Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 4
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Development of a Disposable Care Package for PICC Disinfection in Postoperative Clinical Surgical Patients

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Abstract: *Objective:* To design a disposable care package for postoperative PICC disinfection for the daily maintenance of postoperative indwelling PICC catheter patients, save the operation time of nurses, reduce the operation difficulty of nurses, increase patient comfort and improve patient satisfaction. *Methods:* The items required for the routine maintenance of PICC catheter shall be packaged separately in a sterile manner, and all items shall be packaged as disposable care package for the maintenance of PICC catheter. *Results:* The use of a special PICC disinfection disposable care package, inside all the items after strict sterile treatment, simple and convenient, save time and effort. *Conclusion:* PICC disinfection disposable care package can reduce the operation difficulty of medical staff, shorten the operation time, increase patient comfort, and facilitate the use of medical staff.

Keywords: Postoperative patient; PICC; Nursing; Aseptic technique

Online publication: April 28, 2025

1. Introduction

At present, many clinical diseases can be solved by arteriovenous puncture, such as upper limb venography and PICC catheterization. The full of PICC catheter is the peripheral vein catheterization to the central vein [1]. Catheterization technology is widely used in clinical due to the advantages of easy operation, safety, soft catheter, easy patient movement and easy fixation of, reducing the pain of repeated puncture, reducing vascular stimulation, and less complications [2, 3]. However, the disinfection of postoperative puncture points and the maintenance of PICC pipes are particularly important [4]. Its widely used in clinical department, has a simple operation, avoid repeated puncture, use safety advantages, but with complications often occur, infection is one of the most common complications, not only to the patient and family brought the physical and economic double pressure, also make the operator nervous, a simple and effective PICC disinfection disposable care package is particularly important [5, 6].

Surgical patients often retain their postoperative PICC catheters in the ward, but there is no dedicated PICC maintenance care package available. In clinical practice, nursing staff must routinely prepare alcohol, iodine, sterile cotton swabs, and stickers. These items are typically scattered across different locations, and each time they are needed, staff must spend time gathering them. This process can be time-consuming and sometimes leads to the omission of certain items [7]. This increases the operational difficulty for medical staff and contributes to heightened patient anxiety.

In order to ensure the best disinfection and maintenance effect, a new type of PICC disinfection disposable care package has been designed in this study, which can effectively solve the above problems.

2. Materials and methods

2.1. Materials

The outer packaging of the disinfection bag is made from PVC material. The disinfection bag primarily consists of five parts: sterile gloves, iodine cotton balls, alcohol cotton balls, film, and tweezers. When disinfecting the catheter, a square package is used. The inner wall of the square package is connected to a rotating column, and the side wall of the rotating column is equipped with disinfection components. These disinfection components are used for disinfecting the catheter. The inner wall of the square package is also fitted with export components, which facilitate the removal of the catheter from the square package.

Additionally, the disinfection assembly includes a partition that is fixed to the inner wall of the square package. The square package, located on either side of the partition, contains a disinfection chamber and a storage chamber. Inside the storage chamber, an airbag is fixed to the inner wall of the square package. The inner wall of the storage chamber is also connected to elastic components, with the end of the elastic assembly fixed to a baffle. This baffle is positioned against the partition's inner wall and serves to separate the disinfection chamber from the liquid storage chamber [8]. The sidewall of the airbag within the square package, as well as the elastic assembly, includes a first sleeve. The first sleeve is fixed to the inner wall of the square package and is connected to a first sliding column and a first sliding cylinder. The first sliding cylinder is linked to the first sleeve by a fixed spring, providing an elastic mechanism [9].

The export assembly features a second sleeve, which is mounted on both sides of the top wall of the square package. The inner wall of the second sleeve is connected to a threaded column. This threaded column passes through the bottom end of the square package, with a top plate fixed to a connecting block. The catheter is connected to the connecting block, which interfaces with both the input and output ports. The output port is wound in the opposite direction to the side wall of the rotating column [10].

