

Application of Chlorhexidine Gluconate Dressing Combined with Cluster Nursing in Artificial Liver Therapy

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Abstract

Objective: To evaluate the efficacy of chlorhexidine gluconate (CHG) antimicrobial dressing combined with cluster nursing in the management of artificial liver catheters. **Methods:** A total of 2978 patients undergoing artificial liver therapy from January 2022 to December 2024 were enrolled. Based on the treatment timeline, patients were divided into a control group (1426 cases, treated from January 2022 to June 2023) and an observation group (1552 cases, treated from July 2023 to December 2024). The control group received standard 3M transparent dressing for catheter site care, while the observation group was treated with CHG antimicrobial transparent dressing combined with cluster nursing. The incidence of catheter-related bloodstream infection (CRBSI), puncture site bleeding, and frequency of dressing changes were compared between the two groups. **Results:** Significant differences were observed in the incidence of CRBSI ($P < 0.05$), with 6 cases in the control group and none in the observation group. The incidence of puncture site bleeding was also significantly lower in the observation group ($P < 0.05$). Additionally, the observation group required fewer dressing changes (1.63 ± 0.67) compared to the control group (3.70 ± 0.85 , $P < 0.01$). **Conclusion:** The combination of CHG antimicrobial dressing and cluster nursing demonstrated superior outcomes in artificial liver catheter management, effectively reducing CRBSI, minimizing puncture site bleeding, and decreasing the frequency of dressing changes.

Keywords

Artificial Liver Support System, Catheter-Related Bloodstream Infection, Chlorhexidine Gluconate Antimicrobial Dressing, Cluster Nursing, Extracorporeal Liver Support Catheter

1. Introduction

The artificial liver support system (ALSS) is a temporary extracorporeal support system designed to partially replace liver function, significantly improving the prognosis of patients with liver failure [1]. During ALSS therapy, vascular access is essential for blood exchange, with the internal jugular vein being the preferred site for catheter placement [2]. However, catheter insertion disrupts the skin barrier, and the neck area is prone to contamination from sweat or moisture, increasing the risk of catheter-related bloodstream infection (CRBSI). In developing countries, the incidence of CRBSI is approximately 0.65% [3]. Infections not only elevate mortality rates but also strain healthcare resources. Additionally, factors such as neck movement, coagulation dysfunction in liver failure patients, and inadequate puncture site compression can lead to bleeding. Traditional methods like hemostatic dressings, compression, and frequent dressing changes may adversely affect patient outcomes. Therefore, effective strategies to prevent infections and bleeding are critical for artificial liver catheter management.

Antimicrobial dressings, which block microbial colonization and control skin flora, play a pivotal role in preventing CRBSI. Cluster nursing, an evidence-based approach, enhances nursing practices by standardizing procedures and improving attention to detail, thereby reducing complications. Perspiration accumulation under the transparent dressing may compromise its adhesive properties, necessitating dressing changes. Frequent dressing replacements increase the risk of catheter dislodgement and impede wound healing [4]. This study explores the combined use of CHG antimicrobial dressing and cluster nursing to mitigate CRBSI, minimize bleeding, and reduce dressing change frequency.

2. Materials and Method

2.1. Study Population

A total of 2978 patients undergoing artificial liver therapy between January 2022 and December 2024 were included. The control group (1426 cases) received treatment from January 2022 to June 2023, while the observation group (1552 cases) was treated from July 2023 to December 2024. Baseline characteristics, including age, gender, and disease type (early liver failure, mid-to-late liver failure, and non-liver failure), were comparable between the two groups ($P > 0.05$, **Table 1**).

Table 1. Comparison of disease categories between the control and observation groups.

Disease Category	Early Liver Failure	Mid-to-Late Liver Failure	Non-Liver Failure	Total
Control Group	545	436	445	1426
Observation Group	602	465	485	1552
χ^2			3.06	
P			0.52	

No significant differences were found between groups.

2.2. Interventions

In both groups, the replacement of artificial liver catheter dressings was performed by nurses certified in specialized artificial liver support therapy. Control Group: Standard 3M transparent dressing was applied after catheter insertion or dressing changes. For bleeding, a 2 × 2 cm 9-layer gauze was placed under the dressing for compression.

