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Bedside ultrasonic localization of the nasogastric tube in a patient with severe COVID-19: A case report

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Abstract

BACKGROUND

The indwelling nasogastric tube is commonly used for supplying enteral nutrition to the patients who are unable to feed by themselves, whereas accurate positioning is essential in indwelling nasogastric tube in the body of the aforementioned patients. In clinical practice, abdominal radiography, auscultation, and clinical determination of the pH of the gastric juice are routinely used by medical personnel to determine the position of the tube. However, those treatments have been proved limitations in specific cases. And there are few case reports on the precise positioning of the nasogastric tube in patients with coronavirus disease-2019 (COVID-19), for whom supply of necessary nutrition support is significant throughout the process of treatment.

CASE SUMMARY

A 79-year-old patient, diagnosed with COVID-19 at the stage of combined syndromes as severe bacterial lung infection, respiratory failure, multiple co-morbidities and a poor nutritional status, had been presented to us and required an indwelling nasogastric tube for enteral nutrition support. After pre-treatment assessments including the observation

of the patient's nasal feeding status, the completion of examining the nasal septal deviation, inflammation, obstruction, nasal leakage of cerebrospinal fluid and other disorders that might render intubation inappropriate, we measured and marked the length of the nasogastric tube to be placed, and delivered the tube to the intended length in the standard way. And then further scrutiny had been conducted to ensure that the tube was not coiled in the mouth and that gentle movements were made to avoid damage to the esophageal mucosa. However, a back draw of the gastric juice by using an empty needle had failed, while the stethoscope could not be used for auscultation due to the specific condition presented by the internal organs of the patient and the end of the tube was placed in saline with no bubbles spilling out. Therefore, it was not possible to determine whether the nasogastric tube was placed exactly in the stomach and no nutrient infusion was performed for the time being. The ultrasound probe was utilized subsequently to view the condition in the stomach of the patient, where the nasogastric tube was seen to be translucent and running parallel to the esophagus shaped as "=". The pre-conditions then were achieved and 100 mL nutritional fluid was fed in the patient who did not experience any discomfort throughout the procedure and his vital signs were stable with no adverse effects.

CONCLUSION

We achieved the successful application of ultrasound to position the nasogastric tube in a 79-year-old patient with COVID-19. The repeatable ultrasound application does not involve radiation, causes less disturbance in the neck and is thus advantageous for rapid positioning of the nasogastric tube and worthy of clinical promotion and application.

Key Words: Ultrasound; Localization; Nasogastric tube; COVID-19; Nutrition supply; Case report

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Core Tip: External nutrition supply *via* nasogastric tube is crucial for the patients who are unable to feed by themselves to sustain physical functions. The traditional methods of indwelling nasogastric tube in a patient's body has encountered limitations in the medical treatment. We present herein, a rare case of application of ultrasonic localization of nasogastric tube in a patient with coronavirus disease-2019, when traditional methods failed to indicate a successful indwelling. This case highlights the importance of appropriate application of ultrasonic localization as a supplementary method to ensure that the nasogastric tube has been placed rightly in the stomach of the patient.

INTRODUCTION

Coronavirus disease-2019 (COVID-19) is a new acute respiratory infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) virus. COVID-19 is characterized by its rapid rate of transmission and the susceptibility of the population. The disease usually manifests with symptoms of fever, dry cough, and fatigue. In severe cases, patients may experience dyspnea and/or hypoxemia in the week following onset. Severe COVID-19 can rapidly progress to acute respiratory distress syndrome, septic shock, irreversible metabolic acidosis, coagulation dysfunction, and multiple organ failure[1-2]. Due to reduced food intake, increased energy consumption, and impaired anabolic functioning, the incidence of malnutrition in these patients can reach 25% to 65%[3], and may adversely affect patient outcomes. Early enteral nutrition is considered to be one of the active treatment measures for critically ill patients as it can reduce the severity of the disease and the incidence of complications, as well as shortening hospitalization and improving patient prognosis of patients[4-6]. The indwelling nasogastric tube is the most commonly used method for supplying enteral nutrition. The tube requires accurate positioning. Traditional

methods include extraction and examination of the patient's gastric juice, followed by determination of the sound of air passing through the liquid. The tube can also be positioned *via* using ultrasound and X-rays. Under COVID-19 and level-three protection requirements, the use of bedside ultrasound is advantageous in this situation where the stethoscope cannot be used and does not require extensive human and material resources.

