Examining the Role of Securement and Dressing Products to Prevent Central Venous Access Device Failure: A Narrative Review

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Abstract

Objective: *To describe the underpinning principles involved in central venous access device (CVAD) securement and dressing products to prevent CVAD failure and complications through a synthesis of research studies.*

Background: *Functional, dependable CVADs are a necessary part of patient care. Dressing and securement products are used to prevent CVAD failure and complications, but there is a large variety of products available for clinicians to access, with variable effectiveness.*

Methods: *A narrative review of studies describing the mechanisms for CVAD securement and dressing products to prevent failure and complication was undertaken. After a systematic search, 20 clinical and laboratory studies were included in the review.*

Discussion: *The major mechanisms by which CVAD dressing and securement products prevent failure are providing a barrier to microbial contamination and motion reduction. CVAD securement and dressing products provide these functions using coating, adhesion, antimicrobial properties, absorbency, and moisture vapor transmission without causing irritation to skin and maintaining visibility of the insertion site. The complexity of patients requiring CVAD securement and dressing means that universal recommendations across CVAD populations and broad generalization of studies from single populations (eg, intensive care) or devices (eg, peripherally inserted central catheters) are ill advised.*

Conclusions: *CVAD securement and dressing products provide important, multifaceted functions to prevent CVAD failure and complication.*

Keywords: *central venous catheterization, health care-associated infection, evidence-based practice, wound care*

Introduction

Central venous access devices (CVADs) are a necessary part of contemporary health care. They provide a consistent method to access the vascular system and infuse vital, vessel-irritant medications and fluids over extended periods of time.[1] Multidisciplinary health care practitioners and patients rely on these devices, assuming they will be functional throughout treatment.

However, the literature has reported high incidences of CVAD failure before the completion of treatment.[2-4] The predominant mechanisms resulting in failure are CVAD-associated bloodstream infection (BSI), thrombosis, occlusion, dislodgement, breakage, and local skin irritation or infection.[5,6] Each of these complications results in an interruption to necessary treatment, the insertion of a replacement vascular access device, and the attributable morbidity and mortality of the complication.

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Many of these complications are considered preventable with the consistent application of evidence-based strategies,[7,8] and should not be viewed as an unavoidable consequence to technical medicine.[9] In recent years international health care agencies have prioritized the prevention of CVAD-associated BSI related to insertion practices within the intensive care setting.[10,11] Celebration over the success of CVAD insertion bundles should be metered by the continuing rate of CVAD failure and complication due to other mechanisms that occur later in the catheter life. Health care practitioners are continuing to search for novel and innovative ways to improve CVAD management for their patients.

Dressing and securement products have always been used as a means to prevent CVAD failure and complication. The first CVAD dressing product utilized in the clinical setting was gauze and tape, with clear polyurethane dressings becoming prominent in the 1980s.[6] Additional CVAD securement has traditionally been achieved via the use of silk or synthetic sutures. There is now a large variety of CVAD securement and dressing products available in the clinical setting, and even more in development.

Securement and dressing products are a practicality of health care provision for all vascular access specialists who insert and manage CVADs. Their importance and relative effectiveness should also not be taken for granted by the wider health care community (eg, oncologists and general surgeons) benefiting from their effectiveness to prevent CVAD failure. The mechanisms by which these products act to prevent CVAD failure may be poorly understood. By reviewing the available evidence surrounding the role of CVAD securement and dressing products, clinicians, researchers, and product manufacturers can work collaboratively to develop practical, effective, and efficient strategies for all patients requiring a CVAD. Previous systematic reviews and meta-analyses have focused on the relative effectiveness of specific dressing and securement products.[6,12-14] Our review focuses on studies that explore the fundamental principles of CVAD securement and dressing products to prevent failure and complication.

Aims

The aim of our review was to synthesize the available literature to describe the underpinning principles involved in CVAD securement and dressing products and how they prevent CVAD failure and complications.

Methods

A narrative review was undertaken to synthesize the accumulated state of knowledge and trends within CVAD securement and dressing research. This includes a priori inclusion criteria for study selection, following the recommendations for narrative review methodology by Green et al.[15]

Eligibility Criteria

All studies that focused on the underpinning principles involved in CVAD securement and dressing products for the prevention of CVAD failure and complications are included in the review. All randomized controlled trials (RCTs) that had previously been included within an included meta-analysis were excluded, to ensure a lack of study result repetition. Studies were excluded if they were not written in English.

Literature Search Strategy

Ovid MEDLINE (1950 to December 2014), Ovid EMBASE (1980 to December 2014), EBSCOhost CINAHL (1982 to December 2014), and Cochrane Central Register of Controlled Trials (December 2014 issue) were systematically and independently searched. Medical subject headings were developed in collaboration with a health care librarian and were *dressing*, *intravenous device*, and *central venous catheters*. Additional studies were identified through searches of bibliographies. Searches were performed without year restrictions and not limited to human studies.

Results

Systematic Search Results

As demonstrated in the preferred reporting items for systematic reviews and meta-analyses flow chart (Figure 1), from the database searches, 213 titles were identified, 66 were removed as duplicates with 147 abstracts reviewed. Seventeen studies were excluded because the authors reported the results of cross-sectional surveys or descriptions of the variety of CVAD dressing and securement practices. Forty-five were RCTs included within the 3 meta-analyses.

Characteristics of Included Studies

Tables 1 and 2 describe the population, interventions, aims, and major findings of the 21 included studies: 3 meta-analyses,[12-14] 6 RCTs,[16-21] 3 quaziexperimental,[22-24] 3 observational cohort,[25-27] and 6 laboratory studies.[28-33]

The overarching principles of CVAD securement and dressing to prevent CVAD failure and complication described within the included studies centred around providing a barrier to microbial colonization and contamination, reducing internal and external motion, and the effect of dressing disruption. CVAD securement and dressing products provide these functions using coating, adhesion, antimicrobial properties, absorbency, and moisture vapor transmission without causing irritation to the skin and maintaining visibility of the insertion site.

Barrier to Microbial Colonization and Contamination

The puncture of the skin by the CVAD provides a potential entrance point for pathogenic bacteria and fungi to enter the surrounding tissue and bloodstream, resulting in local or systemic infections. One of the primary functions of CVAD dressings is to provide a physical barrier from external contaminants onto the CVAD exit site. However, the shielding mechanism is only effective if contaminants are not present under the dressing, and the dressing environment does not provide a setting for microbes to proliferate.[20] An industry-sponsored laboratory study, carried out by Bashir et al,[28] found that with site antisepsis using 2% chlorhexidine gluconate (CHG) in 70% alcohol on healthy volunteers in accordance with product manufacturers recommendations and international clinical practice guidelines, skin flora was still not completely eradicated. The skin underlying the CVAD is never completely sterilized.