Audit on incidents and knowledge of nurses regarding chemotherapy extravasations at day care oncology of a tertiary care hospital in Karachi, Pakistan

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Research Article

ABSTRACT

Purpose: Extravasations of cytotoxic agents after intravenous administration results in serious damage to the tissues leading to local injury and tissue necrosis. Worldwide incidence of extravasation ranges from 0.1% - 6%. Patient education, early identification and management can reduce morbidity associated with chemotherapy extravasation.

Method: This audit was conducted at day care oncology of Aga Khan University Hospital to assess the knowledge of nursing staff regarding identification, management and teaching to the patients about of chemotherapy extravasations before and after teaching (intervention) sessions. These sessions were conducted monthly, for a year (July 2016 till June 2017). We also recorded incidents of extravasation reported before (February till June 2016) and after (July till November 2017) intervention.

Results: A total of twelve nurses were audited before and after the intervention. Their mean age was 36.08 years ±3.35 (range 32-42 years). They had median 5 years' (range 1-13 years) experience at Daycare Oncology. Overall, 63% and 96% had demonstrated and answered the steps of identification and management correctly in audit before and after intervention respectively (P<0.001). Incidence of chemotherapy extravasation was 0.128% (7/5461) and 0.054% (3/5546) before and after intervention. In total, vinorelbine was the most common drug associated with such incidence (50%). Most had grade II reaction (50%) and history of chemotherapy (70%) was the most common risk factor.

Conclusion: Our hospital based incidence of chemotherapy extravasation is comparable to international data. This may be reduced further by improving knowledge of nurses regarding prevention, prompt identification, management and education of patients.
INTRODUCTION

Chemotherapy extravasation is an accidental leakage of the drug from the vein into the surrounding tissues resulting in an injury which ranges from very mild skin reaction to severe tissue necrosis\(^1,2\). Chemotherapy drugs are categorized as vesicants or irritants. Vesicant drugs are considered more harmful because they have the potential to cause damage of vein and skin leading to tissue necrosis and blister formation\(^3\). Irritants are drugs which may cause pain, irritation and inflammation without formation of blisters\(^3\).

Extravasation can cause swelling, erythema, tissue damage, blistering, sloughing, tissue necrosis, and significant morbidity that may require surgical intervention\(^4\). Despite the many precautionary measures, accidental extravasations still occur, both from peripheral and central line. Extravasations are very rare. Overall incidence of extravasation ranges from 0.1% - 6% through peripheral venous access\(^5\) and from 0.26 to 3% when dispensed through a central venous access\(^6,7\). In a recent study incidence of extravasation was 0.09%\(^8\).

Hence it is very important to carryout audit on knowledge of staff on chemotherapy extravasations assessment and management. Extravasation could be prevented by continuous education of medical team and patient, proper venous access and following guidelines on prevention and management of chemotherapy extravasation\(^9-11\).

An audit was conducted to determine how closely current policy of prevention and treatment of chemotherapy extravasation is being followed\(^3,10,11\). We designed a survey to assess the knowledge regarding identification, management and patient teaching of nurses regarding extravasation before and after intervention. The aim of this study also includes determining the hospital based incidence of chemotherapy extravasation before and after intervention.

MATERIALS AND METHODS

Study design

It’s a before and after intervention trial of nurses, in which clinical audits were carried out to compare standards of prevention, identification, treatment and patient teaching of chemotherapy extravasation.

