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Article

Clinical Application Effect Analysis of the Improved Nasopharyngeal Swab Sampling Method for COVID-19 Nucleic Acid Testing

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Abstract: This study aims to evaluate the clinical application effect of an improved nasopharyngeal swab sampling method for COVID-19 nucleic acid testing. A total of 100 nasopharyngeal swab samplers were randomly divided into two groups: a control group using the conventional sitting position method and a study group employing a lying position method combined with a protective face shield. The sensitivity scores and levels of patient cooperation were compared between the two groups. Results showed that the mean patient cooperation scores were 6.90 ± 1.23 in the control group and 8.25 ± 0.56 in the study group, indicating significantly better performance in the study group ($p < 0.05$). The incidence of adverse reactions, including nausea, sneezing, and coughing, was also lower in the study group (1 case of nausea, 0 cases of sneezing, and 1 case of coughing) compared to the control group (3 cases of nausea, 2 cases of sneezing, and 2 cases of coughing; $p < 0.05$). Furthermore, safety and psychological assessments revealed that patients in the study group had lower fear and perceived exposure scores than those in the control group ($p < 0.05$). In conclusion, the improved nasopharyngeal swab sampling method for COVID-19 nucleic acid testing demonstrated enhanced effectiveness and patient comfort, making it a suitable approach for preliminary screening.

Keywords: COVID-19; nasopharyngeal swab sampling; clinical application

1. Introduction

With the spread of the epidemic, many regions in our country have reported related cases. These cases indicate that the main route of COVID-19 transmission is through droplets. Close contact with a high viral load and density of the infection source increases the risk of infection [1]. During the sampling process of pharyngeal swabs, sneezing can be induced by external stimuli. The high-speed ejection of droplets in a short time can cause contamination and pose a threat to medical staff. Pharyngeal swabs are mainly divided into nasopharyngeal swabs and oropharyngeal swabs. The current methods for collecting nasopharyngeal swabs include standing and sitting positions. This study focuses on the improved nasopharyngeal swab sampling method for COVID-19 nucleic acid testing, and the specific research is as follows.

2. Materials and Methods

2.1. General Information

One hundred nasopharyngeal swab samplers were selected and randomly divided into two groups (the control group and the study group). The control group used the sitting position method, while the study group used the lying position method combined with the protective face shield method. In the control group, there were 30 males and 20 females. In the study group, there were 28 males and 22 females. Inclusion criteria: First, no restrictions on gender and age. Second, informed consent from the participants. Exclusion criteria: First, inability to accurately recall the operation process.

2.2. Methods

Control group: The sampler stands in front of the patient, with the face at the same level as the patient. The sampler inserts the swab stick into the patient's nostril, with a length and position similar to the lying position, reaching the posterior wall of the patient's nasopharynx, and gently rotates it once (if reflexive coughing occurs,

pause for a moment) before slowly removing the swab. The lying position method is used to observe the number of secretions and subsequent processing.

Study group: First, a dedicated protective face shield for nasopharyngeal swabs is made (including a protective face shield body, which consists of a transparent protective plate. The inner side of the transparent protective plate is equipped with a hollow rectangular plate, one end of which has an adjustable arc-shaped plate. The adjustable arc-shaped plate is equipped with a flexible gel on one side. This is a disposable nucleic acid testing protective face shield). A clean face shield is taken, and a sampling hole is cut in the central lower part of the face shield, close to the patient's nostril, for the swab to enter the nasal cavity. Second, the steps for collecting nasopharyngeal swabs in the lying position are as follows. Before collection, the patient is clearly informed of the name of the procedure and the main steps. Hand hygiene disinfection is performed before the operation, and corresponding preparations are made. The patient is examined in a supine position on the hospital bed, with the head located on the left side of the sampler, the neck extended 10-15°, and the head tilted to the side by about 10°. The sampler should stand on the patient's right side, using the patient's left side, with the front of the chest close to the patient's head and ear, at a vertical distance of 30-50 cm. Before starting the operation, the patient is instructed to relax and not to hold their breath consciously. The cleaned and disinfected nasopharyngeal swab is fixed on the patient's face, and the skin is disinfected. The sampling hole exposes the nostril for sampling, and the skin is disinfected. The distance from the tip of the nose to the earlobe is measured with the swab stick, and the stick is fixed at the marked position with the thumb and index finger. The swab stick is gently inserted into the nasal cavity by about 1 cm. The swab stick is gently raised, maintaining an angle of 80-90° with the face and sliding forward by 5-6 cm. When the front end of the swab stick touches an obstacle, and the index finger of the swab stick touches the tip of the nose, reaching the posterior wall of the nasopharynx, it is gently rotated once (if reflexive coughing occurs, pause for a moment) and then smoothly removed. The secretions on the end of the swab stick are observed. If a large number of secretions is adsorbed, the swab stick is placed into the specimen tube. If the number of secretions is relatively small, the swab stick is used to repeat the above steps to collect from the other nostril [2]. While placing the swab stick into the specimen tube, it is also placed into an independent specimen device bag and sealed.

