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Original Article

Medical cold compress for medical device-related pressure injury during the coronavirus disease 2019 outbreak

Xiaolei Yang[1*], Hanfang Ma[2*], Yonghua Li[1], Li Zhang[1], Haiqin Yang[1]

Departments of [1]Anesthesiology, [2]Medical Center, Shanghai Changzheng Hospital, Naval Medical University, Shanghai, China. [*]Equal contributors and co-first authors.

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Abstract: Objective: Our aim was to investigate the effect of medical cold compress on preventing medical device-related pressure injuries (MDRPIs) that cause pain and itching of medical staff in the contact area of the mask and skin during the coronavirus disease 2019 outbreak. Methods: We enrolled 120 medical staffs in a hospital in the Wuhan epidemic-stricken area and randomly divided them into the observation group (used medical cold compress before wearing medical protective equipment) and the control group (didn't use medical cold compress before wearing medical protective equipment), with 60 cases in each group. The cumulative use time of medical personal protective equipment (PPE) within a day, the continuous use time of PPE, average scores of overall discomforts (respiratory resistance caused by PPE, itching and pain in the contact area of the mask, etc.), and the incidence of skin allergy and contact dermatitis were recorded and compared between the two groups. Results: The time of cumulative use of PPE in a day and the time of continuous use of PPE were both significantly longer in the observation group than in the control group ($P<0.001$). Furthermore, the observation group showed significant decrease in the average scores of overall discomforts including respiratory resistance, itching and pain ($P<0.001$), and the incidence of skin allergy and contact dermatitis than the control group ($P<0.05$). Conclusions: Medical cold compress can exert a protective effect on MDRPIs in first-line medical staff, and prolong the use time of medical PPE, which is of high value for clinical application.

Keywords: Coronavirus disease 2019 pneumonia (Covid-19), medical cold compress, medical device-related pressure injury, prevention

Introduction

Medical device-related pressure injuries (MDRPIs) are a common issue faced by first-line medical staff that needs to be solved urgently during the outbreak of coronavirus disease 2019 (COVID-19).

MDRPIs are defined as localized damage to the skin and/or underlying soft tissue usually over a bony prominence or related to a medical or other device. The injury can present as discomfort sensations such as pain, itching and tightness to the skin, mucosal tissue and non-bony prominence [1-4]. At present, it remains inconclusive as to how to alleviate facial MDRPIs in medical staff.

According to traditional methods, medical cold compress used in our study is ameliorated, made from polymeric hydrogels (matrix) and mainly composed of polyethylene film, hydrogel layer and non-woven fabric layer [5]. Cold compress can not only reduce the sensitivity of nerve endings and the pain threshold in humans, but also cause constriction of capillaries, relieve local congestion and inhibit inflammation and suppuration through cold receptors [6, 7]. Currently, cold compress is known as the adjuvant treatment for sensitive skin after laser operation or allergic skin diseases such as allergic dermatitis in clinical practice. However, researches on the application of medical cold compress in MDRPIs have not yet been reported. Herein, we aimed to explore the effect of medical cold compress on the prevention of MDRPIs, provide corresponding protective measures for front-line medical staff during the epidemic, so as to avoid injuries caused by

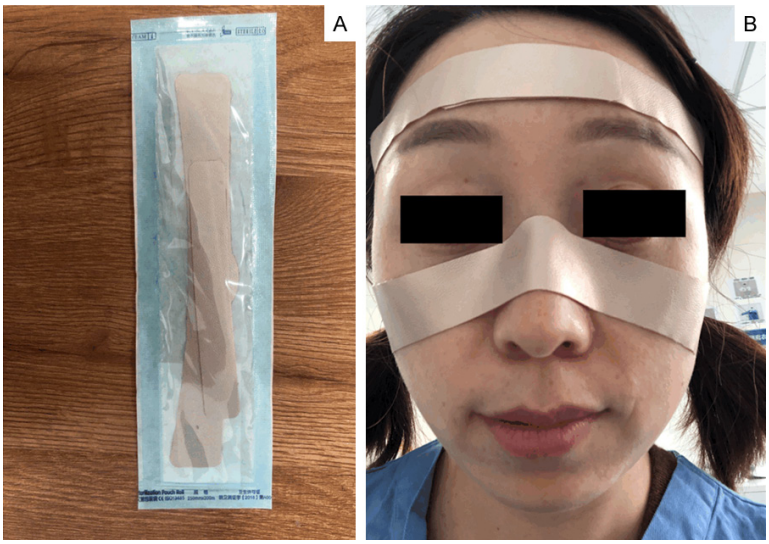

Figure 1. Sample and use method of medical cold compress. A. Sample of medical cold compress; B. Schematic diagram of wearing medical cold compress.

wearing medical personal protective equipment (PPE) such as masks for a long time and facilitate work efficiency.