A questionnaire was developed to assess knowledge on recent guidelines. An audit core team was formulated which includes Physician, in charge nurse of day care oncology and Pharmacist. All nursing staffs treating patients with intravenous chemotherapy were questioned about their knowledge and management of chemotherapy extravasation. In addition, nurses were asked to demonstrate how they follow the guidelines on management of chemotherapy extravasation. This data was recorded by in charge nurse of daycare. They were assessed on the following check points:

1. Knowledge about extravasations management.

Nurses in day care oncology should know all steps involve in management of extravasation as stated in figure 1\(^10,11\).
2. Education of patient

Patient was taught that chemotherapy drugs may damage veins especially with vesicant drugs. Therefore they need to report to day care oncology head nurse if any of following are noticed: pain, redness, burning at site of intravenous cannula. This is reported based on grading stated in table 1 \[12\].
Table 1: Grade of chemotherapy induced extravasation

<table>
<thead>
<tr>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain at site</td>
<td>Pain at site</td>
<td>Pain at site</td>
<td>Pain at site</td>
</tr>
<tr>
<td>Swelling with no skin blanching</td>
<td>Swelling with skin blanching</td>
<td>Swelling with skin blanching</td>
<td>Reduced capillary refill with or without arterial occlusion/blistering</td>
</tr>
<tr>
<td>Normal peripheral pulsation and capillary refill</td>
<td>Normal peripheral pulsation and capillary refill</td>
<td>Normal peripheral pulsation and capillary refill</td>
<td>Reduced capillary refill with or without arterial occlusion/blistering</td>
</tr>
</tbody>
</table>

Cohort

All patients admitted for receiving chemotherapy at Oncology daycare center were eligible for inclusion to calculate the incidence of chemotherapy extravasation. All daycare nurses involved in chemotherapy administration were assessed. Two time periods were chosen for comparison. A period before the introduction of teaching sessions, between February till June 2016 and a period after the introduction of the teaching sessions between July till November 2017.

Variables

The main outcome variable was incidence of chemotherapy extravasation. The chemotherapy agent, timing and grade of extravasation were documented. The severity of an infiltration or extravasation injury was graded based on skin appearance, edema, perfusion and pain. In addition risk factors such as diabetes mellitus, patient’s age, skin disease, sensory neuropathy, adequacy of cannula were recorded.

We also assessed improvement in knowledge of nurses after intervention.

Intervention

Sessions on prevention, identification, treatment and teaching of patient regarding chemotherapy extravasation were held once every month. Following education of the nurses for one year (July 2016 till June 2017), the post-implementation period of data collection and analysis took place in first week of July 2017, using the same questionnaire criteria used for the initial collection. The educational sessions subsequently continued each month. There were twelve nurses in day care oncology. All twelve nurses in day care were audited for management of extravasations and complete teaching to the patient about extravasation signs and symptoms. Patient’s data was collected from July till November 2017 to check incidents reported during this time.

A flowchart illustrating multi-stage approach utilized for audit is shown in figure 2.
DATA ANALYSIS PLAN

Data were entered and analyzed in Statistical Package for Social Sciences 19.0 version. (SPSS, Inc., Chicago, IL, USA). Descriptive analyses were run to compute frequencies and proportions for categorical variables. Means and standard deviations were calculated for quantitative variables. Hospital based incidence rate of chemotherapy extravasation was computed. Paired t-test was applied to assess difference between pre-intervention and post-intervention scores of assessment for following chemotherapy extravasation policies and incidence of chemotherapy extravasation. A p-value of <0.05 was taken significant for inferential statistics.

RESULTS

A total of twelve nurses were audited before and after the intervention. Their mean age was 36.08 years ±3.35 (range 32-42 years). They had median 10 years of experience as a nurse (range 2-20 years) with median 5 years’ (range 1-13 years) experience at Daycare Oncology.

Comparison of audit scores for verbal assessment and demonstration is given in Figure 3A and Figure 3B.
Before the intervention, nearly all nurses knew how to confirm extravasation, stop chemotherapy, remove cannula and inform doctor. Similarly, most of the nurses did not know the following steps in management of extravasation: ascertaining back flow, aspirating residual drug, applying pressure at site, circling affected area, applying cold/hot compression, applying antidote and reporting incidence of chemotherapy extravasation. Almost one third of the nurses were not giving teaching to patients regarding signs and symptoms of extravasation such as development of pain, redness and burning. After the intervention, a significant improvement was seen in management and patient teaching. Overall, 63.02% and 96.87% had demonstrated the steps of identification and management correctly in audit before and after intervention respectively (P<0.001). Similarly 63.54% and 96.87% answered the steps correctly in audit before and after intervention respectively (P<0.001).