The square package side wall is provided with a square mouth, the outer side of the square mouth is fixed connected with a first connecting plate, the square package side wall above the first connecting plate has the top of the second connecting plate, the second sliding plate has a sliding pad, the second sliding column and the second sliding plate with a rotating plate, the top of the square mouth is provided with a protective cover, the square package is provided as a transparent material.

2.2. Methods

To begin, open the PICC disinfection disposable care kit and put on sterile rubber gloves. Start by disinfecting the skin around the catheter insertion site, followed by using an alcohol cotton ball to clean the puncture point. Once

this is done, secure the catheter with a protective film. During the catheterization process, regularly monitor the skin around the insertion site and carefully observe and document any signs of blood infiltration at the puncture point.

When disinfecting the catheter, rotate the rotating plate to move it away from the limit column. This action causes the second spring's elastic force to drive the second sliding column, which in turn moves the sponge pad downward. The sponge pad will then gently press against the top of the first connecting plate, allowing it to clean any remaining disinfectant from the catheter's side walls

Attached below is **Figure 1**, which is a structural diagram of the utility model device**.**

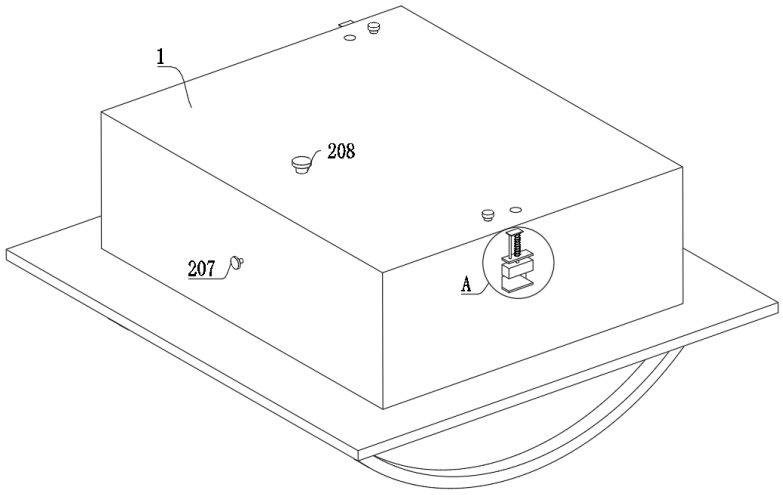

Figure 1. A structural diagram of the utility model device.

The technical scheme of the utility model embodiment will be described in detail below, with reference to the accompanying drawings. It is important to note that the described embodiment represents only one example of the utility model, rather than all possible embodiments. Based on the embodiments of the utility model, any other variations or embodiments that can be derived by those skilled in the art, without inventive effort, will fall within the scope of the utility model's protection. **Figure 2** shows the local amplification structure of point A in **Figure 1**.

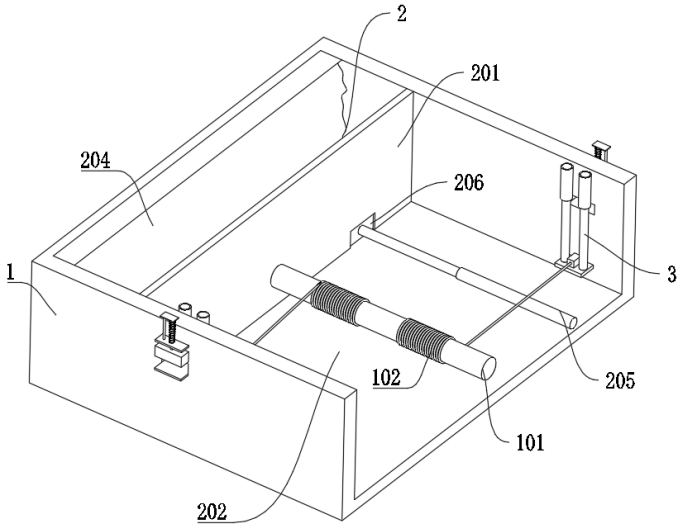

Figure 2. The local amplification structure of point A.