Materials and methods

Subjects

A total of 120 medical staffs in a Hospital in the Wuhan epidemic-stricken area from January 2020 to March 2020 were recruited including 16 males and 104 females, with an average age of (32.4±4.5) years old. These subjects were randomly divided into the observation group (used medical cold compress before wearing medical protective equipment) and the control group (didn't use medical cold compress sticker before wearing medical protective equipment), with 60 cases in each group. The study had been approved by the Ethics Committee of the hospital, and the research subjects had signed an informed consent form.

Inclusion criteria: Medical staffs wore medical protective equipment from January 2020 to March 2020 in the Hospital for fight against COVID-19; medical staffs who filled out the questionnaire about the use of medical protective equipment and cold compress; medical staffs with complete data of the observation indexes before and after the use of medical cold compress. Exclusion criteria: Medical staffs with skin ulceration, redness and swelling at the bone carina; medical staffs had a history of allergy to medical cold compress and contact dermatitis.

Methods

Use method of medical cold compress: Firstly, the sticking area of skin was cleaned by normal saline or running water, especially for the dandruff and sebum on the pressed part, and was dried. Secondly, the medical cold compress was taken out. Thirdly, the sticking position was determined according to your wearing position and habits. Usually, the medical cold compress was stuck on the forehead and sides of the nose. The sticker should be stuck as flat as possible to avoid the decrease of airtightness caused by excessive pulling or wrinkles. Finally, when the medical staff wore PPE, they should adjust the protective equipment gently to place it on the contact area with the cold compress at the most suitable position.

The medical cold compress was made by the School of Pharmacy of The Second Military Medical University and Shanghai Tiyi Medical Technology Co., Ltd. (Hubao Equipment No. 20200005). The sample and wearing method of the medical cold compress are shown in **Figure 1**.

Outcome measures

A self-made questionnaire was used to investigate the condition of subjects used or not used medical cold compress. The content included gender, age, history of allergies, history of contact dermatitis, the type of medical PPE, the length of continuous use of protective equipment, the cumulative time of using PPE in a day, and the feelings of using protective equipment with or without using cold compress. For the use feeling investigation of protective equipment, the subjects pointed it with a total score of 10 points: 1-4 points indicated they had slight feelings which basically do not affect work; 5-7 points indicated they

Table 1. Comparison of the duration of continuous use of protective equipment between the two groups

	Control group	Observation group
Cases (n)	60	60
Time of continuous use of protective equipment (h)	4.52±1.21	6.78±1.47
t	22.89	
p	<0.001	

Table 2. Comparison of cumulative use of protective equipment in one day between the two groups

	Control group	Observation group
Cases (n)	60	60
The cumulative use of protective equipment in a day (h)	7.38±2.32	9.93±2.44
t	140.2	
p	<0.001	

had obvious feelings which slightly interfered their normal work; 8-10 points indicated they had strong feelings that affect normal work. The questionnaire was determined by two rounds of consultation with 8 medical and nursing experts.

The continuous use time of medical protective equipment with or without medical cold compress as well as and the cumulative time in a day and the respiratory resistance caused by medical protective equipment were calculated. Injuries including the itching, pain, skin indentation, redness and swelling, erosion in the contact area of mask and skin, and difficulties including stuffiness, fogging of glasses and face mask, peculiar smell were recorded. The general discomfort score and incidence of skin allergies and contact dermatitis caused by medical protective equipment were also evaluated.

The respiratory resistance caused by PPE was tested with a special breath resistance detection device: after ensuring the gas tightness and working status of the detection device, the system resistance of the detection device was set to 0. The medical protective equipment was adjusted to a proper position and tightness, then the ventilation was adjusted to 85 L/min and the expiratory resistance was recorded.