In 2016, before the intervention out of 5461 patients, seven (0.128%) developed incidence of chemotherapy extravasation. Four (57%) were due to vinorelbine, two (28%) due to docetaxel and one due to doxorubicin (14%). Out of 7 patients, six (85.71%) had incidence in 72 hours where as one (14.29%) had within 24 hours after administration of chemotherapy.
Figure 3B: Comparison of audit scores for demonstration of prevention, management and patient teaching of chemotherapy extravasation, before and after intervention.

In 2017, after the intervention out of 5546 patients, three (0.054%) developed extravasation of chemotherapy. Two were due to docetaxel and one due to vinorelbine. Among these, one incidence occurred right after completion of chemotherapy, one 24 hours and the last one 7 days after administration of chemotherapy. Details of patients who developed extravasation incidences are given in Table 2.

Table 2: Details of patients who developed chemotherapy extravasation incidences before (2016) and after (2017) intervention

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Date</th>
<th>Chemotherapy Protocol</th>
<th>Immediate Reaction</th>
<th>Delayed Reaction</th>
<th>Extravasation Grade</th>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinorelbine</td>
<td>2/23/2016</td>
<td>Vinorelbine</td>
<td>-</td>
<td>72 hours</td>
<td>2</td>
<td>BMI 49</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>3/4/2016</td>
<td>Vinorelbine</td>
<td>-</td>
<td>72 hours</td>
<td>2</td>
<td>Age 73</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>3/4/2016</td>
<td>Vinorelbine</td>
<td>-</td>
<td>72 hours</td>
<td>2</td>
<td>Pain Treatment Yes</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>4/12/2016</td>
<td>Carboplatin &amp; Taxotere</td>
<td>-</td>
<td>24 hours</td>
<td>1</td>
<td>DM Yes 73</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>4/18/2016</td>
<td>Vinorelbine</td>
<td>-</td>
<td>72 hours</td>
<td>1</td>
<td>Sensory Deficit No</td>
</tr>
<tr>
<td>Taxotere</td>
<td>4/19/2016</td>
<td>Gemcitabine &amp; Taxotere</td>
<td>-</td>
<td>72 hours</td>
<td>2</td>
<td>DM No 21</td>
</tr>
<tr>
<td>Doxorubicin</td>
<td>4/21/2016</td>
<td>R-CHOP</td>
<td>-</td>
<td>72 hours</td>
<td>3</td>
<td>Skin Disease No</td>
</tr>
<tr>
<td>Vinorelbine</td>
<td>7/5/2017</td>
<td>Vinorelbine</td>
<td>Occurred right after finishing vinorelbine</td>
<td>2</td>
<td>28.7</td>
<td>Inadequately placed catheter No</td>
</tr>
<tr>
<td>Taxotere</td>
<td>10/18/2017</td>
<td>Taxotere &amp; Herceptin</td>
<td>-</td>
<td>24 hours</td>
<td>3</td>
<td>No 62</td>
</tr>
<tr>
<td>Taxotere</td>
<td>11/12/2017</td>
<td>Taxotere &amp; Cyclophosphamide</td>
<td>-</td>
<td>After 7 days</td>
<td>1</td>
<td>Yes 51</td>
</tr>
</tbody>
</table>

Table 2: Details of patients who developed chemotherapy extravasation incidences before (2016) and after (2017) intervention.
We were unable to find any significant risk difference between incidence of chemotherapy extravasation reported in 2016 and 2017. Among the ten patients who developed incidence of chemotherapy extravasation (7 in 2016 and 3 in 2017) five patients (50%) had grade 2, three (30%) grade 1 and two (20%) grade 3 extravasation injury. Three (30%) were obese, four (40%) were ≥60 year old, seven (70%) had history of receiving chemotherapy in the past and three (30%) had diabetes mellitus. Overall none of these patients had any sensory deficit, skin disease or inadequately placed cannula.