Patient comfort survey: Patients with mental disorders, impaired consciousness, or inability to express their feelings are excluded.

2.3. Observation Indicators

(1) Patient cooperation score (with a full mark of 10 points; the higher the score, the better the effect).

(2) Nausea, sneezing, and coughing conditions.

(3) Fear and perceived exposure scores (with a full mark of 10 points; the lower the score, the better the effect).

2.4. Statistical Analysis

SPSS 20.0 was used for statistical analysis, with $p < 0.05$ indicating a statistically significant difference.

3. Results

Table 1, by comparing the cooperation levels of the patients, the scores for the control group and the study group were 6.90 ± 1.23 and 8.25 ± 0.56, respectively. The study group had better patient scores.

Table 1

Patient Cooperation Scores

Group	Score
Control Group	6.90±1.23
Study Group	8.25±0.56
t	6.907
p	0.000

Table 2, by comparing the adverse reactions of the patients, the number of patients experiencing nausea, sneezing, and coughing in the control group were 3, 2, and 2, respectively, while in the study group, these numbers were 1, 0, and 1, respectively. The study group had significantly better results ($p < 0.05$).

Table 2

Comparison of Adverse Reaction Incidence Rates Between the Two Groups

Group	Nausea	Sneezing	Coughing
Control Group	3（12.0）	2（8.0）	2（8.0）
Study Group	1（4.0）	0（0.0）	1（4.0）
t	5.864	6.210	7.121
p	0.000	0.000	0.000

Table 3, by conducting a safety and psychological assessment of the patients, the study group had lower fear and perceived exposure scores compared to the control group ($p < 0.05$).

Table 3

Safety and Psychological Assessment Scores of the Two Groups

Group	Fear	Perceived Exposure Risk
Control Group	5.90±1.24	6.90±1.02
Study Group	3.23±1.20	3.34±1.32
t	6.890	5.123
p	0.000	0.000

4. Discussion

In the prevention and control of COVID-19, the key factors to control the spread of the epidemic and reduce the mortality rate are early detection, early reporting, and early treatment. The current key to epidemic prevention and control is “earlier and faster.” Manual investigation methods are inefficient and prone to omissions and errors [3]. During the COVID-19 pandemic, the main method for confirming COVID-19 is nasopharyngeal swab testing, which has significant value for epidemic control. When sampling in the sitting position, the sampler should stand in front of the patient, with the line-of-sight level with the patient, and the linear distance is generally about 30 cm. According to relevant data, the horizontal distance of droplets

from a patient's sneeze is about 1 cm, and the sampler's face and respiratory openings are exposed to the patient's droplet contamination range, which can ultimately prevent medical staff from working. By using the lying position sampling method, the patient's posture can be changed to a supine position. In addition, the sampler should stand on the side of the patient, with the face and respiratory openings about 30 cm higher than the patient's supine position [4], avoiding contamination from the patient's coughing and droplets. Moreover, the lying position method can meet the needs of patients who cannot sit or stand conveniently. The collection of nasopharyngeal swabs in the lying position changes the patient's posture and tilts the patient backward, anatomically structuring the patient to avoid a sense of emptiness. The operation process is closer to the patient, making the sampling operation easier. This method avoids the traditional sitting position and reduces the pain. By reducing the dwell time of the swab stick in the nasopharynx, the patient's comfort is increased, and the patient is more likely to cooperate with the sampler's work [5].

During the sitting position sampling process, due to the poor comfort of the patient, nausea and coughing are easily induced when the nasopharynx is touched. This forces the sampler to adopt the lying position method for sampling, which can prove the above advantages. The overall risk of dangerous behavior is significantly lower than that of the sitting position. The single sampling time in the lying position is significantly longer than that in the sitting position. While significantly increasing the contact time between the swab stick and the nasopharyngeal mucosa, it also increases the sense of contact. This not only increases the psychological safety of the sampler but also helps improve the quality of specimen collection [6]. Currently, the lying position method and protective face shield can improve cooperation. While reducing discomfort such as nausea and coughing, they can also enhance the reliability of the test results. Under the protection of the face shield and other tertiary protections, the patient's sneeze can easily contaminate the protective suit [7]. The method designed in this study allows the patient's face to tilt to the opposite side. While the sampler stands on the side of the patient, they can avoid the space where the patient may cough and prevent contamination. This method can meet the needs of patients who cannot stand [8].

In summary, the use of the new type of nasopharyngeal swab testing in the collection of nasopharyngeal swabs not only improves the results of nasopharyngeal swab collection but also reduces the negative rate of specimen collection and

alleviates the situation of re-positive [9]. In the prevention and control of COVID-19, a specimen collection plan with enhanced protection using a dedicated protective face shield with a local opening is applied. Before more convenient improvements and equipment updates, the lying position method is used for large-scale preliminary screening of the population [10]. In conclusion, the application of the improved method for nasopharyngeal swabs has a relatively good overall effect.

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