CASE PRESENTATION

Chief complaints

A 79-year-old patient was admitted to the Department of Critical Care Medicine, the COVID-19 Specialist Hospital of the Wuhan Taikang Tongji Hospital, with severe COVID-19, coronary atherosclerotic heart disease and cerebral infarction in March 2020.

History of present illness

The patient had developed fever without obvious inducement seven weeks before, with a body temperature reaching 38.5 ℃, fatigue and anorexia. The body temperature then fluctuated between 36.5 ℃ and 38 ℃. Since the onset of the disease, the patient had had no contact with COVID-19 patients. At the time of admission, the patient was severely ill, complicated by pulmonary bacterial infection, respiratory failure, co-morbid diseases, and poor nutrition. The patient required a nasogastric tube for enteral nutritional support, which was inserted in the hospital under medical supervision.

History of past illness

The patient had a history of cerebral infarction and had recovered through drug treatment without obvious impairment of either action or speech.

Personal and family history

There was no history of COVID-19 or other ill health in the patent's family.

Physical examination

On arrival at the department, the nutritional status of the patient and the feasibility of nasal feeding the patient were assessed. In addition, the patient was investigated for nasal septum deviation, nasal inflammation, obstruction, cerebrospinal fluid rhinorrhea, and other conditions that would render indwelling unsuitable.

Laboratory examinations

After admission, laboratory examinations were conducted and the patient received anti-infection and antiviral treatment, together with treatments for improving cardiac function, blood transfusions, and other symptomatic treatments.

Imaging examinations

An initial imaging evaluation with brain computed tomography (CT) scan suggested multiple small punctate hypodense foci next to the lateral ventricles bilaterally, with ischaemic changes and a high probability of acute ischaemic stroke; the chest CT revealed scattered patches and cloudy fuzzy shadows in both lungs, and the patient was considered to have been infected with COVID-19.

FINAL DIAGNOSIS

The patient was severely ill, complicated by pulmonary bacterial infection, respiratory failure, co-morbid diseases, and poor nutrition. The patient required a nasogastric tube for enteral nutritional support.

TREATMENT

The required length of the nasogastric tube was determined and marked during physical examination. The tube was then inserted to the predetermined length by the routine procedure. And the nasogastric tube was gently placed to avoid damaging the esophageal mucosa and to ensure that the tube was not coiled in the mouth.

OUTCOME AND FOLLOW-UP

However, the gastric juice was not able to be extracted using an empty needle. Meanwhile, due to the particular circumstances, the stethoscope could not be used for auscultation. The end of the nasogastric tube was placed in normal saline solution without bubble overflow. As a result, it was not known whether the tube was in the stomach and no nutrient solution was injected. The tube position was then examined *via* ultrasound. The ultrasonic probe could clearly identify the circular nasogastric tube and comet tail sign through the cross-section after the esophageal inlet. On examination of the longitudinal section of the esophagus, it was observed that the nasogastric tube was running parallel in the esophagus, seen as two parallel transparent hyperechoic images in the shape of "=" (Figure 1). This indicated the position of the nasogastric tube, and then 100 mL of the nutrient solution was injected. The patient had suffered no discomfort and the vital signs were stable without adverse reactions.

DISCUSSION

Routine diagnostic methods

Conventional auscultation: Conventionally, a stethoscope with a 50 mL disposable syringe is used for auscultation. Initially, 20 mL - 30 mL of air is rapidly injected, followed by repeated auscultation in the abdomen. Detection of a high-profile sound of air passing through the liquid indicates that the tube is located in the stomach.

Extraction of gastric juice: A sterile syringe is connected to the end of the tube to determine whether gastric juice can be extracted.

Overflowing bubbles: The end of the tube is placed in a bowl filled with cold boiled water or normal saline to determine the presence of bubbles.

Plain X-ray abdominal radiograph examination: A bedside X-ray film is taken within two hours after insertion of the nasogastric tube, and mobile digital radiography is

performed. The radiologist obtains anterior-posterior chest images according to the specifications and completes the film reading and the report.

Ultrasonic localization: The gas status in the patient's stomach should be identified. If a strong echo appears with too much gas, this may affect the judgment of the result. It is thus necessary to extract the gas before exploration. After inserting the nasogastric tube, the circular tube and the comet tail sign could be clearly seen in the transverse section after the ultrasonic probe passes through the esophageal inlet. In the longitudinal section, the nasogastric tube is found to run parallel in the esophagus, seen as two parallel transparent hyperechoic images in the shape of "=".

