in the future, and will play a more positive role, so as to accumulate more practical nursing experience.

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