

Fault Analysis and Treatment of Air Conditioning System in Hospital Clean Operating Room

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Abstract: Nowadays, the Requirements of the Public for the Hospital Environment Are Becoming More Stringent, and the Requirements for the Hospital's Clean Operating Room Are Even More Prominent. the Hospital Clean Operating Room Air Conditioning System is Responsible for Controlling the Indoor Environment, Including the Removal of Dust, Harmful Gases, Bacteria and Other Work. However, in the Event of a Malfunction in the Hospital Clean Operating Room Air Conditioning System, It Not Only Affects the Operation of the Operating Room, But May Have Uncontrollable Consequences for Ongoing Surgery. Based on This, This Paper Briefly Introduces the Indoor Air Conditioning System of Hospital Clean Operation, Analyzes the Possible Failures, and Proposes Corresponding Treatment Methods to Provide a Theoretical Reference for the Normal Operation of the Air Conditioning System.

1. Introduction

1.1 Literature Review

The role of the operating room air conditioning system is extremely important for the high standards of clean operating rooms for the environment. The air conditioning system maintains room temperature during surgery and removes impurities from the air to prevent infection during surgery (Cheng, 2014). Liu Peng scholars combined with the problems frequently encountered in the air-conditioning system in the laminar flow operating room, analyzed that the clean operating room has the following three problems. First, the fluctuation range of temperature and humidity in the operating room during the adjustment process is too large; second, the wind pressure in the operating room is deviated; third, the humidity in the operating room is high in summer (Liu, 2014). Based on the above problems, Xu Yong refined them to the parts of air conditioning system, which may be caused by aging of temperature sensor, too much scale covering on the electrode piece, making the electrode piece unable to contact with water, too much filter dust blocking the air duct, etc. (Xu, 2012). Wang Yang scholars put forward a variety of treatment methods for the problems in the air conditioning system. For example, reasonable improvement of heat recovery design, rational use of frequency converters, and use of secondary air return treatment (Wang, 2015). Gai Xuehao scholars proposed to maintain the system and try to avoid failures. Specifically, it is the practice of air return cleaning, clear filter, water quality inspection, pressure gauge inspection (Gai, 2016). Sun Limin scholars studied the design of air conditioning systems and divided them into airflow calculation, new exhaust design, airflow organization, differential pressure control, positive and negative pressure switching, and return air system (Sun, 2012).

1.2 Purpose of Research

With the economic and social development of China, the national medical level has continuously increased. And the operating environment has become more sophisticated, many hospitals have begun to deploy clean operating rooms to meet the high standard operating room environment requirements. Since the clean operating room has strict requirements on the operating environment, the operation and maintenance of the air conditioning system is also extremely important. The normal operation of the air conditioning system directly determines whether the clean operating room can be put into normal use. However, when I combed related research, I found that most

scholars are not comprehensive enough for fault analysis. Based on this, this paper studies and analyzes common faults, and proposes a targeted treatment method, which has important practical significance for the operation of hospital clean operating room.

2. The Clean Operating Room Air Conditioning System Function Introduction

The clean operating room generally adopts a centralized air conditioning system, and the air conditioning system is mainly composed of an air conditioning unit, a new air unit, an exhaust fan unit, and a ventilation duct. In general, air conditioning units are located in professional computer rooms, and ventilation ducts are installed by professionals in accordance with hospital air supply requirements (Zhen and Li, 2018). The air conditioning unit is mainly composed of the following parts. First, the fresh air filtration stage. Includes primary filter, damper switch, pressure sensor and more. Second, the heating phase. This stage is only responsible for heating the cold air and transporting it to the operating room when appropriate. Third, the fresh air return to the wind mixing stage. At this stage, the fresh air and the operating room return air are mixed, and the treatment is delivered to the operating room. Fourth, the fan phase. The main components of the fan stage include inverter fans, pressure sensors, and inverters. Fifth, the current sharing section. At this stage, the airflow maintains normal flow, which is convenient for the crew to check and repair. Sixth, cooling and heating stages. At this stage, two functions are realized. One is to heat the cold air, and the heat source air is cooled. Seventh, the humidification section. Since the operating room has humidity requirements for the environment, it is necessary to set up a test after the medium-effect filtration section to prevent excessive humidity and bacteria. Eighth, the medium efficiency filtering stage. The medium efficiency filter installed at the end of the air conditioning unit mainly works to filter particles with a radius of 5 μm or more. Ninth, the disinfection phase. It is usually placed next to the air outlet to perform the final disinfection of the air supply system to prevent bacteria from entering.

The design principles of the air conditioning system in the clean operating room generally meet the following three requirements to ensure that it is suitable for the surgical environment. First, the air conditioning system is placed separately from the auxiliary equipment. Second, separate air conditioning systems should be used for the primary and secondary clean operating rooms to prevent pressure differences. Third, the third and fourth clean operating rooms can share an air conditioning system, but the fresh air import needs to be implemented separately or simultaneously.

