Intervention efficacy of MARSI nursing management on skin injury at peripherally inserted central catheter insertion site on oncological patients

Yi Zhao | Lingling Bian | Jinna Yang

Department of Surgery, Peking Union Medical College Hospital, Beijing, China

Correspondence
Lingling Bian, Department of Surgery, Peking Union Medical College Hospital, No.1 Shuaifuyuan Dongcheng District, Beijing 100730, China. Email: bianll@pumch.cn

Funding information
the 2017 Peking Union Medical College Hospital Nursing Research Fund, Grant/Award Number: XHHLYK201706; The Non-profit Central Research Institute Fund of the Chinese Academy of Medical Science, Peking Union Medical College, 2018 Central Universities’ Basic Scientific Research Project, Grant/Award Number: 3332018040

Abstract
To evaluate the intervention efficacy of medical adhesive-related skin injury (MARSI) nursing management at peripherally inserted central catheter (PICC) insertion site on oncological patients. This study used the case-control research method. We randomly divided 156 patients with PICCs implanted in our hospital’s surgery department from January 2019 to December 2020 into a control group (85 patients) and an intervention group (71 patients). The control group was the conventional nursing care group, and the intervention group was the MARSI nursing management group. Through implementing a series of interventions (ie, risk assessment, risk prevention, and risk management) for the MARSI nursing care management group, the incidence rate of MARSI, and its types (including mechanical injury, dermatitis, maceration, and folliculitis) were compared between the two groups. The total incidence rate of MARSI was 30.59% in the control group and 7.04% in the intervention group (P < .05), and the difference was statistically significant. The incidence rate of mechanical injury in the control group was 12.94%, which decreased to 2.82% after intervention (P < .05), and the difference was statistically significant. The incidence rate of dermatitis in the intervention group was 11.76%, which decreased to 2.82% after intervention (P < .05), and the difference was statistically significant. By implementing MARSI nursing care management, the incidence rate of MARSI at PICC insertion site can be effectively reduced.

KEYWORDS
medical adhesive-related skin injury, nursing management, oncological patients, peripherally inserted central catheter

Key Messages
• this prospective study is the first, to our knowledge, to evaluate the intervention efficacy of medical adhesive-related skin injury (MARSI) nursing management at peripherally inserted central catheter (PICC) insertion site. We found that the incidence rate of MARSI at PICC insertion site can be effectively reduced by implementing MARSI nursing management
this study used the case-control research method. We randomly divided 156 patients with PICCs implanted in our hospital’s surgery department from January 2019 to December 2020 into a control group (85 patients) and an intervention group (71 patients). The control group was the conventional nursing care group, and the intervention group was the MARSI nursing management group.

by implementing MARSI nursing care management, the incidence rate of MARSI at PICC insertion site can be effectively reduced.

1 | INTRODUCTION
Double-lumen high-pressure resistant injection through the peripheral vein into a central venous catheter (ie, power-injectable peripherally inserted central catheter [PICC]) offers many advantages, such as a long retention time, large inner lumen, and fast flow rate. In addition, it can be used to monitor hemodynamics and for the high-pressure injection of a contrast agent. The technique has been widely used in clinical practice and is an important venous pathway for the long-term infusion treatment of tumor patients. Skin adhesives play a very important role in protecting the patient’s wounds and fixing the pipeline. However, if the adhesive is too viscous, it may cause wounds or damage to the surrounding skin when the adhesive is removed. Frequent PICC local dressing change results in the destruction and peeling of skin layers and change in the skin barrier function in patients, making them highly susceptible to medical adhesive-related skin injury (Marsi). Marsi was first defined in 2013, as an occurrence in which erythema and/or other manifestation of cutaneous abnormality, including vesicle, bulla, erosion, or tear persists 30 minutes or more after removal of the adhesive. The most common types of Marsi are mechanical skin injury, contact dermatitis (CD), folliculitis, and moisture-associated skin damage. Relevant studies have found that the incidence of Marsi at a PICC insertion site in tumor patients was 26.40%–33.99%. However, clinical nurses do not pay sufficient attention to Marsi in China, and their overall level of knowledge, attitudes, and practices require improvement. In addition, Broadhurst et al has demonstrated that at present, healthcare institutions in different regions continue to diverge substantially in the management of skin integrity injury at the central venous access. Thus, to standardise Marsi management, it is urgent to develop an evidence-based Marsi management strategy. Considering risk assessment, prevention, and management, this study systematically examined intervention on the skin at PICC insertion site. Such intervention could effectively reduce the occurrence of Marsi and deserves an introduction into clinical practice.