Referring to **Figure 2** above, a disposable care package for PICC disinfection is provided, consisting of a square bag (1). The inner wall of the square bag (1) is connected to a rotating column (101), which is wrapped with a catheter (102). The square bag's inner wall also houses a disinfection component (2), which is designed to disinfect the catheter (102). Additionally, the square bag's inner wall is equipped with an export assembly (3), which serves to guide the catheter (102) out of the square bag (1).

The disinfection component (2) includes a partition (201), which is fixed to the inner wall of the square bag (1). The square bag (1) is divided by the partition (201) into a disinfection chamber (202) and a storage chamber (203). The storage chamber (203) is connected to an air chamber (204) and is equipped with an elastic assembly (205). The elastic assembly (205) includes a baffle (206), which, along with the partition (201), helps separate the disinfection chamber (202) from the storage chamber (203).

Next, **Figure 3** below is a schematic diagram of the partial section structure of the utility model device and **Figure 4** is a schematic diagram of the utility model device (forward section). **Figure 5** is a schematic diagram of the elastic component of the utility model (schematic).

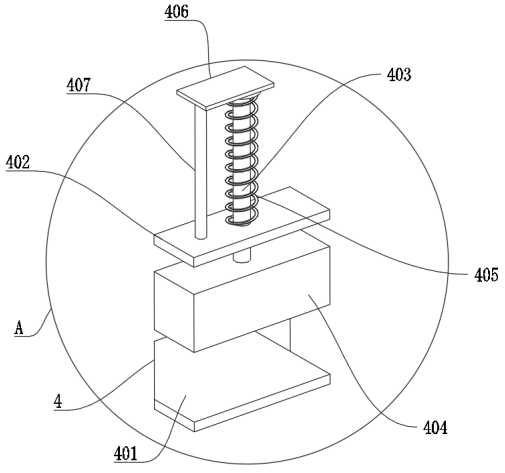

Figure 3. Schematic diagram of the partial section structure of the utility model.

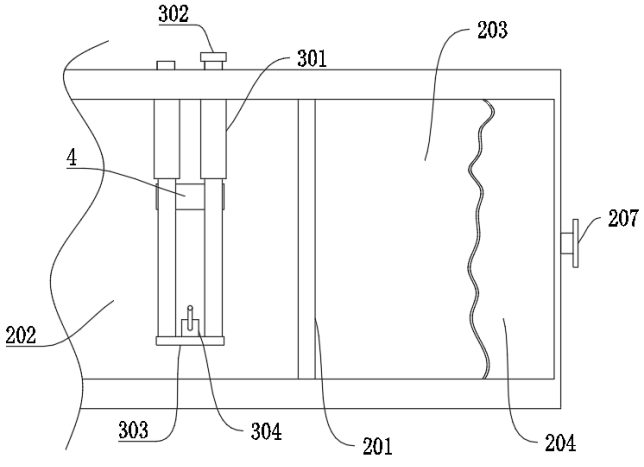

Figure 4. A schematic diagram of the utility model device (forward section).

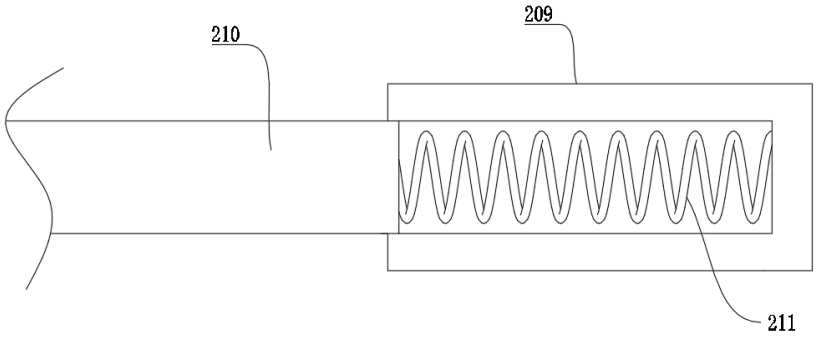

Figure 5. A schematic diagram of the elastic component of the utility model (schematic).

