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Decreasing Skin Breakdown Around Central Lines in Patients Receiving Thiotepa Prior to Bone Marrow Transplantation

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Abstract

Skin breakdown occurring around central line dressings increases the risk for infection and bacteremia in all patients. The risk is magnified when experienced in pediatric patients receiving marrow-ablative therapy. A staff nurse on an inpatient pediatric oncology and bone marrow transplant unit noted an increased incidence of skin breakdown around central line dressings in patients receiving Thiotepa prior to bone marrow transplantation. Although there is a wealth of information surrounding routine care of central venous access devices, there is little evidence surrounding care with impaired skin integrity. A staff nurse turned to expert opinion and consensus revealed the use of nonocclusive dressings for central lines. A new protocol for changing central line dressings was developed to decrease the rate of skin breakdown. The protocol utilized gauze and a self-adherent wrap instead of tape to secure central lines. Bone marrow transplant staff nurses were educated prior to the practice change, and compliance was monitored through observation and review of documentation in the electronic medical record. A retrospective chart review compared the rate of skin breakdown and central line associated blood stream infections pre- and postpractice change. The overall percentage of skin breakdown surrounding central lines was reduced by over 80%.

Keywords

thiotepa, skin breakdown, central line, infection, nonocclusive dressing, bone marrow transplant

Thiotepa is a chemotherapy agent used in pediatric patients for marrow-ablative therapy prior to bone marrow transplantation. Thiotepa has improved the rates of engraftment and quickened neutrophil recovery in both children and adults when used in a combination of conditioning regimes (Sanz et al., 2012). Thiotepa, a highly lipophilic and alkylating agent, excretes active metabolites through the patient's skin (Schandevyl & Bauters, 2018) leaving them at risk of skin toxicity and breakdown. Skin toxicity is manifested by skin discoloration, pruritus, blistering, desquamation, and peeling, which may be more severe in skin folds and under dressings such as central lines. The extended half-life of Thiotepa and its metabolites Tepa leave patients at risk for skin toxicities from the beginning of the infusion until 48 h after the final dose is administered (Schandevyl & Bauters, 2018). Skin breakdown increases the risk of infection, especially when it occurs around a central venous access device. That risk is magnified when it involves patients with neutropenia and cellular and humoral immunity from marrow aplasia and can contribute to the development of sepsis and septic shock (Morrison, 2010).

Skin breakdown is detrimental to all patients, but particularly to pediatric patients receiving bone marrow ablative therapy and methods aimed to reduce or eliminate skin breakdown are imperative. Complications associated with skin breakdown around central venous access devices (CVADs) can be painful, disfiguring, and potentially lead to progression of bloodstream infections (Ullmann et al., 2019). An acute care oncology/bone marrow transplant unit at a free-standing, urban pediatric hospital observed an increased incidence of skin breakdown, most seen were erythema and skin tears, surrounding central line dressings in patients receiving Thiotepa.

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The organization's current standard included the use of a dressing, consisting of a 2 × 2 gauze to cover the line insertion site, secured with paper tape around all four sides of the gauze. The site was cleaned with a Chlorohexidine swab for 30 s and allowed to dry for 60 s. Patients were bathed, and the central line dressing, clothing, and linens were changed every 6 h from the administration of the first dose of Thiotepa to 24 h after receiving the last dose. Lotion and cream use were prohibited. Skin breakdown was noted when tape was removed from the patient's skin during frequent central line dressing changes. The increase in skin breakdown triggered the question, would implementing a new standard for central line dressings, decrease the risk of skin breakdown in pediatric patients receiving Thiotepa for bone marrow transplant conditioning without increasing the risk of central line infections?

Literature Review

A comprehensive literature search was conducted using multiple databases accessed through the Health Sciences Digital Library. Literature related to Thiotepa, skincare, central line dressing, and skin breakdown was sought. Databases included EBSCO Host, Cumulative Index of Nursing and Allied Health Literature, PubMED, and Cochrane Database of Systematic Reviews. Proper maintenance of central venous catheters when Thiotepa is not being administered includes disinfecting all hubs and ports of the central line, changing dressings every seven days for semipermeable dressings, or as needed when they become damp, loose, or visibly soiled (The Joint Commission, n.d.). Although there is robust evidence guiding the routine care of CVAD sites, there is a scarcity of literature addressing the maintenance of sites with impaired skin integrity (Broadhurst et al., 2015). Lack of literature forced clinicians to turn to consensus opinion among clinical experts for acquisition of empirical evidence. In addition to personal communication with respected colleagues, a query of the Association of Pediatric Hematology/Oncology Nurses Member Connection related to care of central line dressings in patients receiving Thiotepa was utilized. Responses from 23 pediatric hospitals, which included 18 American Nurses Credentialing Center Magnet® designated organizations and hospitals ranked in the top 10 *U.S. News World Report* best children's hospitals honor roll in 2018, were collected and synthesized. Consensus from expert opinion identified consistencies with the project facility's current practice except for the use of the new acquired dressing for CVADs instead of tape.