2 | METHODS

2.1 | Inclusion criteria and exclusion criteria

2.1.1 | Inclusion criteria
1. Patients with a cancer diagnosis, 18 years or older, and ability of language communication with data collectors.
2. The enrolled patients used a new model of high-pressure injection-resistant reinforced polyurethane double-lumen power-injectable PICC with a 6 Fr tube diameter and a flow rate of 5 mL/s.
3. In the enrolled patients, PICC lines should be placed with finally tip position in distal third of superior vena cava or cavo-atrial junction.

2.1.2 | Exclusion criteria
1. The patients were delirious or uncooperative in the research.
2. After catheter insertion, X-rays showed that the head of the double-lumen power-injectable PICC was placed outside the middle and lower third of the superior vena cava.
3. After double-lumen power-injectable PICC insertion, catheter maintenance was not performed in our hospitals.

2.2 | Research method

A total of 156 patients with PICCs enrolled in our hospital’s surgery department from January 2019 to December 2020. All patients were suffering from cancer. The control group is the conventional nursing care group, and the intervention group is the Marsi nursing care management group.

2.2.1 | Conventional nursing care group
In this group, the conventional dressing change process was adopted as follows. Prior to dressing change, the
condition of the puncture site and surrounding skin was assessed. Subsequently, the puncture site was disinfected and air-dried. Next, the site was stabilised by applying film (universally used) and ordinary adhesive tape was used to fix the line on the skin. The dressing was changed once weekly. If drainage was present, the dressing was changed in a timely fashion. When removing the dressing, it was removed at a low angle and in parallel fashion. At the same time, the patient’s skin around the puncture site and the catheter was observed. If there was any abnormality, a nursing intervention was performed.

2.2.2 | MARSI nursing care management group

On the basis of conventional nursing care, a systematic intervention process was developed. Risk assessment, prevention, and management were implemented throughout the process to offer the following countermeasures. The details are as follows.

1. Risk assessment

A MARSI skin information file was established for each patient with PICC. The file included a risk assessment table of MARSI high-risk factors and a skin information collection table. We should assess skin for colour, uniformity, texture of appearance, and integrity. After reviewing and searching the domestic and foreign literatures, based on the 2013 consensus statements, as well as experience in maintaining PICCs, we summarised the influencing factors of MARSI on the skin of PICC, a total of 12 items, and assign values according to the degree of influence. We then developed the assessment table for the MARSI high-risk factors. The influencing factors with a score of 2 were as follows: age (ie, ≥65 years), moist and sweaty skin, medication history (eg, chemotherapy drugs, long-term glucocorticoid use, anti-inflammatory drugs, anticoagulants), previous disease history (eg, diabetes, infection, renal insufficiency, immunodeficiency, venous hypertension), skin allergy (particularly medical adhesive allergy), and local oedema. The influencing factors with a score of 1 were as follows: baseline skin condition (eg, eczema, dermatitis), female, malnutrition (BMI < 18.5), dehydration, and radiotherapy treatment (eg, phototherapy). The total score was calculated, and stratified assessment was conducted to establish the high-risk population. Patients with scores greater than or equal to 2 were classified as the MARSI high-risk population. Those with scores less than 2 were the general population. Before the infusion of drugs and maintenance of the pipeline, it is necessary to observe the skin condition of the general population, and then observe the skin damage after the medication and maintenance. If there were abnormalities, the MARSI skin information collection table was completed and recorded. On the basis of the general population, observation and recording frequency should be strengthened for the high-risk population. The skin condition should be evaluated, and the MARSI skin information collection table should be completed after each removal of the adhesive to dynamically identify high-risk patients and provide a basis for formulating personalised protection plans.

