Drug Related Problems at the Intensive Care Unit of a University Hospital in Saudi Arabia

Hatem O. Qutub1, MBBS, MD, FCCP, FCCM, Mastour S. Alghamdi2, PhD, Mohammad A. Randhawa3, MBBS, M. Phil, PhD, Raniah A. Al-Jaizani2, M. Pharm, Rayan Y. Mushtaq2, D. Pharm, and Mohammad J. Akbar2, D. Pharm

1Intensive Care Unit, King Fahd Hospital of the University, Dammam, Saudi Arabia
2Department of Pharmacology, College of Medicine, University of Dammam, Dammam, Saudi Arabia
3At the time of study: Department of Pharmacology, College of Medicine, University of Dammam, Dammam, Saudi Arabia
Present: Department of Pharmacology, College of Medicine, Northern Border University, Arar, Saudi Arabia

ABSTRACT

Background: Medication errors can lead to mild or severe drug related problems. Drug related problems are sometimes unpredictable and can occur without medication errors. Awareness and identification of medication errors and drug related problems aids in adoption of measures to prevent and treat them.

Objective: Present study aimed to find out prevalence of drug related problems reporting or occurring at Intensive Care Unit of King Fahd Hospital of the University, Dammam, Saudi Arabia.

Methods: Scrutinizing written files of all patients reporting to Intensive Care Unit, from January to December 2012.

Results: Out of 193 files reviewed, 33 patients (17.1%) had trivial to serious drug related problems, including 8 (4.1%) deaths. Drugs commonly involved in these problems were anticoagulants (Warfarin and heparin, alone or in combination with aspirin or clopidogrel; 8 cases, 24.2%), anti-epileptic drugs (Carbamazepine and phenytoin; 6 cases, 18.2%), immune suppressants (Azathioprine and prednisolone; 4 cases, 12.1%), antibiotics (Ciprofl oxacin, imipenum, tazocin and vancomycin; 4 cases, 12.1%) and drugs of abuse and dependence (Alcohol, benzodiazepines, cannabis and opioids; 4 cases, 12.1%). Amongst drug related problems detected, 6 cases (18.2%) were linked to drug interactions. Almost 60% of drug related problems found were preventable, including those due to overdose toxicity, non-compliance and drug-drug interactions.

Conclusions: Mild to severe drug related problems occurred in intensive care unit of a university hospital and about half of them were preventable. It is hoped that the awareness and insight of drug related problems will help to improve patient care.

Keywords

Drug related problems, Intensive care unit, University hospital.
INTRODUCTION

A Drug Related Problem (DRP) may be defined as an undesirable patient experience that involves drug therapy and that actually or potentially interferes with a desired patient outcome\(^{[1]}\). Therefore, the definition of a DRP includes more types of problems than encountered in adverse drug events or adverse drug reaction (ADE/ADR), which is defined as any unexpected or dangerous reaction to a drug \(^{[2]}\). ADE has also been defined by the World Health Organization (WHO) as “A response to a drug which is noxious and unintended and which occurs at doses normally used in man for the prophylaxis, diagnosis, or therapy of disease, or the modification of physiological function”\(^{[3]}\). According to these definitions, perhaps, it is difficult to include non-compliance to treatment and drug abuse in the list of ADEs. However, the term DRP would encompass such types of problems as well.

ADEs (or DRPs) may or may not result from medication errors - for example, cough due to an ACE inhibitor in a patient without a history of ACE inhibitor induced cough is not the result of a medication error, while a medication error has occurred if the patient has a prior history of ACE inhibitor induced cough\(^{[4]}\). Moreover, an ADE (or DRP) related to hypersensitivity or idiosyncrasy to drugs is not because of medication error.

National Coordinating Council for Medication Error Reporting and Prevention defines a medication error “…as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use”\(^{[5]}\). More simply, a medication error is “any error occurring in the medication use process”\(^{[6]}\).

A DRP is essentially different from a medication error. A medication error is more process orientated than outcome orientated. If something goes wrong in the prescribing or dispensing process, then it is automatically regarded as a medication error whether or not there is an impact on patient outcome. In contrast, DRP is mainly concerned with the outcome\(^{[7]}\).

The term 'DRP' is not unique for a problem with drug therapy. Other terms have also been proposed, including 'Drug Therapy Problem', 'Pharmaceutical Care Issue' and 'Pharmacotherapy Failure'\(^{[8-10]}\), which correspond to negative clinical outcomes resulting from the use or the lack of use of medicines. All these terms may stand for similar concepts as DRPs. However, the concept of DRPs is essential for pharmaceutical care and the pharmaceutical care process\(^{[11]}\).