Based on the evidence, a standardized method for changing central line dressings of patients receiving Thiotepa was warranted. The aim of the quality improvement project reported was to develop and implement a standardized approach for central line dressings for pediatric patients receiving Thiotepa on a hematology/oncology/bone marrow transplant unit to decrease skin breakdown around CVAD without negatively impacting central line–associated blood stream infection (CLABSI) rates.

Methods/Implementation

A quality improvement project was conducted at a 313-bed free-standing pediatric hospital in Western Pennsylvania. A staff nurse on a 19-bed acute care hematology/oncology and bone marrow transplant unit was the lead. Stakeholders including staff nurses, bone marrow transplant attendings, clinical education specialists, and unit and hospital leaderships were supportive of the project. Approval was obtained from the organization's Quality Review Committee.

A new practice for central line dressing change was developed based on a consensus from stakeholders and expert opinion and implemented on all bone marrow transplant patients receiving Thiotepa. The practice change involved using sterile scissors to cut a slit halfway up two 2 × 2 gauzes. One gauze was placed above the insertion site with the slit open to the bottom. The other 2 × 2 was placed below the insertion site with the slit open to the top. The gauze overlapped each other, surrounding the insertion site and the line exited between the two openings. A 4 × 4 gauze was placed over the 2 × 2s and line. A gauze bandage was then wrapped around the patient's torso, circling the chest, and going over the shoulder on the same side as the central line and then back around the chest just under the central line. The motion was repeated using the length of the gauze roll as Figure 1 illustrates. For patients with two central lines, the gauze bandage was wrapped around the chest and alternated above each shoulder before wrapping once under the central lines. A self-adherent wrap was applied over the gauze wrap utilizing the same application process. No changes were made regarding bathing, linen and clothing change, process for cleaning the insertion site, and timing of the dressing change.

Bone marrow transplant staff nurses were educated on the practice change by the project lead beginning with an introductory email followed by face-to-face education utilizing simulation and return demonstration. Nurses who missed the simulation education sessions received 1:1 education at the patient's bedside. Patient safety, quality improvement, and evidence-based practice are engrained within the academic medical center, and the project was readily accepted by staff.

The practice change began in January 2018. Dressing change compliance was monitored by the project lead through observation and review of documentation in the electronic medical record. Compliance was reinforced

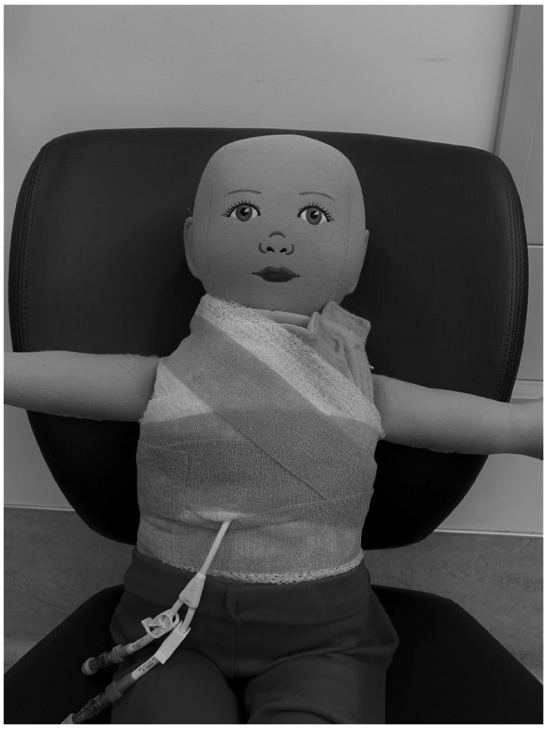

Figure 1. Demonstration of new central line dressing.

by the project lead, unit director, and bone marrow transplant attendings.