2. Risk prevention

Based on the risk assessment results, the key prevention types for high-risk patients were determined, and a personalised risk prevention plan was developed. For high-risk patients with mechanical injury-inducing factors (eg, age, diabetes, renal insufficiency, immune deficiency, varicose veins, local oedema, radiotherapy), individualised selection of a suitable medical adhesive should be used. A small square gauze can be placed on the PICC connection site to prevent skin damage, or a self-adhesive thin foam dressing can be fixed on the tail of the catheter and under the thumb clip to prevent mechanical skin damage. When necessary, medical adhesive removers can be used to protect skin integrity. For high-risk patients with dermatitis-inducing factors (eg, history of skin allergy, seasonal factors, chemotherapy drugs, dehydration), one should minimise or avoid the use of skin irritant disinfectant. In addition, one can choose to wash the skin with sterile saline, use 1% dynamic iodine to disinfect the skin, and when the skin is completely dry, evenly apply skin protectant while avoid touching the puncture point. Subsequently, the puncture point should be covered with film. For patients with a history of allergy to medical adhesive, the care provider should avoid using the problematic adhesive and opt for a hypoallergenic adhesive instead. For patients with high-risk of maceration-and folliculitis-inducing factors (eg, wet, sweaty skin, or malnutrition), a silver ion alginate antibacterial dressing can be used selectively. Such dressings can release silver ions in a sustainable and effective manner, rapidly sterilise, rapidly absorb wound exudate in large quantities, and confine the exudate to prevent infiltration of the skin around the wound. For patients with moist skin and perspiration, one should choose a medical adhesive with good air permeability and change it appropriately. For patients with wound exudation prone to infection, one can choose a chlorhexidine acetate antibiotic transparent dressing, and appropriately fix it.
3. Risk management
Risk management was implemented throughout the process for the MARSI nursing management group, and the quality of risk assessment efficacy and prevention was strictly controlled. A MARSI nursing management research group, which included a professor of nursing, two in-charge nurses was created to establish a MARSI standardised training programme for patients with double-lumen power-injectable PICCs. The group also systematically strengthened MARSI theoretical knowledge and clinical skills training for the unit’s nursing staff to improve MARSI risk identification and prevention awareness. The education and training for nursing staff in this study includes skin preparation, adhesive product application and removal techniques, skin protection barriers and the use of glue removers, etc. A MARSI management and supervision mechanism was established for catheter maintenance quality control, and the MARSI risk assessment-related rules, regulations and preventative measures were revised for the double-lumen power-injectable PICC insertion site in the unit. Nursing care procedures and standards for preventing MARSI were formulated. The nursing staff was regularly assessed and trained. Only qualified staff members were permitted to provide care independently. Real-time, dynamic supervision of the MARSI risk maintenance process by the nursing staff was conducted to discover problems in a timely manner and to identify their causes to facilitate rectification. In addition, to prevent reoccurrence, such problems were regarded as key focus of the supervision. Finally, the supervision endeavoured to strengthen the MARSI quality control of the catheter insertion site.

2.3 | Assessment method
A MARSI skin information collection table was established for each patient, and the researchers filled in the MARSI information of the catheter insertion site according to the patient stratification assessment plan. After the removal of medical adhesive at the catheter site, if skin abnormalities (such as erythema with or without blisters, erosion or laceration lasting 30 minutes or longer) were observed, the condition was diagnosed as MARSI and documented.

2.3.1 | Evaluation index
Common types of MARSI include mechanical skin injuries, for example, pressure injuries, tension injuries, epidermal peeling injuries, skin laceration injuries, dermatitis (CD, allergic dermatitis), maceration, and folliculitis. A literature review indicated that a MARSI skin assessment scale for adults has yet to be developed. The classification of MARSI in this study was determined by the research team (including vein and skin pressure ulcer nurses) and dermatologists based on the definition of various injuries and clinical experience.

2.4 | Statistical method
SPSS 28.0 software was used for statistical analysis. The quantitative data were expressed as the mean ± SD, and the t test was used for comparison. The qualitative data were expressed as cases and percentages and compared using chi-square tests. A rank sum test was used for rank data, whereby \( P < .05 \) was considered to indicate a statistically significant difference.

2.5 | Ethics
This study was approved by the ethics committee of the Peking Union Medical College & Chinese Academy of Medical Sciences (JS-2474). Respondents completed an informed consent form in which they agreed that their data could be used in the project.

3 | RESULTS

3.1 | MARSI occurrence at the double-lumen power-injectable PICC site
The total incidence rate of MARSI was 30.59% in the control group and 7.04% in the intervention group. The incidence rate of mechanical injury in the control group was 12.94%, which decreased to 2.82% after intervention (\( P < .05 \)). The difference was statistically significant. The incidence rate of dermatitis in the intervention group was 11.76%, which decreased to 2.82% after intervention (\( P < .05 \)), and the difference was statistically significant. The incidence rate of both maceration and folliculitis decreased (\( P > .05 \)), and the difference was not statistically significant (Table 1).

