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Original Article

Evaluation of Intravenous Drug Incompatibilities in the Intensive Care Units of Mitiga Military Hospital and Tripoli University Hospital, Tripoli, Libya

Zeineb Alsharef[1*] and Ahmed Abired[2]

1 .Basic nursing department, nursing collage, University of Tripoli, Tripoli, Libya.

2. Department of physiotherapy, Medical Sciences and Technologies Collage, Tripoli, Libya.

Corresponding Email: Zeinebalsharef@gmail.com

ABSTRACT

This study aimed to evaluate intravenous (IV) drug incompatibilities in the Intensive Care Units (ICUs) of Mitiga Military Hospital (MMH) and Tripoli University Hospital (TUH). It sought to gather data on the compatibility of the most commonly used drugs when infused through the same line. Additionally, it attempted to generate a compatibility drug chart with reliable and updated information to improve safety in the administration of drugs to critically-ill patients. This was a retrospective clinical study. Data were obtained from 200 prescriptions in the MICUs of MMH and TUH. The study focused on IV drugs routinely administered in the ICUs at the same time. Consideration was given to the variables of age, gender, total number of medications, total number of IV medications, as well as types of IV medications. Data analysis was conducted using SPSS Version 26. Demographic findings showed that major age groups were (46-55), (56-65), (66-75) years, mean age was 61.61 years and 1.12:1 were male female ratio. Findings also revealed that, 6 IV drug pairs were categorized as drug incompatibilities out of 10. 11.5% of patients were given incompatible drug pairs, followed by 21% of patients who were given compatible pairs while 25.5% were given drug pairs with no confirmed data. The most frequent incompatible drug was Pantoprazole and the most frequent incompatible pair was Pantoprazole and Furosemide. In conclusion, the incidence of drug incompatibilities in ICUs was predominant. Pantoprazole, Furosemide and Meropenem were identified as the most frequent drugs involved in IV drug incompatibilities.

Keywords: Intravenous, Drugs Incompatibilities, Pantoprazole, Meropenem, Furosemide

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INTRODUCTION

Critically-ill patients in Intensive Care Units (ICUs) receive several intravenous (IV) medications and IV fluids in multiple doses with limited venous access, which increase the need for a multiple and frequent administration of combined IV medications through a single vascular line, which can lead to a medication error, known as drug incompatibility. Drug incompatibilities are physical and chemical reactions that occur in vitro between two or more drugs when the solutions are combined in the same syringe, tubing, or bottle. Physical reactions can cause visible changes, including precipitation; changes in color, consistency, or opalescence; or gas production. Chemical reactions are caused by molecular changes, and they are considered significant when more than 10% degradation of one or more of the solution's components occur. The major reason for differentiating these two types of incompatibilities is based on the contact time between one drug and the other. In the case of Y-site drug administration, the contact time is approximately 1 to 2 minutes depending on the infusion flow, whereas the contact time between drugs mixed in the same syringe or IV bag can last for hours or days, and chemical reactions can occur during that period [1,2]. Drug incompatibilities can lead to reduced drug activity or inactivity, the formation of a new toxic or nontoxic active ingredient, increased toxicity of one or more of the involved drugs, and organoleptic changes [3]. In addition, the lack of data on the safety of mixing two drugs continues to create issues in the day-to-day work of ICU nursing staff. As a result, nurses have to look for new IV lines to administer drugs separately and this can disastrously escalate the risk of infectious and thromboembolic complications. Mixing or not mixing is one of the most highly recommended measures for the safe administration of drugs requiring reliable information available on drug compatibility when administering common drugs to patients in the ICU [4]. A chart was created with all the possible combinations of drugs of interest. Boxes were labeled symbol letters of ''C'' if the mix was compatible, ''I'' if incompatible and ''N'' for a drug combination without compatibility data. The purpose of present study is threefold. Firstly, it attempts to evaluate intravenous drug incompatibilities in the Intensive Care Unit (MICU) of Maitiga Military Hospital (MMH) and Tripoli University Hospital (TUH). Secondly, it seeks to gather data on the compatibility of the most commonly used drugs at an MICU when infused through the same line. Lastly, it endeavors to generate a compatibility chart with reliable and updated information to improve safe administration of drugs to seriously-ill patients.

METHODS

Data Collection

This study employed retrospective clinical research. Data were collected from 200 prescriptions in the MICUs of Mitiga Military Hospital (MMH) and Tripoli University Hospital (TUH) during the years 2022–2023, with a total of 100 prescriptions per hospital. The study centered on intravenous drug routinely used in the ICU and administered at the same time. The following variables were taken into account: age, gender, the total number of medications, the total number of

intravenous medications, types of intravenous medications and the presence and type of potential incompatibilities (PI). Prescriptions were collected only once per patient to avoid overrepresentation of patients who were in the hospital for a longer period. Both the number of patients affected by the administration of incompatible drugs and the frequency of incompatible drug combinations administered were analyzed.