The severity or the magnitude of harm suffered by a patient from MEs has been indexed by National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP), which includes five categories (E to I)\(^{[12]}\):
- Category E: harm that contributed to or resulted in temporary harm to the patient and required intervention.
- Category F: harm that contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization.
- Category G: harm that contributed to or resulted in permanent patient harm.
- Category H: harm that required intervention to sustain life.
- Category I: harm that contributed to or resulted in the death of a patient.

DRPs may be preventable or non-preventable. A preventable DRP may be defined as an injury that is the result of an error at any stage during the process of medication. One example is a coma due to overdose of a sedative (Diazepam), or coma due to usual dose of a sedative (Diazepam) in the presence of a drug which can inhibit its metabolism (Cimetidine). A non-preventable DRP may be defined as an injury due to a drug where there is no error in the medication process. Such is the case when an allergic reaction occurs in a patient not previously known to be allergic to that drug, or a mild side effect that results from a usual dose of the drug (dry mouth with atropine or imipramine)\(^{[13]}\).

There are quite a few published articles related to the prevalence of MEs and DRPs in the literature. More insight into the prevalence, type and the severity of harm caused by MEs could help reduce the frequency of these harmful events\(^{[14]}\). Some of these published reports related to DRPs in intensive care units are mentioned here as examples. In a prospective multi-center study conducted in Morocco, the incidence of adverse drug events in intensive care units was 15.5%. Out of these, 46.2% were preventable, which occurred because of errors in prescribing, administration, transcription and dispensing stages\(^{[15]}\). In a French study for the detection of medication errors in an intensive care unit, 26.8% of patients experienced at least 1 medication error and 9.3% suffered from adverse drug events\(^{[16]}\).

In a systemic review conducted in Belgium regarding the incidence and preventability of adverse events, the percentage of surgical and medical adverse events requiring admission to the ICU ranged from 1.1% to 37.2%, and the preventability of adverse events varied between 17% and 76.5%, while the mortality percentages varied between 0% and 58%\(^{[17]}\). Similar studies have been conducted in other countries such as Brazil, Canada, Chile, India, The Netherlands and USA with varying results\(^{[18-21]}\).

In Saudi Arabia, three studies were found regarding hospital admissions due to drug related problems (DRPs). One of these studies was related to admissions in a medical ward of a district hospital mainly due to overdose toxicity or adverse drug reactions. In the second, the incidence of admissions because of DRPs was determined in the
emergency department of a tertiary hospital. In the third the epidemiology of DRPs and the related risk factors were studied in hospitalized children[22-24]. Recently, the impact of computerized physician order entry on medication errors and adverse drug events was investigated in an Armed Forces Hospital[25].

The present study is the first of its kind conducted in an Intensive Care Unit in Saudi Arabia. The study aims to determine the prevalence of drug related problems reporting or occurring at the Intensive Care Unit (ICU) of the King Fahd Hospital of the University, Alkhobar. It is hoped that the study will provide an insight about the drug related problems encountered in a medical intensive care unit and will aid in finding solutions.

METHODS

Written files of all patients reporting to the Medical ICU of the King Fahd Hospital of the University (KFHU), Dammam, Saudi Arabia in the year 2012 (January to December) were scrutinized by a team comprised of a Physician, a Clinical Pharmacologist and a Clinical Pharmacist. The study was approved by the Ethical Committee of the Deanship of Research, University of Dammam, Saudi Arabia (Grant No. 2012095).

The Medical ICU at KFHU is a closed ICU with a total of 6 beds. The unit is run by a dedicated staff specializing in intensive care. The ICU admits an average of between 220-250 patients per year. All medical cases referred either from the emergency department of the KFHU or from other hospitals. The ICU is well equipped with all invasive and non-invasive monitoring systems along with qualified ICU nurses and respiratory therapists. The ICU is also a part of post graduate training programs at KFHU. There is no separate clinical pharmacologist or clinical pharmacist in the unit, however it is regularly visited by the hospital clinical pharmacists who give their expert opinion.

The demographic data, diagnosis, drugs used for management and the outcome of treatment of cases suspected to be DRPs were entered in the prescribed questionnaire and analyzed. The data was then entered in the Microsoft Excel Program (Version No. 8.1) for the calculation of the prevalence of DRPs.

RESULTS

From a total of 247 patients admitted to the ICU of the King Fahd Hospital of the University, Dammam, from January to December 2012, the written files of 193 patients were available in the record room and reviewed. Of the files sorted out, 33 (17.1%) were found to suffer from trivial to severe DRPs. Of the 33 DRPs identified 18 were males (54.5%) and 15 females (45.5%), with ages ranging from 16-87 years. 23 (69.7%) were Saudi nationals and 10 (30.3%) were non-Saudis.