Statistical analysis

The data was analyzed by SPSS 22.0 software. The measurement data were expressed as mean ± standard deviation and the comparison intra-group adopted paired t test. The counting data were expressed as case number and percentage, and one-way analysis of variance was used for comparison between groups. P<0.05 indicated that the difference was statistically significant.

Results

The observation group had longer continuous use time of protective equipment than the control group

The time of continuous use of medical personal protective equipment (PPE) of the observation group was 4.52±1.21 h, which was significantly longer than that of the control group (6.78±1.47 h, P<0.001; **Table 1**).

The observation group had longer cumulative use time of protective equipment in a day than the control group

The cumulative time of PPE in the observation group was 7.38±2.32 h, which was significantly longer than that of the control group (9.93±2.44 h, P<0.001) (**Table 2**).

The observation group had less protective equipment caused discomforts than the control group

The average scores of overall discomforts caused by wearing PPE between the two groups were compared. In the observation group, the scores of indicators including itching and pain in the contact area of the mask and skin, skin indentation etc., were all significantly lower than those in the control group (P<0.001; **Table 3** and **Figure 2**).

Table 3. Comparison of the discomfort scores of wearing protective equipment between the two groups

Indicators	Control group	Observation group	t	P
Cases	60	60		
Respiratory resistance	4.44±0.35	3.52±0.24	42.23	<0.001
Itching	3.93±0.52	2.67±0.13	18.21	<0.001
Pain	5.33±0.48	2.67±0.11	41.84	<0.001
Skin indentation	6.26±0.79	2.56±0.18	35.37	<0.001
Skin redness	5.07±0.25	2.41±0.13	73.12	<0.001
Skin erosion	3.15±0.42	1.67±0.27	22.96	<0.001
Muggy	5.26±0.44	3.41±0.33	26.05	<0.001
Fogging of glasses or mask	5.22±0.26	4.07±0.28	23.31	<0.001
Undesirable odor	4.41±0.72	3.11±0.51	11.41	<0.001
Overall discomfort	5.85±0.79	3.11±0.38	24.21	<0.001

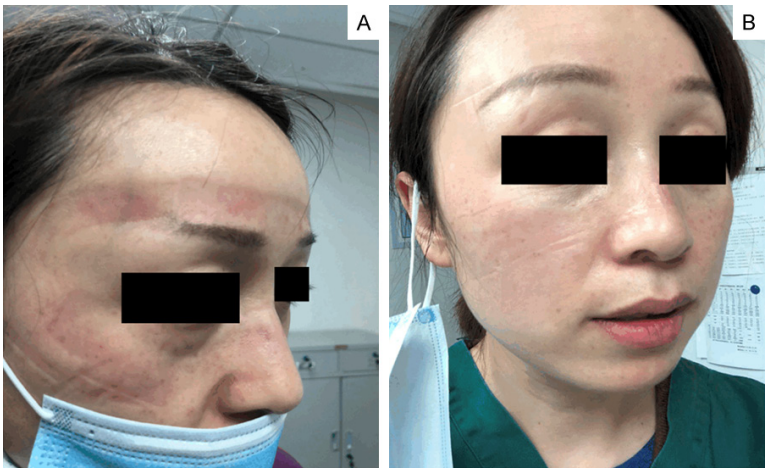

Figure 2. Comparison of skin indentation between the two groups. A. Subjects in the control group who wore medical protective equipment without medical cold compress have serious skin indentation. B. Subjects in the observation group who wore medical protective equipment with medical cold compress have fewer skin indentations.

Table 4. Comparison of the incidence of skin allergies and contact dermatitis between the two groups

	Control group	Observation group	t	P
Cases	60	69		
Skin allergy	6 (10%)	1 (1.7%)	6.32	0.012
Contact dermatitis	8 (13.3%)	3 (5%)	8.57	0.003

The observation group had lower incidence of skin allergy and contact dermatitis than the control group

The incidence of skin allergies and contact dermatitis caused by medical protective equipment in the observation group was significantly lower than the control group (P=0.003; **Table 4**).