Data Analysis

Data analysis was conducted using SPSS Version 26. Descriptive statistics in the form of frequencies and percentages was run to analyze the obtained data. Also, a Chi-square test was used to investigate the relationship between receiving treatment in different hospitals groups and the state of compatibility between IV medications inside MICUs of these hospitals. Finally, a one-way ANOVA test was run to compare the means between groups of routes of the drug administration. $P<0.05$ was considered to be statistically significant.

RESULTS

Figure 1. Demonstrated the age range of MICU cases in Mitiga Military Hospital and Tripoli University Hospital among 16 – 95 year olds. Results unveiled that major age groups ranged between were (46-55), (56-65), (66-75) year olds with equal numbers of patients 44 (22%). This was closely followed by the age subgroup (76-85) year olds with 32 cases (16%) of patients, which was then followed by the age subgroup (26-35) year olds with 16 patients (8%), (86-95) and (36-45) year olds with 10 (5%), 6 (3%), respectively. The least age group admitted was (16-25) year olds, with 4 patients (2%). The results have also showed that the number of cases attended MICU were 106 male patients (53%) compared with 94 female patients (47%) and 1.12 : 1 were male: female ratio.

Figure 1. Distribution of MICU patients according to different age group.

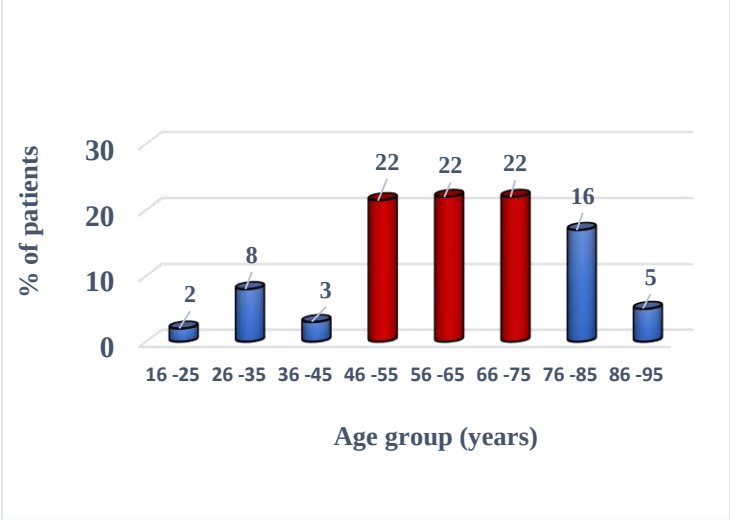

Figure 2. Uncovered that the total number of IV medications prescribed was 816. This constituted 81.92% of 996 of the total number of medications used at MICUs.

Fig 2. Percentage of IV medications among the total number of medications used at MICUs

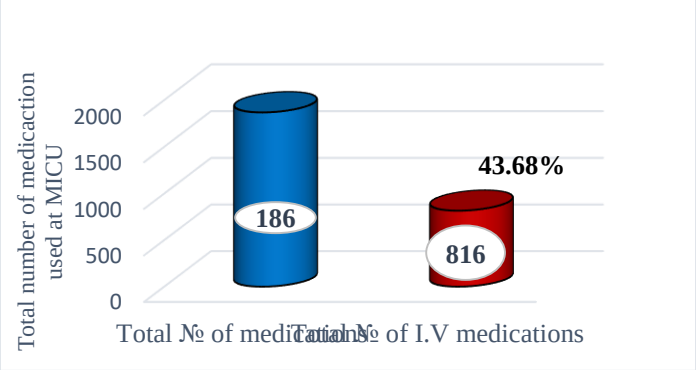

Table 1. reported that the highest percentage 19% (19) patients was treated with Pair №1, followed by 9% (9) cases for both Pair № 3 and Pair № 5. Besides, 7% (7) of patients were treated by Pair № 4. Pair № 5 reported for only 4% (4) cases at the MICU of Maitiga Hospital.

Table 1. Frequency and percentage of medications pair used the MICU of Maitiga Hospital.

	Pair № 1	Pair № 2	Pair № 3	Pair № 4	Pair № 5
	Pantoprazole + Furosemide	Pantoprazole + Meropenem	Pantoprazole + Ceftriaxone	Meropenem + Furosemide	Ciprofloxacin + Ceftriaxone
F	19	4	9	7	9
%	19%	4%	9%	7%	9%

Table 2. Reported that the highest percentage 22% (22) of patients were treated with Pair № 1, followed by 17% (17) cases who were treated with Pair № 4. Besides, 11% (11) of patients were treated by Pair № 2. Pair № 3 Pair № 5 reported equal percentage for 9% (9) cases in the MICU of Tripoli University Hospital.