Disadvantages of conventional diagnostic methods and advantages of ultrasound diagnosis

Auscultation: When air is injected into the nasogastric tube, the sound of air passing through liquid is strongly discernable on auscultation. The sound of air injected into the trachea and pleural cavity is not easy to distinguish from that injected into the stomach. Therefore, it is not easy to accurately distinguish the location of the nasogastric tube by auscultation. And some patients may present with clinical manifestations such as choking and decreased oxygen saturation[7]. Given that COVID-19 is a Class B infectious disease and can be transmitted by contact and droplets, medical personnel need level-three protection when entering the Red zone to reduce the risk of infection. Additionally, a stethoscope used in the Red zone becomes a contaminated object, and viruses and other pollutants may attach to the surface. Because of this, the stethoscope should not come into direct contact with the body surface of the medical personnel. In addition, the senses, including sensation in the limbs and, especially, hearing, are greatly weakened, which adversely affects the accuracy of judgment and auscultation. Therefore, conventional auscultation in patients with COVID-19 increases the risk of exposure of medical personnel to the virus and is also difficult to implement.

Extraction of gastric juice: Clinically, we found that most of the critical patients with COVID-19 were unable to eat. After insertion of the nasogastric tube, adhesion and reverse folding of the tube may occur, resulting in too little liquid in the stomach. As a result, it was impossible to locate and extract the nasogastric contents accurately, thus limiting the efficacy of the gastric juice extraction method.

Bubble overflow method: The end of the tube is placed in a bowl filled with normal saline to determine overflow of the bubbles. However, bubble overflow may only indicate that the tube is in the airway and is not able to detect whether it is in the stomach. It is also not recommended for routine use as it may increase the risk of inadvertent aspiration when the patient is aspirating[8].

Plain abdominal X-ray examination: The determination of nasogastric tube positioning by bedside radiography is the gold standard for determining accurate positioning; however, this has the disadvantages of high levels of radiation and the length of the procedure, making it unsuitable for repeated use[9-10]. In addition, with COVID-19, all medical personnel are required to use grade-three protection. And the removal of instruments from the radiology department not only increases the workload for the radiology personnel but also affects the timing and efficiency of the treatment. Also, when performing abdominal plain X-rays for severely ill patients, usually at least three medical personnel are required to move and place the body in position, resulting in increased physical exertion. Furthermore, when moving, the radius of action would tend to increase, as would the amount of perspiration from the medical personnel, which would tend to reduce the effectiveness of the protective clothing and thus increase the risk of exposure. For patients with severe disease, there are usually many tubes attached. The risk of tube slippage would increase and thus the quality of nursing would tend to be reduced during movement.

Ultrasonic localization: Studies have reported a 100% accuracy rate of bedside ultrasound in determining the success of gastric tube placement[11].Ultrasound is a non-invasive procedure with the advantages of repeatability and a lack of radiation[12]. For unconscious patients, bedside ultrasound positioning is safe and can be carried out with other diagnostic and treatment measures without affecting mechanical ventilation, delaying treatment, and transferring risk. Furthermore, bedside ultrasound has been reported to intuitively indicate the patient's condition and pathology, improve the precision of clinical diagnosis, guide the positioning of intubation and puncture operation and therefore reduces damage to the laryngeal mucosa caused by repeated manipulation[13]. Moreover, given its intuitive, fast, accurate, and convenient features, bedside ultrasound has been applied as a standard tool for monitoring and evaluating severely ill patients and positioning of punctures in intensive care unit, anesthesia, and emergency departments in numerous countries[14-16]. It is not difficult to locate the position of the nasogastric tube if the thyroid and tracheal positions are located. In addition, there is less disturbance to the neck. If the position of the nasogastric tube cannot be determined due to pseudo-interference or other causes, about 20 mL of air should be quickly injected into the tube. This would result in the formation of a prominent gas reflection plane, and the position of the tube would be visible as a strong strip echo under ultrasound. The intensive care unit of our department has an ultrasound machine to reduce the increased workload caused by repeated demand. This instrument is always available to facilitate the timely diagnosis and treatment of patients.

CONCLUSION

Accurate positioning of the nasogastric tube in severely ill patients with COVID-19 using bedside ultrasound could reduce both the risk of viral exposure to medical personnel and the clinical workload, as well as avoid X-ray radiation. Bedside ultrasound localization of the nasogastric tube produces immediate accurate results, thus gaining valuable time for clinical treatment and effectively improving both the

potential success of the treatment and prognosis of the patient. It is thus worthy of clinical promotion and application.

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