Data Collection

A retrospective chart review was conducted for one year both pre- and postpractice change utilizing the electronic medical record. Information was collected on age, race, gender, diagnosis, skin breakdown, Thiotepa dose, number of days of administration, and central line–associated bloodstream infections. Six different doses were ordered for patients as per hospital protocol. Depending on the patient's diagnosis, specific doses in milligrams per kilogram were assigned along with how many days the patient would receive Thiotepa. For example, most patients with the diagnosis of acute myeloid leukemia received doses of 5 mg/kg/dose, whereas neuroblastoma patients' dose was 300 mg/m^2/dose. Skin breakdown was defined as erythema and skin tears including blistering and bleeding. Patients receiving Thiotepa who demonstrated skin breakdown or burns in areas other than around the central line dressings were excluded. Nursing documentation and physician clinical notes were reviewed from the start of Thiotepa administration until three days after the last dose to determine when and where skin breakdown occurred. Three forms were examined including the nursing integumentary assessment and access device form, in addition to the bone marrow transplant attending's clinical note. Pre and post central line dressing change data were compared assessing the rate of skin breakdown and number of central line associated bloodstream infections per 1,000 central line days.

Table 1. Sample Demographics.

	Preimplementation *n*	Postimplementation *n*
Gender		
Male	19	21
Female	12	8
Race		
White	26	25
African American	2	2
Asian	3	2
Age		
0–2 years	14	14
3–5 years	5	4
6–10 years	6	3
11–18 years	2	5
> 18 years	4	2

Results

Thirty-one patients preimplementation and 29 patients postimplementation were compared as seen in Table 1. The overall percentage of skin breakdown surrounding central lines was reduced by 71.4% as displayed in Figure 2. The decrease represents 11 out of 31 patients with skin breakdown in the preintervention group and 3 out of 29 in the postintervention group. In addition, skin breakdown according to Thiotepa dose and number of administration days was reviewed. The percentage of skin breakdown was reduced in relation to the cumulative dose of Thiotepa except in one dose, 20 mg/kg as illustrated, and the most significant decrease occurred in patients receiving the cumulative dose of 10 mg/kg (Figure 3). Skin breakdown rates decreased for all patients, despite the number of days Thiotepa was administered (Figure 4). A quick analysis of patient age and skin breakdown was examined to rule out any age-related differences. As Table 2 depicts, all age groups demonstrated a decreased rate of skin breakdown except for patients aged 6 to 10 years whose rate remained the same. Finally, CLABSI rates were compared pre and postimplementation and though data was not limited to those receiving Thiotepa, the change did not negatively affect the unit rates.

Discussion

The purpose of the quality improvement project was to develop an improved process for central line dressing

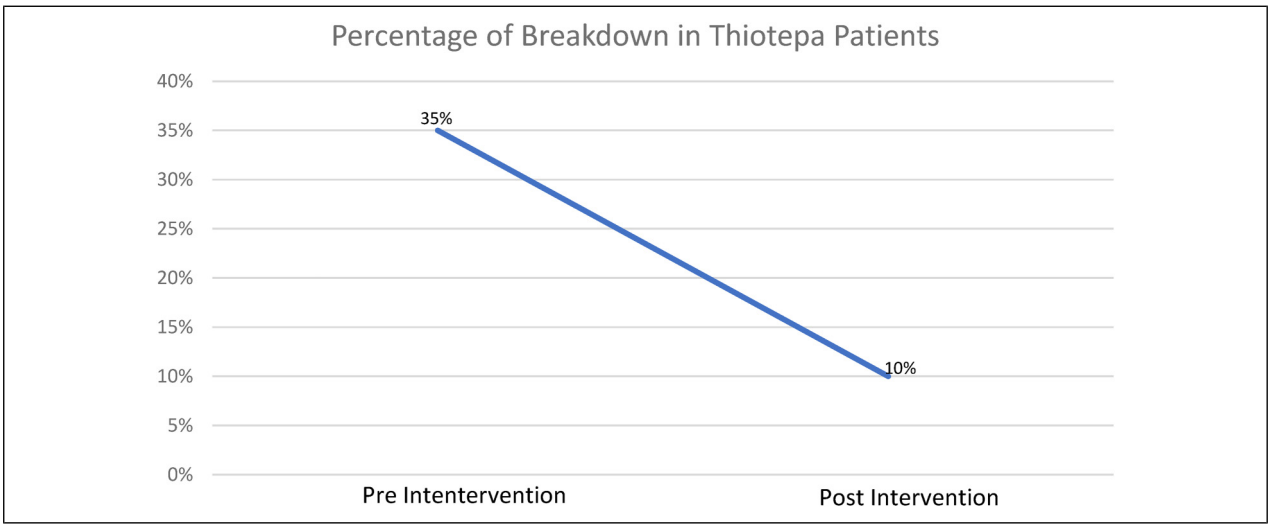

Figure 2. Pre- and postintervention skin breakdown percentages.