**DISCUSSION**

Chemotherapy extravasation is considered an important quality indicator in oncology, as its incidence is associated with significant morbidity [14]. Its proper assessment, management and teaching to the patients play a vital role while dealing with all oncology patients on cytotoxic drugs [9, 15]. With continuous education of nurses, we report a significant (P<0.001) improvement in knowledge, management and teaching of chemotherapy extravasation.

In a study reported by Verity et al, 44% of the nurses were often/always concerned about chemotherapy extravasation and 64.3% felt that they needed additional education on its management [16]. In order to safely administer chemotherapy a joined effort by all oncology team members is needed. It’s important that both nurse and patient are aware of the potential side effects of extravasation [14, 17]. In a study by Coyle et al, there was 90% reduction in incidence of extravasation by improving initial assessment, patient education, and encouragement of central venous access devices for long infusions [15]. We report 43% improvement in incidence of chemotherapy extravasation after implementation of teaching sessions.

Half of our incidences of chemotherapy extravasation were associated with vinorelbine and 40% were due to docetaxel infusion. Various studies report equal pharmacokinetics and efficacy of oral vinorelbine [18, 19]. In order to reduce extravasation incidences due to vinorelbine, we suggest switching intravenous vinorelbine to oral formulation. In addition we propose giving vinorelbine and docetaxel through central venous access. This may reduce the incidence of chemotherapy extravasation by 90%.

In addition to all the safety measures, providence of education regarding signs and symptoms of extravasation injury is of paramount importance to the patient [9]. Around 90% of the incidences reported in this study occurred after the administration of chemotherapy at daycare, with some occurring 3 to 7 days later. Having knowledge about symptoms and signs associated with extravasations would enable patient and family to report the symptoms on time. This would also lead to early treatment hence preventing further damage.

Risk factors for chemotherapy extravasation can be divided into factors which are related to patient and features associated with cannula and infusion. Patient related factors include old age, obesity, thin and fragile veins, history of cytotoxic treatment in the past, prolonged infusions, skin diseases such as psoriasis and eczema and sensory deficits [1, 16, 20-22]. Features associated with cannula and infusion include lack of expertise of staff inserting the peripheral catheter, inadequately placed venous catheter, unfavorable site, inappropriate dressing or poor cannula fixation and multiple cannula attempts [10, 20, 21]. In this study, history of receiving chemotherapy was the most common risk factor (70%), followed by old age, obesity and diabetes mellitus. None of our patients were reported to have skin disease, sensory deficit or inadequately placed cannula.

Multiple studies report efficacy of topical dimethyl sulfoxide for anthracyclines and mitomycin; hyaluronidase for vinca alkaloids and taxanes; and dexrazosane for anthracyclines [23, 24, 25]. Apart from dimethyl sulfoxide none of these antidotes are available at our institute, which is a limitation of our study.

To the best of our knowledge this is the first study from our region reporting incidents and knowledge of nurses regarding chemotherapy extravasation. The second audit was started in August 2017 and is currently in progress. In future we plan to develop educational material and videos on extravasations identification, patients teaching and management for day care oncology nurses.
CONCLUSION

Our hospital based incidence of chemotherapy extravasation of 0.128% before and 0.054% after intervention is comparable to international data of 0.1% - 6%. We report significant improvement knowledge of nurses regarding prevention, prompt identification, management and education of patients by continuous teaching sessions.

CONFLICT OF INTEREST

The authors have no conflicts of interest (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript.

ETHICAL APPROVAL

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Our study protocol was initially accepted from the Ethical Review Committee of our institution with ERC # 4521-Onc-16. Therefore, written informed consent was taken from nurses before asking them for study participation.

REFERENCES


