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Research Article

Saving Recourses and Controlling Wastage: 24-Hour Supply vs. Late Mix of Intravenous Vancomycin

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Abstract

Vancomycin is a potent tricyclic glycopeptide antibiotic, used to treat bacterial infections caused by Gram-positive bacteria. It is renally excreted. Therefore, monitoring trough levels is highly important to ensure safety and efficacy. Vancomycin has good stability after preparation, which lasts for weeks, depending on temperature. Hence, pharmacy, in KAMC-MNGHA, used to provide each patient with all doses to cover 24 hours. Unfortunately, because doses and/or frequency are usually increased/decreased for the patients based on their renal function and drug levels, many doses are not given and wasted. That practice has been changed to prepare each dose of vancomycin 2 - 3 hours before time of administration. As a result, number of wasted doses has decreased significantly. Consequently, hospital resources are saved and shortage of essential materials is prevented.

Keywords: Wastage; Intravenous; Vancomycin; *Staphylococcus aureus*

Introduction

Vancomycin is a tricyclic glycopeptide antibiotic initially produced by the organism *Streptococcus orientalis*. It is well known that vancomycin is one of the common antibiotics used in treatment of numerous bacterial infections caused by gram-positive bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA).

It is also effective for streptococci, enterococci, and methicillin-susceptible *Staphylococcus aureus* (MSSA) infections, [1] by inhibiting bacterial cell wall formation [2].

Vancomycin therapy requires monitoring to ensure safety and efficacy by periodic renal function tests and complete blood cell counts [3]. Moreover, assessment of vancomycin trough levels is strongly recommended after the third dose of intravenous (I.V.) administration, which allows healthcare professionals to evaluate the efficacy of the vancomycin dosing regimen and clearance of the drug by the individual patient. In case of infections caused by MRSA, it is recommended to maintain trough levels in the range (15 - 20 mg/L) [4].

Vancomycin is manufactured as white to almost white or slightly pink or yellow freeze-dried powder, packed in sterile vials, with 2 strengths: 500 and 1000 mg. A study was conducted to determine the stability of vancomycin in dextrose 5% in water (D5W) and sodium chloride 0.9% normal saline (NS) solutions. They found that at room temperature, vancomycin concentrations decreased less than 6% for 17 days whereas in the refrigerated and frozen samples, less than 1% reduction was found throughout the study. The

study concluded that vancomycin hydrochloride is stable in D5W and NS for 17 days at 24 °C and for 63 days at 5 and -10 °C [5].

The Pharmaceutical care department (PCD) in King Abdulaziz Medical City (KAMC), Ministry of National Guard Health Affairs (MNGHA), Riyadh provides various services concerning patient care and medication safety. There are multiple admission wards with different specialties in KAMC-MNGHA, where neonatal, pediatric and adult patients are admitted. Therefore, the PCD provides its services via a number of satellite pharmacies located all over the hospital to cover all inpatient units. I.V. antibiotics at KAMC-MNGHA, are prepared by the PCD either as batch or late-mix. An I.V. antibiotic is considered as batch when the stability after preparation is more than 24 hours. In such workflow, computerized pharmacy system prints automatically labels of all doses of vancomycin of all patients admitted in the hospital on that day. Later, after preparing the doses for the whole day for each patient, they distributed to the admission units at specific time [6]. On the other hand, a list of late mix medications has been made to include selected items due to stability and cost concerns. Thus, each dose is prepared at least 2 - 3 hours before administration time [7]. Actually, the computerized pharmacy system is programmed to print one label for each dose at scheduled times every day. These doses are mixed and then sent to each patient prior to their time of administration.

Previously, in our practice, vancomycin was considered as batch item. The PCD used to prepare it as 24-hour supply according to the frequency. However, after a patient receives a third dose of vancomycin, trough levels are usually measured. Therefore, physicians may modify the dose and/or frequency or even discontinue the medication. As a result, previously prepared doses would not be administered to patients leading to medication wastage.

With regard to the coronavirus pandemic (COVID-19), it has dramatically affected supply chains of various medically important materials including medications, which had negative impact on their availability in hospitals in many countries [8,9]. For instance, in the United States, shortages of medications have reached more than 80% in 2020 compared to those reported in 2019 in half of the time [10]. In addition, a report has shown that although the U.S. manufactures many medical and pharmaceutical items, it relies on other countries including China, India and Europe as main supplier. However, during COVID-19, global production and shipping has been disrupted due to responses of lockdown, shortage of staff [11]. Therefore, and to reduce medication shortage in our institution, different strategies have been considered, one of which has been to shift vancomycin from batch list to that of late mix medications.

Aim of the study

The aim of this study was to decrease wastage of vancomycin and ensure better utilization of the resources by preparing the doses at least 2 to 3 hours in advance of administration time.

Methods and Materials

We used one-gram vials of vancomycin and D5W and NS solutions for I.V. infusion. The study was conducted at the KAMC-MNGHA, Riyadh in June 2022. For two weeks each, data of wasted vancomycin doses were collected before and after the shifting to late mix list form all inpatient wards. Particularly, neonatal and pediatric admission units were excluded due to their small doses in comparison to those of adults.

Data source and statistical analysis

For data collection, we utilized the computerized pharmacy system to check each patient's profile and track modification of doses. The unused doses were collected from all admission wards in the hospital for manual counting. Next, we analyzed the data and compared them, to determine the effect on medication wastage after shifting vancomycin to late mix list.

Results

Approximately, total number of 1-gram vancomycin vials used by the PCD to prepare all doses for admitted patients was 2000 vials. We found that around 350 vials of 1-gram vancomycin were wasted in two weeks of the study when it was supplied as batch, i.e., supplying all doses required for 24 hours. Notably, after including vancomycin in the late mix list, i.e., supplying each dose at least 2 hours prior to the administration time, the number of wasted vials has been significantly decreased. To be precise, only 14 vials of the same strength were wasted. In fact, when the wastage was controlled, resources, effort and time were saved and thus, they have been all utilized properly for the benefit of our hospital.

Discussion

The practice of preparing vancomycin for all patients every day was developed for better workflow and to make all doses available when administration time was due. The computerized pharmacy system prints automatically all labels of vancomycin doses of the patients admitted on that day. However, such practice had

been a process, which consumes a lot of effort, time and resources. Indeed, monitoring trough levels, modifying doses accordingly, or discontinuation of therapy and consequently, wasting the unused doses have made it important issue to consider. For these reasons, this study was initiated for two weeks to find out whether to follow the same practice or prepare each dose before the due time of administration. Thus, around 2000 vials of 1-gram vancomycin were supplied to the PCD. For two weeks, vancomycin had been supplied to hospital patients as batches. Our data showed that like 350 vials were wasted. In other words, 17.5% of the vials were wasted. On the other hand, specific modifications have been made to the computerized pharmacy system to let it recognize vancomycin as late mix medication so that labels are automatically printed at scheduled timings before the administration time of each dose. It was expected that the number of wasted vials would decrease. Nevertheless, the level of reduction was significant; only 14 vials were wasted, which saved a lot of vials and avoid shortage.

Conclusion

There was a significant decrease in the number of wasted vancomycin vials after initiating late mix workflow in preparing vancomycin doses for admitted patients. Such results have been encouraging to deal with vancomycin as late mix. In fact, several comparative studies may be carried out with other medications to control wastage and save resources.

Acknowledgment

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Declaration of Interest

None declared.

Ethical Approval

This is an inpatient pharmacy project that was approved by the Pharmaceutical Care Department, in KAMC-MNGHA, Riyadh. The study does not reveal any confidential information or identifiers.

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