3. The Hospital Clean Operating Room Air Conditioning System Common Faults Overview

3.1 Air Conditioning Filter Blockage

At present, most hospitals control the cost of operation, generally the filters in the air conditioning system are regularly cleaned up and then continue to be used. However, this method replaces the cost of the instrument with the labor cost and has no practical effect. In addition, the filter performance after cleaning is far less than the new filter. Even in the actual operation process, the filter after cleaning will be blocked many times, resulting in the central pressure control system out of control, and the temperature and humidity of the clean operating room cannot be adjusted according to the surgical arrangement. This will cause the filter to become clogged or even damaged.

3.2 Exhaust Fan Failure

The clean operating room is extremely demanding in the surgical environment, producing harmful bacteria when exhausting air and most of the microorganisms are exhaust fan failures. When a fault occurs, the fan and the air duct are accompanied by vibration and there is noise. To troubleshoot the exhaust fan, first make sure that the damper is open, then remove the damper and filter, and separate the motor from the exhaust fan. If the motor is running normally without noise, the blower failure can be confirmed.

3.3 Air Conditioning System Health Impact

Most of the current air conditioning systems are centrally located in the upper part of the operating room, and the fresh air is regulated by the central system. However, most of the new air outlets are extremely noisy. The air-conditioned room has a lot of bacteria due to the long-term static dust falling, which has a great influence on the surgical requirements of the clean operating room. Because the operating room ceiling of the hospital will leave construction waste or dust, it will sometimes be affected by wind and rain, bringing external bacteria, especially rainwater, which will breed bacteria, so that it can not meet the requirements of clean operating room.

3.4 Air Conditioning Use Time is Not Properly Controlled

When the hospital clean operating room requires surgery, all procedures and systems must be in a controllable state, and the pressure of each other in the connected operating room cannot occur. However, most hospitals increase the operating cost because of the frequent meetings of air-conditioning systems, and choose to perform pressure adjustments during surgery. Although this choice increases the cost, it takes a long time to reach the environmental standard in the emergency use of the operating room, which hinders the urgency of the operation and delays the treatment of the patient.

4. Clean Operating Room Air Conditioning System Troubleshooting Method

4.1 Replace Filter

Under normal circumstances, the air conditioning system uses a central control system. When the filter is too long or the performance is degraded, the corresponding alarm system of the control panel will promptly indicate that the filter has insufficient service life and needs to be replaced in time. When the filter cleaning has no practical effect, the new filter should be replaced. Because the filter replacement frequency is mostly once in 15 months, there is no need to worry about the problem of excessive replacement cost. In addition, disposable filters can be used, which are replaced once every six months, but with relatively little investment.

4.2 Exhaust Fault Clearing

In addition to the failure of the exhaust fan to repair in time, it is necessary to prepare for the exhaust failure. Firstly, an air exhaust device should be installed above the operating table of the clean operating room. The air exhaust device needs to install the primary effect and medium efficiency filter at the same time, and also install the constant air volume device on the pipeline. For the need to switch between positive and negative pressure in a clean operating room, it is recommended to set up a double exhaust. When the demand is positive, use a low air volume exhaust fan. When demanding negative pressure, use a high air volume exhaust fan. In order to prevent the virus from entering when the exhaust fan fails, a disinfection device should be installed at the air outlet to effectively remove the exhaust failure.

4.3 Strictly Control the Air Conditioning System

For the air conditioning system health control, it is recommended that when the clean operating room is built, the professional cleaning personnel will completely clean the entire construction, and the concrete ceiling will be covered with aluminum film. For clean operating room floors, general operating room floor tiles cannot be used and epoxy floors are required. It can also be waterproof and moisture-proof while ensuring the cleanliness of the floor. The machine room above the operating room requires all dust-proof coatings to reduce the dust coverage of the equipment.

4.4 Combined System

In order to ensure the timeliness of surgery, while taking into account the cost savings of the hospital, it is best to use a combination system of dispersion and air supply. The combined system divides the functions of the clean operating room air conditioner and the maintenance pressure into

two parts, each of which is controlled, but does not affect the overall operation of the operation. The combined system is operated simultaneously during the surgical work to provide a standard for the surgical environment. When the operation is stopped, in order to save costs, the air conditioning system will not be shut down, and the positive pressure air supply system will still be operated to keep the environment unchanged. This skill ensures clean and sterilized clean room and saves hospital operating costs.

5. Conclusion

The clean operating room requires an air conditioning system to purify the air, and the indoor temperature and humidity are properly controlled according to the surgical requirements. Therefore, the staff needs to have a detailed understanding of the clean operating room air conditioning system, can identify the general fault and solve the fault in time to ensure the normal operation. However, the staff should increase the inspection of the air-conditioning system in daily work, find problems in a timely manner, and stifle the failure in the initial stage to avoid the impact of the air-conditioning system failure on the operation. In this way, it is possible to effectively control adverse factors in the air to cause infection to the patient, reduce the risk of surgery, and avoid medical problems.

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