Observation Group: CHG antimicrobial transparent dressing was used, with an additional adhesive strip for point-to-point compression using gauze. Cluster nursing was implemented, including:

- 1) Project Management Team: Comprising experienced clinicians and nurses from infectious diseases and hospital infection departments.
- 2) Standardized Protocols: Evidence-based guidelines for catheter maintenance, regular audits, and continuous quality improvement.
- 3) Dressing Changes: Regular inspections for redness, exudate, or loosening. Dressings were changed if saturated, displaced, or every 7 days.
- 4) Patient Education: Enhanced training for nurses and educational materials for patients to improve self-management.

2.3. Outcome Measures

1) CRBSI cases were identified based on the 2021 Chinese National Guidelines for Vascular Catheter-Associated Infection Prevention, with data extracted from the hospital's electronic infection control monitoring platform [5].

2) Assessment Criteria for Puncture Site Bleeding

Grade I: Minor oozing, bleeding area ≤ (1 cm × 1 cm)

Grade II: (1 cm × 1 cm) < bleeding area ≤ (2 cm × 2 cm)

Grade III: Bleeding area > (2 cm × 2 cm), completely saturating the gauze dressing

Note: Dressing change and symptomatic treatment should be performed for Grade II or higher bleeding.

3) Dressing change frequency was recorded and compared between groups from catheter insertion to removal.

2.4. Statistical Analysis

Data were analyzed using SPSS 20.0. Categorical variables were compared using χ^2 tests, and continuous variables with t-tests ($P < 0.05$ considered significant).

3. Results

CRBSI: 6 cases in the control group vs. 0 in the observation group ($P = 0.001$). The control group had 6 cases of catheter-related bloodstream infection, including: 3 cases of *Staphylococcus aureus*, 1 case of *Aeromonas veronii*, 1 case of *Klebsiella pneumoniae*, and 1 case of *Staphylococcus epidermidis*.

Bleeding: 233 cases (16.3%) in the control group vs. 86 (5.54%) in the observation group ($P = 0.008$).

Dressing Changes: 3.70 ± 0.85 (control) vs. 1.63 ± 0.67 (observation, $P = 0.01$).
(Table 2)

Table 2. Comparison of CRBSI incidence, puncture site bleeding, and dressing change frequency between groups [n(%)].

Group	CRBSI Cases n (%)	Puncture Site Bleeding Grade [n (%)]				Dressing Changes (Mean \pm SD)
		I	II	III	Total Bleeding n (%)	
Control	6 (0.42)	154	47	32	233 (16.3)	3.70 ± 0.85
Observation	0	42	26	18	86 (5.54)	1.63 ± 0.67
χ^2/t	5.22		3.18			3.58
P	0.001		0.008			0.01

Statistically significant ($P < 0.05$).

4. Discussion

With the increasing adoption of artificial liver support systems, catheter-related complications have become more prevalent, among which catheter-related bloodstream infection (CRBSI) and puncture site bleeding are the most common and clinically significant. Frequent dressing changes not only increase the risk of catheter dislodgement and bleeding but also impair wound healing.

Conventional transparent dressings combined with gauze exhibit poor fluid absorption, necessitating frequent replacements in cases of bleeding while obscuring visualization of the puncture site. In contrast, the chlorhexidine gluconate (CHG) dressing comprises two components: a transparent film and an antimicrobial gel pad containing 2% CHG, which provides broad-spectrum antibacterial activity. The CHG gel pad forms a microbial barrier, effectively absorbing exudate, blood, and sweat while maintaining antimicrobial efficacy and transparency even at saturation [4]. Its self-adherent design enhances catheter stability, reducing mechanical stress on the puncture site. The transparent material allows continuous visual monitoring for early complication detection. An integrated adhesive strip enables targeted compression over gauze, offering hemostasis—particularly critical for the >50% of enrolled patients with coagulation dysfunction due to liver failure. By absorbing minor bleeding and reducing dressing change frequency, CHG dressings significantly lower CRBSI incidence and overall treatment costs, alleviating patient burdens.

5. Conclusion

The application of chlorhexidine gluconate (CHG) dressings in artificial liver catheter management demonstrates comprehensive clinical benefits: effectively reducing bacterial colonization at both puncture sites and catheter surfaces while accelerating the eradication of local pathogens. The integrated gel pad additionally absorbs minor hemorrhage, thereby shortening wound healing time and decreasing maintenance frequency. This multimodal approach not only alleviates patient discomfort but also generates significant economic advantages through reduced

material costs and nursing workload [6]. Our findings confirm that the combined use of CHG antimicrobial dressings with evidence-based care bundles achieves optimal catheter maintenance outcomes, strongly supporting its widespread implementation in clinical practice.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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