Based on **Figure 1–5**, the side wall of the outer airbag (204) within the square package (1) is fixed with an air inlet (207), and the top of the square package (1) is equipped with an inlet (208). The elastic assembly (205) includes a first sleeve (209) fixed to the inner wall of the square package (1). The first sleeve (209) is connected to a first sliding column (210), which is fixed to the baffle (206). A first spring (211) is placed between the first sliding column (210) and the first sleeve (209).

To use the catheter (102), disinfectant is filled into the reservoir chamber (203) through the inlet (208). When sterilizing the catheter, the airbag (204) can be inflated through the air inlet (207). This inflates the airbag within the reservoir chamber (203), increasing the pressure inside the chamber. As a result, the first sliding column (210) moves the baffle (206) away from the partition (201), allowing the inner cavity of the first sleeve (209) to connect the disinfection chamber (202) and the reservoir chamber (203). This connection causes the disinfectant from the reservoir chamber (203) to flow into the disinfection chamber (202), effectively disinfecting the catheter (102) wrapped around the rotating column (101).

Referring to **Figure 1–4**, the export assembly (3) includes a second sleeve (301), which is mounted on both sides of the inner top wall of the square bag (1). The second sleeve (301) is equipped with a threaded column (302), and the bottom end of the threaded column (302) is connected to a connecting plate (303). The connecting block (304) passes through the connecting plate (303) and the output port, which is positioned opposite to the side wall of the rotating column (101).

After disinfection, turning the threaded column (302) causes it to slide onto the connecting plate (303), which in turn moves the connecting block (304) along the end of the catheter (102). This action pulls the catheter (102) out of the square bag (1). To prevent the catheter from extending too far outside the square bag (1), the rotating column (101) is tightened by rotating it, effectively controlling the length of the catheter (102) outside the square bag.

Referring to **Figures 1–5**, the side wall of the square package (1) features a square port (4). Outside the square port (4), the side wall of the square package (1) is fixed with a first connecting plate (401), and above this, the side wall is connected to a second connecting plate (402). A second sliding column (403) is attached to the top of the second connecting plate (402), and a sponge pad (404) is mounted on the second sliding column (403). The second sliding column (403) works with the second connecting plate (402) and a limit column (407), with a protective cover surrounding the square port (4). The square package (1) is made of transparent material.

It is important to note that when the catheter (102) is pulled out from the square port (4), the rotating plate (406) is turned away from the limit column (407). Due to the elastic force of the second spring (405), the second sliding

column (403) moves downward, causing the sponge pad (404) to press against the top of the first connecting plate (401). The sponge pad (404) then cleans any remaining disinfectant on the side wall of the catheter (102). The transparent material of the square package (1) allows for clear visibility of the situation inside.

The operation begins by filling the disinfectant into the storage chamber (203) through the inlet (208). Before using the catheter (102) for sterilization, the airbag (204) is inflated via the air inlet (207), causing the airbag to expand within the reservoir chamber (203) and increase the pressure inside. This pressure causes the first sliding column (210) to move the baffle (206) away from the partition (201), connecting the disinfection chamber (202) to the reservoir chamber (203). As a result, the disinfectant in the reservoir chamber (203) flows into the disinfection chamber (202), disinfecting the catheter (102) wrapped around the sidewall of the rotating column (101). After disinfection, the threaded column (302) is rotated, making it slide along the support plate (303) and driving the connection block (304), which pulls the catheter (102) away from the limit plate (406) by rotating the rotating plate (406). Meanwhile, the second sliding column (403) moves downward, causing the sponge pad (404) to press against the top of the first connecting plate (401), cleaning any residual disinfectant from the catheter's sidewall.