3.2 | MARSI mechanical injury occurrence at the double-lumen power-injectable PICC site
The incidence rate of pressure injury in the control group was 4.71%, which decreased to 1.41% after intervention.
The difference had statistical significance. The incidence rate of epidermal exfoliation injury in the control group was 3.53%. After intervention, the incidence decreased to 0 ($P < .05$). The difference was statistically significant. A comparison for each type is shown in Table 2.

### 3.3 Occurrence of MARSI dermatitis at the double-lumen power-injectable PICC insertion site

The incidence rate of dermatitis in the control group decreased from 11.76% to 2.82% after intervention ($P < .05$), and the difference was statistically significant. In addition, the incidence rate of all types of MARSI decreased, with the most significant reduction occurring in the incidence of mechanical injury, followed by dermatitis and maceration (Table 1). These outcomes suggest that MARSI nursing management can effectively reduce the risk of MARSI occurrence. When the MARSI nursing management group was compared with the conventional nursing group with respect to risk assessment, prevention, and management, the MARSI prevention system represented a basis on which to offer patients a personalised catheter maintenance plan.

According to the MARSI high-risk factor assessment table, care providers should focus on identifying high-risk patients, improving the attention paid to and the observation frequency of such patients, understanding the skin condition of the catheter site in a timely manner, taking measures to prevent injury as soon as possible, and preventing the progression of the injury. There was a significant difference in the incidence of dermatitis between the two groups. Specifically, the incidence rate of dermatitis in the conventional nursing care group was 11.76%, which decreased to 2.82% after intervention ($P < .05$), and the difference was statistically significant. In addition, in terms of the injury degree of dermatitis, only two patients in the MARSI nursing management group compared with the conventional nursing group.

### 4 DISCUSSION

The results of this study indicate that the total incidence rate of MARSI at the catheter insertion site was significantly decreased in the MARSI nursing management group compared with the conventional nursing group ($P < .05$), and the difference was statistically significant. In addition, the incidence rate of all types of MARSI decreased, with the most significant reduction occurring in the incidence of mechanical injury, followed by dermatitis and maceration (Table 1). These outcomes suggest that MARSI nursing management can effectively reduce the risk of MARSI occurrence. When the MARSI nursing management group was compared with the conventional nursing group with respect to risk assessment, prevention, and management, the MARSI prevention system represented a basis on which to offer patients a personalised catheter maintenance plan.
group had mild injuries, and no moderate or severe injury occurred (Table 3). Several studies have demonstrated the increased risk of skin injury for patients when clinical nurses conduct the PICC nursing care procedure. How to select the most suitable adhesive product according to the patient’s condition is a problem that medical and nursing staff often face in clinical practice. In addition, clinical nurses rarely use skin protectants, and the related practice urgently requires improvement. Moreover, PICC fixed adhesive-related skin injury is related to factors such as allergy to film and tape, the poor air permeability of film, the disinfectant not being dry, or dressing and tape sticking too tightly. MARSI nursing management strengthens risk prevention and provides targeted preventative measures for potential risks that may occur in catheter maintenance. The results indicate that the total incidence rate of mechanical injury decreased most significantly, while the incidence rate of all other types also decreased (Table 2). In 2013, 23 industry experts from various specialties in the United States jointly issued an expert consensus on skin damage caused by medical adhesives, clinical nurses have insufficient understanding of its risk of occurrence and pay it insufficient attention. In addition, there is a lack of references and guidance related to MARSI prevention. The MARSI nursing management method was effectively implemented and progressed via the measures taken by the MARSI nursing management group. These measures included implementing full-process risk management and a supervision mechanism; standardising the education and training plan; refining the different types of high-risk preventative nursing measure; improving the unit nursing staff’s attention, assessment, and maintenance ability with respect to MARSI; dynamic tracking and feedback summaries; and continuously improving quality care.

It will be a widely accepted standard that skin be assessed patients with PICC during maintaining, with more frequent assessment of patients at higher risk for skin breakdown or damage. During the use of adhesive-containing products, skin assessment is particularly important, especially for patients at high-risk of adhesive-related injuries. We must actively identify patients at high-risk for MARI is a key step of prevention. In this regard, we can take adequate precautions to help protect the skin from harm. By assessing MARSI risks, it is vital to actively take measures to prevent the occurrence of risks, and to be able to manage them correctly after they occur.