Table 2. Frequency and percentage of drugs pair used in the MIUC of Tripoli University Hospital.

	Pair № 1	Pair № 2	Pair № 3	Pair № 4	Pair № 5
	Omeprazole + Ceftriaxone	Omeprazole + Paracetamol	Ciprofloxacin + Ca gluconate	Furosemide + Ca gluconate	Omeprazole + Meropenem
F	22	11	9	17	9
%	22%	11%	9%	17%	9%

Fig 3. Indicated that out of a total 10 IV drug pairs, 6 of them were found in the database of drug incompatibilities. 11.5% (23) patients were given incompatible drug pairs, followed by 21% (42) Patients who were given compatible pairs, while 25.5% (51) of total 200 patients were given drug pairs with no confirmed data available.

Fig 3. Distribution of drugs pairs among Patients

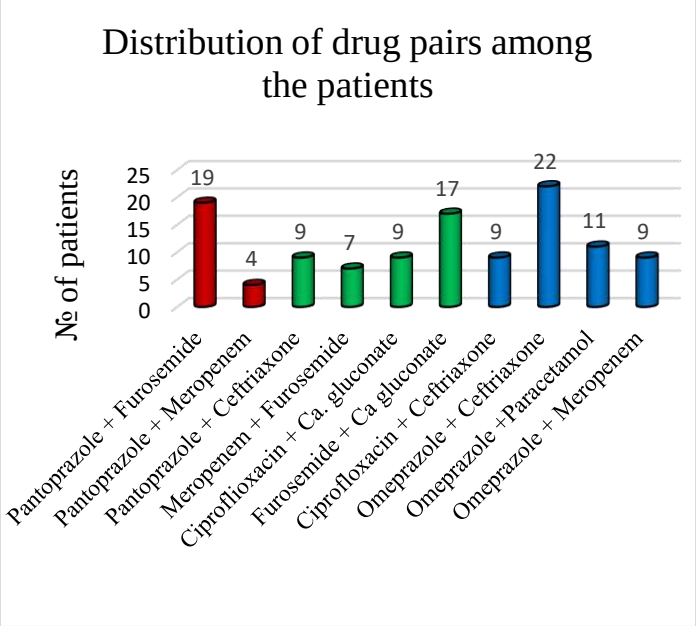

Table 3. Chart of Drug Compatibility for Intravenous medications in MICUs.

	Omeprazole	Ciprofloxacin	Furosemide	Meropenem	Pantoprazole	Ceftriaxone	Paracetamol	Calcium gluconate
Omeprazole				N		N	N	
Ciprofloxacin						N		C
Furosemide				C	I			C
Meropenem	N		C		I			
Pantoprazole			I	I		C		
Ceftriaxone	N	N			C			
Paracetamol	N							
Calcium gluconate		C	C					

C = Indicate Compatibility
I = Indicate incompatibility
N = No data available

A total of 8 frequent drugs selected and a table prepared by displaying compatibility information. On each axis of the table, the most frequent drugs are listed by ingredient name. Compatibility information is expressed where each drug meets. Those with compatible results were expressed as (C), and those with incompatible results were expressed with (I). Drugs with no study results expressed as (N).

DISSCUSION

Incompatibilities relating to the administration of medications are a significant issue, especially in the ICUs, where the administration of intravenous medications is vital for day-to-day clinical practice. This prevalent problem confirmed by a number of studies demonstrating that drug incompatibilities are common in ICUs possibly contributing to a percentage ranging from 14.3% up-to-25% of all ICU medication errors [5,6,7]. Results regarding the occurrence of polypharmacy in ICUs, the mean of 9.34 drugs per prescription demonstrated a high number of drugs per patient, which is indicative of a profile of polypharmacy in ICUs. The presence of several drugs and a high rate (43.68%) of intravenous administration with an average of (4.08) drugs per prescription are indicators that reflect the seriousness of the studied cases and the increase of risk factors for drug incompatibility [8]. These results were similar to study results of critically ill patients hospitalized in the Adult Intensive Care Unit of the Hospital de Clínicas de Porto Alegre (HCPA), identifying 1019 prescriptions with an average of 10.2 drugs per prescription, where the average intravenous drug was 6.5 per prescription [3]. It is challenging for the nursing staff to schedule the medications and manage intravenous therapy to

minimize adverse effects that can result from both drug interactions and incompatibilities in polypharmaceutical patients. When patients have a large number of prescribed medications, they are actually at danger of drug interactions. The likelihood of medication interactions increases 9.8 times with every additional prescription taken and the number of prescribed drugs is substantially correlated with the occurrence of incompatibilities [9, 10].