Drugs involved in causing DRPs were anticoagulants (warfarin or heparin alone or along with aspirin or clopidogrel) in 8 cases (24.2%); anti-epileptic drugs (Carbamazepine and phenytoin) in 6 cases (18.2%); immune suppressants (Azathioprine and prednisolone) in 4 cases (12.1%); antibiotics (Ciprofloxacin, imipenem, tazocin and vancomycin) in 4 cases (12.1%); antihypertensive drugs, diuretics and digoxin, alone or in combination, in 3 cases (9.1%); NSAIDs in 2 cases (6.1%); antipsychotics in 2 cases (6.1%); and 4 cases (12.1%) relating to drugs of abuse and dependence (Alcohol, benzodiazepines, cannabis and opioids). Death in the hospital was reported in 8 cases (4.1%) out of the 193 cases reviewed.

Some of the DRPs were possibly related to drug interactions: A) Warfarin or heparin with aspirin or clopidogrel causing more severe internal bleeding and even cerebral stroke (3 cases); B) Aclintandredures due to esomeprazole causing increased chances of super infection with broad spectrum antibiotics (ciprofloxacin and tazocin, 2 cases); C) Antihypertensive drugs (Lisinipril, atenolol and amiodipine) with diuretics (furosemide), causing severe hypotension and bradycardia (1 case). This amounts to a total of 6 cases (18.2%) of drug-drug interactions. Other important causes of DRPs, besides drug interactions, were 12 cases of overdose toxicity (36.4%), and 3 cases of non-compliance to treatment (9.1%), (Key notes of Table 1).

Almost 60% of the DRPs found were preventable including those due to overdose toxicity (12 cases, 36.4%), drug interactions (6 cases, 18.2%) and non-compliance (3 cases, 9.1%). An overview of drugs involved in 33 cases of DRPs, problem category (according to NCC-MERP) and the management and outcome is given in Table 1.

DISCUSSION

The present study showed the prevalence of DRPs that required admission or occurred during ICU stay, which was 17.1% of total cases reviewed, and nearly 60% of them were preventable. Similar results have been reported in the literature for the incidence of DRPs. A systemic review of 27 studies conducted in Belgium found: the incidence of admissions in ICUs due to surgical and medical adverse events ranged from 1.1% to 37.2%; the preventability of adverse events varied from 17% to 76.5%; and the death rates varied between 0% and 58%[16]. The results of the present study indicate that the prevalence of DRPs, preventability and mortality are close to the average results reported in this review. In a multi-center study conducted in Morocco, the incidence of ADEs in ICUs was 15.5% with 46.2% of these being preventable. These results are also in line with the present study's results[16]. In a recent prospective cohort study conducted in an academic hospital in Saudi Arabia the overall incidence of ADEs was 8.5 per 100 admissions, with the highest rate occurring in the intensive care unit (21.1 per 100 admissions). Of all ADEs, 59% were rated as significant, 35% as serious and 6% as life threatening, while 30% were considered as preventable[17]. In the present study the prevalence of DRPs in ICU was 17.1%, similar to the above mentioned study but with almost 60% of these being preventable, double the figures of above mentioned study. This difference could probably be due to the differences in the inclusion criteria for preventability of ADEs or DRPs between the two studies.
To the human is to err, thus errors in the administration of drugs are no exception. Errors in the medication can be either predictable and, therefore, possible to avoid (e.g. unnecessary drug therapy, incomplete drug therapy, ineffective drug, dosage too low, dosage too high, non-compliance); or unpredictable and thereby difficult to foresee (e.g. hypersensitivity and idiosyncratic reactions). Therefore, not all DRPs are the result of an error, as an unpredictable DRP can still occur without any error[27].

DRPs are more likely to occur in critically ill patients for many reasons: first, the complexity of their disease creates challenges in drug dosing; second, vulnerability to rapid changes in pharmacotherapy provide opportunity for ample distractions; third, the administration of complex drug regimens increases the chances of drug interactions; finally, the mode of drug administration is mostly intravenous infusion which further increases the risk. Therefore, the outcome of DRPs in an ICU is of the most serious consequences, possibly resulting in end-organ damage and even death[28]. In the present study deaths were mostly due to warfarin, alone or in combination with anti-platelets, 4 out of 8 deaths (50%), all females. Another female patient died because of bleeding from gastrointestinal tract and cerebral stroke related to an NSAID. One more female death was linked to multiple drug therapy for treatment of severe hypertension (Lisinopril, atenolol, amlodipine and frusemide). Amongst two male deaths; one was associated with overdose of a benzodiazepine, being abused, and the other developed severe hypertension and stroke due to non-compliance to treatment (Table 1, Category I).