Discussion

An outbreak of COVID-19 occurred in Wuhan, China in December 2019 first and is rapidly becoming a worldwide epidemic. COVID-19 pneumonia is transmitted through the air by coughing and sneezing as respiratory system infections (e.g., influenza), but the transmission route of COVID-19 is still unclear [8, 9]. As a result, wearing medical PPE is essential in fighting against the pneumonia epidemic. Since bands of PPE such as protective goggles and masks are tightened to avoid contamination, MDRPIs including swelling, pain, itching, and ulceration can easily occur with deep skin indentations in medical staff after hours of high-intensity work, which increases the risk of infections [2, 10, 11]. Our study indicated that MDRPIs are common before the use of medical cold compress, causing physiological damage to medical staff and seriously affecting the development of medical work.

The main reasons for MDRPIs: 1. Pressure: The protective goggles and masks need to be closely fitted to the skin for better protection, and the small contact surface and hard texture of masks and goggles increase the local tissue pressure. 2. Shear and friction force: The thin skin of the nasal bridge, zygomatic region and ears makes it easy to create shear and friction force. 3. Moisture: Medical staff profuse perspiration in the face due to the poor air permeability of protective clothing, resulting in

moisture under the device, which further increases the risk of skin injuries after hours of work. 4. Allergy: A minority of medical staffs may be allergic to mask materials. 5. Lack of water: Medical staff cannot supplement water in time, which affects the balance at the skin surface and tends to cause skin injuries. The predilection sites of MDRPIs are in the nose, cheeks, forehead, and posterior auricle [12, 13]. Hence, valid protection for these sites is particularly important to prevent MDRPIs in medical staff and promote their work efficiency.

In our study, we identified that observation group had less discomforts caused by the use of PPE than the control group. Medical cold compress is a semipermeable membrane (breathable but water-impermeable) made from polymer materials, which can prevent the penetration of microorganisms and the invasion of bacteria. Besides, medical cold compress can move accordingly with thin and elastic characteristics to help reduce the respiratory resistance caused by tight-fitting PPE. Meanwhile, there is decreased facial indentation depth and incidence of skin allergy and contact dermatitis because medical cold compress is closely fitted to the skin [14, 15]. Studies reported by Zhang and Xu et al. have unveiled that medical cold compress has a significant effect on eye protection in patients undergoing general anesthesia, through good physical protection, which has improved ocular comfort and prevented complications [5, 14]. Similarly, our study revealed that, for one thing, medical cold compress could play an important role as physical barrier and alleviate the allergy and contact dermatitis. For another, there was decrease in respiratory resistance by reducing local pressure and in facial indentation depth.

Additionally, our study showed that medical cold compress could reduce the local itching and pain. This may be because its main component is hydrophilic gel, in which glycerol and water can help replenish the water content of the skin, protect the skin barrier, decrease sensitivity and increase the tolerance of the skin, and menthyl lactate can spread to the subcutaneous tissue, leading to regional hypothermia, reduction of regional blood flow, and alleviation of local redness, swelling and erosion [16-18]. Cold compress treatment decreases the sensitivity of local nerve endings, the conduction of nerve impulses and the pain threshold, thereby relieving the sensation of pain [6, 19, 20]. Xu et al. found that medical cold compress could prevent phlebitis in the elderly and relieve symptoms of local skin redness, swelling and pain, which is consistent with the results of our study [21].

Furthermore, medical cold compress can reduce the respiratory resistance resulting from the use of PPE, discomfort sensations (e.g., itching at the contact site of masks, pain, tightness), the incidence of skin allergy and contact dermatitis caused by PPE and the risk of infections of medical staff, and improve the feeling of comfort. Thus, the cumulative wearing time of PPE within a day and continuous wearing time of PPE were prolonged, which can validly facilitate their work efficiency, providing a strong support for fighting against the COVID-19 epidemic. However, with limited data in our study for the comparison of skin allergy and contact dermatitis, we're aware of that a direct association between skin allergy and contact dermatitis and medical cold compress cannot be proved, so researches are still needed to get a more precise conclusion.

To sum up, medical cold compress can prevent MDRPIs effectively in first-line medical staff, and prolong the wearing time of PPE by alleviating the feeling of discomfort, which has a high value in clinical practice.

Disclosure of conflict of interest

None.

Address correspondence to: Haiqin Yang and Li Zhang, Department of Anesthesiology, Shanghai Changzheng Hospital, Naval Medical University, No. 415 Fengyang Road, Huangpu District, Shanghai 200003, China. Tel: +86-13601669127; E-mail: gyhqyygy@sina.com (HQY); Tel: +86-13621724497; E-mail: 604720185@qq.com (LZ)

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