5 | CONCLUSION

In conclusion, in the areas of risk prevention control and systematic full-process management, the MARSI nursing management method can effectively reduce the risk of MARSI. We need to encourage more researchers to pay attention to MARSI evidence-based prevention strategies to reduce complications, increase patient satisfaction, and improve clinical prognosis.

However, to provide a foundation for the standardisation of skin injury management at the PICC insertion site, the relatively small sample size of this study requires expansion, and the MARSI preventative measures require further improvement.

ACKNOWLEDGEMENTS

We express our sincere gratitude to all the patients who so graciously agreed to participate in this study. We are also thankful for the support provided by the ethics agency.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in https://figshare.com/articles/dataset/data_xlsx/19721743/1

REFERENCES

1. McNichol L, Lund C, Rosen T, Gray M. Medical adhesives and patient safety: state of the science: consensus statements for the assessment, prevention, and treatment of adhesive-related skin injuries. J Wound Ostomy Continence Nurs. 2013;40(4):365-380.
2. Lin S, Lai L, Wu L, Chen L, Zhao Y. The incidence rate and influencing factors of medical adhesive related skin injury at a PICC catheter site among breast cancer patients. Chin Nurs Res. 2018;32(5):806-809.
3. Zhao H, Huang H, Wei Q, et al. Medical adhesive-related skin injury associated factors at PICC insertion site in patients with hematologic malignancies. Chin J Pract Nurs. 2017;33(5):335-340.
4. Zhao H, Wei Q, Li G. Investigation and analysis of nurses’ current understanding of medical adhesive-related skin injuries. J Qilu Nurs. 2017;23(5):4-6.
5. He J, Yin Z, Zhong X. Study on the current status of knowledge, attitudes, practices and influential factors of clinical nurse’s prevention of medical adhesive-related skin injury. J Nurs Train. 2017;32(17):1544-1548.
6. Zhou Y, Chen L, Zhang J. Attitudes and practices of ICU nurses with medical adhesive-related skin injury and their influential factors. J Nurs. 2017;24(10):51-55.
7. Broadhurst D, Moureau N, Ullman AJ. Central venous access devices site care practices: an international survey of 34 countries. J Vase Access. 2016;17(1):78-86.
8. Brett DW. Impact on pain control, epidermal stripping, leakage of wound fluid, ease of use, pressure reduction, and cost-effectiveness. J Wound Ostomy Continence Nurs. 2006;33(6):S15-S19.
9. Koval KJ, Egel KA, Polatsch DB, Baskies MA, Homman JP, Hiebert RN. Tape blisters following hip surgery. A prospective,
randomized study of two types of tape. *J Bone Joint Surg Am.* 2003;85(10):1884-1887.

10. LeBlanc K, Baranoski S. Skin tears: state of the science: consen-
sus statements for the prevention, prediction, assessment, and
treatment of skin tears©. *Adv Skin Wound Care.* 2011;24(9):
2-15.

11. Gray M, Black JM, Baharestani MM, et al. Moisture-associated
skin damage: overview and pathophysiology. *J Wound Ostomy
Continence Nurs.* 2011;38(3):233-241.

12. Lund C. Medical adhesives in the NICU. *Newborn Infant Nurs
Rev.* 2014;14(4):160-165.

13. Wang J, Gao Y, Chen W, Wei L, Zhang H. Cost-effectiveness
analysis of three different dressings used after PICC catheter-
ization. *J Chin Nurs Manag.* 2011;3(15):88-90.

14. Mei S, Yu J, Zhang X. Investigation of the knowledge and
behavior of clinical nurses involving the prevention of medical
adhesive-related skin injury in a grade A tertiary hospital.
*J Nurs.* 2016;23(17):54-57.

15. Xu B, Geng C. *Safety Guidelines for Vascular Access in Tumor
Treatment.* Beijing, China: Peking Union Medical College
Press; 2015:122-123.

**How to cite this article:** Zhao Y, Bian L, Yang J. Intervention
efficacy of MARSI nursing management on skin injury at peripherally
inserted central catheter insertion site on oncological patients. *Int Wound J.* 2022;19(8):
2055-2061. doi:10.1111/iwj.13805