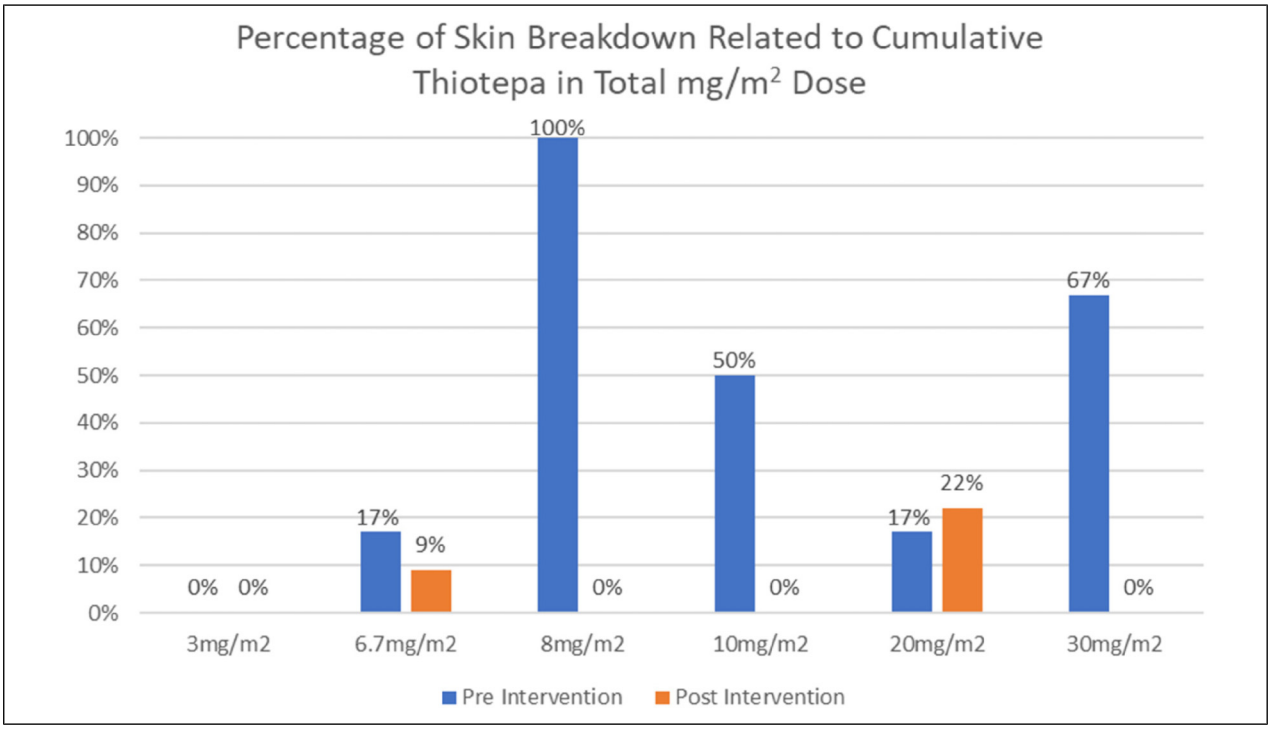

Figure 3. Percentage of skin breakdown related to cumulative Thiotepa dose.

changes to decrease the rate of skin breakdown in patients receiving Thiotepa. A new protocol was developed based on a consensus of expert opinion. The new process was implemented for a trial period and found to have an overall 71.4% reduction in skin breakdown. Decreased rates of skin breakdown were noted despite the age of patients and the number of administration days. Of the six different cumulative Thiotepa dosages assigned, all but one group demonstrated a decreased skin breakdown rate. The dose of 20 mg/kg had an increased number of skin breakdown postimplementation, but more patients received this dose compared to the preintervention group. Cumulative dosages and days of administration are determined by the patient's diagnosis and assigned protocol. Therefore, the dose and days of administration were used for comparison instead of diagnosis. Information on gender and race was collected, but not analyzed. The dramatic decrease