Pantoprazole and Furosemide (19 %), Pantoprazole and Meropenem (4%), were the most frequent incompatible drugs in this study. In MICUs, all drugs are crucial and extremely important. Thus, nurses should take extra caution when planning and administering drugs. Pantoprazole was the drug most commonly reported in cases of incompatibility at 11.5%, and the fact that this drug was prescribed and administered so frequently in intensive care units, may make it more common in cases of relative incompatibility. This can increase the necessity to adhere to a manufacturer's recommendations for the administration of pantoprazole by dedicated line and avoid co-administration with other IV solutions [11] and should not be simultaneously administered through the same line with other intravenous solutions [12]. Nurses must be knowledgeable in pharmacology to discuss with the other health care team the possibility of replacing drugs with a compatible therapeutic alternative, as well as the indication of a venous catheter that offers a greater number of routes. Most importantly, the nursing staff's ability to conduct safe actions and qualified care should always be checked [13]. Another safety strategy is about the clinical pharmacy's regular presence in ICUs, which helps to reduce drug incompatibility by assisting the nursing staff to answer questions during the various stages of intravenous therapy [14]. With these findings, the study produced a chart (Table 3) that clarify the results of most common intravenous drugs compatibility, that can be utilized by nursing stuff at ICU to reduce harm or avoid the event caused by the incompatibility. Due to the lack of obtained information, the current study could not analyze the drugs compatibilities of the following chief drug pairs; Ciprofloxacin and Ceftriaxone, Omeprazole and Ceftriaxone, or Omeprazole and Paracetamol, Omeprazole and Meropenem. Therefore, the fact that many drugs in this study were not examined for drug compatibility highlights the deficiency of knowledge about drug compatibilities and the need for additional research on the topic.

CONCLUSION

Based on obtained findings, the incidence of drugs incompatibilities in ICUs was common (11.5%). Pantoprazole, Furosemide and Meropenem were recognized as the drugs that were most frequently found in intravenous drug incompatibilities. Moreover, the number of drugs and prescription of Pantoprazole, Meropenem, and Furosemide were the risk factors for potential incompatibilities. Also, there was a significant number of untested drug combinations, highlighting the need for additional studies on this subject to provide improved safety regarding intravenous drug administration.

Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

REFERENCES

1. Manrique-Rodríguez, S., et al., Development of a compatibility chart for intravenous Y-site drug administration in a pediatric intensive care unit. Journal of infusion nursing, 2012. 35(2): p. 109-114.
2. Bertsche, T., et al., Prevention of intravenous drug incompatibilities in an intensive care unit. American Journal of Health-System Pharmacy, 2008. 65(19): p. 1834-1840.
3. Marsilio, N.R., D.d. Silva, and D. Bueno, Drug incompatibilities in the adult intensive care unit of a university hospital. Revista Brasileira de terapia intensiva, 2016. 28: p. 147-153.
4. Lao, G.C., et al., Compatibility of drugs administered as Y-site infusion in intensive care units: A systematic review. Medicina Intensiva (English Edition), 2020. 44(2): p. 80-87.
5. Taxis, K. and N. Barber, Incidence and severity of intravenous drug errors in a German hospital. European journal of clinical pharmacology, 2004. 59: p. 815-817.
6. Tissot, E., et al., Medication errors at the administration stage in an intensive care unit. Intensive care medicine, 1999. 25: p. 353-359.
7. Taxis, K. and N. Barber, Ethnographic study of incidence and severity of intravenous drug errors. Bmj, 2003. 326(7391): p. 684.
8. Santos, L.d., et al., Perfil das interações medicamentosas solicitadas ao centro de informações sobre medicamentos de hospital universitário. Revista HCPA. Vol. 31, n. 3 (2011), p. 326-335, 2011.
9. Paes, G.O., et al., Drug incompatibility in the ICU: review of implications in nursing practice. Rev Eletrôn Enferm, 2017. 19: p. a20.
10. Cortes, A.L.B. and Z.R. Silvino, Factors associated to potential drug interactions in one Intensive Care Unit: a cross-sectional study. Escola Anna Nery, 2019. 23.
11. Sandoz Pantoprazole PRODUCT MONOGRAPH. 2019. p. Page 1 of 38.
12. Collins, S.R., Elsevier's 2022 Intravenous Medications-E-Book: A Handbook for Nurses and Health Professionals. 2021: Elsevier Health Sciences.
13. Bertsche, T., et al., A purging procedure for pantoprazole and 4-lumen catheters to prevent IV drug incompatibilities. Pharmacy world & science, 2010. 32: p. 663-669.
14. Scrignoli, C., V. Teixeira, and D. Leal, Drug interactions among the most prescribed drugs in adult intensive care unit. Rev Bras Farm Hosp Serv Saude [Internet], 2019.