3. Advantages

(1) Easy to operate and easy to use

The device offers a simple and reliable solution for clinical operations, ensuring safety and efficiency. It effectively addresses issues such as unprofessional PICC disinfection, incomplete supplies, and the inconvenience of traditional disinfection methods. Designed for ease of use, the device allows a single medical staff member to efficiently prepare all necessary items, saving time and effort during disinfection. This improvement in work efficiency helps reduce resource waste. Additionally, the device's convenient daily maintenance enhances patient comfort. With its compact size, it also helps lower medical costs for patients, contributing to increased satisfaction for both patients and their families.

(2) The material is simple and safe, and the device is practical and reliable

The product is made from non-toxic, tasteless polyethylene polymer material, ensuring no irritation to the patient's skin or respiratory system. It is cost-effective and offers significant advantages over traditional sterile items, particularly in reducing postoperative allergies and enhancing patient comfort. This makes it ideal for widespread use in clinical settings. Additionally, the device features a compact, reasonable design with a simple structure, offering the benefit of easy disinfection and eliminating the complexities of traditional disinfection processes. As a result, it helps reduce the infection rate, further improving patient safety.

4. Conclusion

The PICC Disinfection Disposable Care Package significantly enhances clinical efficiency and patient care by streamlining the disinfection and maintenance process for peripherally inserted central catheters (PICCs). This all-in-one kit reduces the operational difficulty for healthcare professionals by providing pre-packaged, standardized components, eliminating the need for time-consuming manual preparation. As a result, it shortens procedural time, allowing medical staff to focus more on patient assessment and care rather than logistical setup.

Additionally, the disposable care package improves patient comfort by ensuring consistent, aseptic techniques, minimizing infection risks, and reducing skin irritation through high-quality, hypoallergenic materials.

Its user-friendly design facilitates quick and hassle-free application, making it convenient for nurses and clinicians to perform PICC line maintenance with precision and confidence.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wu X, Sun W, Cao J, et al., 2024, Standardize the Management of PICC Operating Nurses to Ensure the Safety of Intravenous Treatment. Nursing Management in China, 14(06): 561–563.

[2] Zhou K, Rowling, Zhou X, et al., 2021, Development of a Pressurized Tourniquet. Journal of Nursing, 28(20): 77–78. DOI:10.16460/j.issn1008-9969.2021.20.077.

[3] Li C, Chai Y, Ge J, et al., 2019, Study on the Effect of Elastic Bandage Compression Hemostasis in Preventing Bleeding at the Puncture Point After PICC Catheterization. General Practice Care, 17(24): 3040–3042. DOI:10.12104/j.issn.1674-4748.2019.24.037.

[4] Xiao L, Wen X, Zhang J, et al., 2020, Comparison of Accreditation and Recertification Systems in China and the United States. Nursing Research, 34(15): 2723–2726.

[5] Wang Y, Ren X, Wang Y, et al., 2018, Clinical Practice to Improve the Availability Rate of PICC Catheterization in Primary Hospitals. Nursing Management in China, 18(10): 1406–1409.

[6] Luo L, Wang G, Qin Y, et al., 2016, Prospective Study of the Incidence and Timing of Venous Thrombosis in Upper Extremity in Tumor Patients. Chinese Journal of Practical Nursing, 32(8): 276–580. DOI:10.12104/j.issn1008-9969.2008.03.013.

[7] Kehlet H, Wilmore DW, 2002, Evidence-Based Surgical Care and the Evolution of Fast-Track Surgery. Annals of Surgery, 248(2): 189–198.

[8] Brown CJ, et al., 2019, Postoperative Pain Management in Orthopedic Surgery: A Multimodal Approach. Journal of Clinical Nursing, 28(15–16): 2710–2721.

[9] World Health Organization, 2017, Guidelines for Safe Postoperative Care. Geneva: WHO Press.

[10] Smith JA, Johnson RL, 2020, The Impact of Patient-Centered Care on Nursing Outcomes. Journal of Advanced Nursing, 76(3): 123–135.