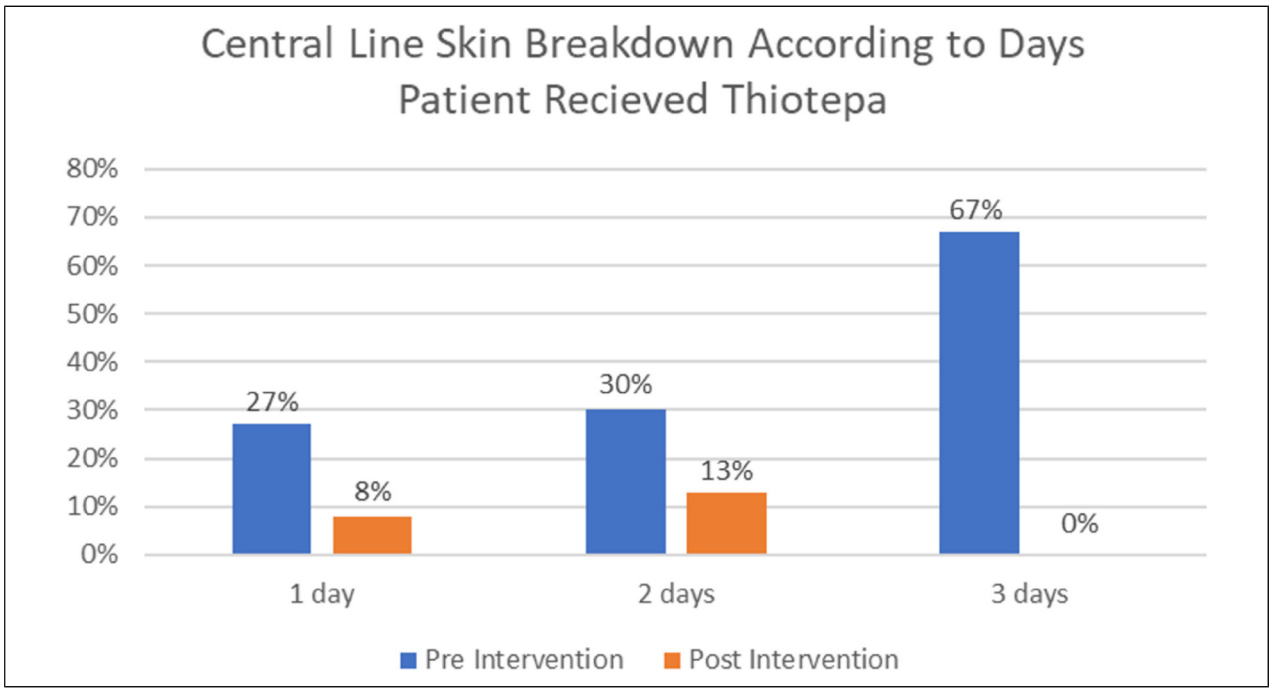

Figure 4. Percentage of skin breakdown related to the number of days Thiotepa was administered.

Table 2. Comparison of Percentages of Skin Breakdown in Patients Receiving Thiotepa Pre- and Postintervention According to Age Groups.

Age groups	Preimplementation		Postimplementation	
	n	%	*n*	%
0–2 years	3	21	2	13
3–5 years	3	60	0	0
6–10 years	2	33	1	33
11–18 years	0	0	0	0
>18 years	3	75	0	0

of skin breakdown in patients receiving three days of Thiotepa may be attributed to a protocol change and an overall decrease in the number of patients requiring treatment for three days. The CLABSI rate improved pre- and postimplementation and was not negatively impacted using the new dressing.

Conclusion

Based on the positive results of this project, the new central line dressing change process was accepted as a standard of care for patients receiving Thiotepa at the project facility. This project demonstrated the positive use of the elimination of adhesives for dressing securement during Thiotepa administration on decreasing skin breakdown without negatively impacting CLABSI rates and can be adopted into any pediatric setting. It also illustrates the benefit of turning to empirical evidence to improve practice when higher levels of evidence do not exist within the body of literature. Nurses should remain persistent and diligent in finding alternative sources of evidence such as professional organizations and networking to improve patient care.

During the implementation of the project, other areas were identified as potential areas for future investigation. It was noted that skin breakdown is not limited to central line dressing sites and included areas breakdown around the diaper area that would need to be explored further. Additionally, the Thiotepa drug insert recommends bathing and changing dressings twice daily for 48 h after

receiving the last dose of Thiotepa (MSN Laboratories Private Limited, 2019), which was not consistent with consensus opinion. Future projects extending the protocol to 48 h may also be an opportunity to improve pediatric patient care.

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Declaration of Conflicting Interests

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