TABLE 1.
An overview of problem category (according to NCC-MERP), drugs involved, management and outcome of 33 cases of DRPs at ICU, King Fahd Hospital of the University, Dammam, Saudi Arabia in the year 2012.

<table>
<thead>
<tr>
<th>(n)</th>
<th>Category</th>
<th>Drug</th>
<th>Gender (n)</th>
<th>Problem</th>
<th>Management/ Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 E</td>
<td>Carbamazepine</td>
<td>M (1)</td>
<td>Skin rash</td>
<td>Soothing cream, drug changed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vancomycin</td>
<td>M (1)</td>
<td>Skin rash and pruritus</td>
<td>Soothing cream, drug changed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prednisolone</td>
<td>M (1)</td>
<td>Hypersensitivity (skin rash)</td>
<td>Soothing cream, brand changed</td>
<td></td>
</tr>
<tr>
<td>19 F</td>
<td>Heparin and Aspirin</td>
<td>F (1)†</td>
<td>Chest pain, shortness of breath and hematuria</td>
<td>Managed with protamine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enoxaparin</td>
<td>F (1)†</td>
<td>Swelling of legs &amp; bruising</td>
<td>Drug stopped, blood transfusion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digoxin</td>
<td>F (1)†</td>
<td>Fatigue &amp; atrial fibrillation</td>
<td>Drug stopped</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phenytoin</td>
<td>M (1)</td>
<td>Hypotension, bradycardia</td>
<td>Changed to valproic acid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phenytoin</td>
<td>M (1)</td>
<td>Hepatitis</td>
<td>Drug stopped</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbamazepine</td>
<td>M (2)†</td>
<td>Non-compliance, leading to seizures</td>
<td>Antiepileptic drugs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbamazepine</td>
<td>F (1)</td>
<td>Ingestion of 10 tablets. Vomiting, confusion</td>
<td>Activated charcoal, IV fluid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Haloperidol</td>
<td>M (1)</td>
<td>Extrapyramidal effects</td>
<td>Procyclidine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorpromazine</td>
<td>M (1)</td>
<td>Neorulet malignant syndrome</td>
<td>Succinylcholine &amp; hydralazine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ciprofloxacins &amp; Esomeprazole</td>
<td>M (1)‡</td>
<td>Super-infection, MRSA, septic shock</td>
<td>Dopamine, IV fluids, Vancomycin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Imipenem</td>
<td>F (1)</td>
<td>Fungal infection</td>
<td>Treated with Flucanozole</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tazocin &amp; Esomeprazole</td>
<td>F (1)‡</td>
<td>Fungal pneumonia</td>
<td>Treated with Amphotericin B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Azathioprine</td>
<td>M (1) F (1)</td>
<td>Bone marrow suppression</td>
<td>Drug stopped, blood transfusion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prednisolone</td>
<td>F (1)†</td>
<td>Cushing syndrome</td>
<td>Drug stopped</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clonazepam</td>
<td>M (1)</td>
<td>Clonazepam withdrawal</td>
<td>Diazepam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alcohol</td>
<td>M (1)</td>
<td>Withdrawal effects</td>
<td>Symptomatic treatment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opioid &amp; cannabis</td>
<td>M (1)†</td>
<td>Overdose toxicity</td>
<td>Naloxone</td>
<td></td>
</tr>
<tr>
<td>3 G</td>
<td>Warfarin</td>
<td>M (2)</td>
<td>Cerebral stroke</td>
<td>Vitamin K</td>
<td></td>
</tr>
<tr>
<td>8 I</td>
<td>NSAIDs</td>
<td>M (1)†</td>
<td>GI bleeding, shock, cerebral stroke</td>
<td>PPIs &amp; treatment of shock</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warfarin</td>
<td>F (2)†</td>
<td>GI bleeding &amp; hemoptysis</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warfarin &amp; Aspirin/Clopidogrel</td>
<td>F (2)‡</td>
<td>Cerebral stroke</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NSAIDs</td>
<td>F (1)†</td>
<td>GI bleeding, shock, cerebral stroke</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lisinopril, atenolol, amlodipine, frusemide</td>
<td>F (1)§</td>
<td>Low BP, bradycardia, azotemia</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antihypertensives (drugs not stated)</td>
<td>M (1)†</td>
<td>Non-compliance Hypertensive emergency, stroke</td>
<td>Death</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benzodiazepine (drug not known)</td>
<td>M (1)†</td>
<td>Toxicity</td>
<td>Death</td>
<td></td>
</tr>
</tbody>
</table>

Key notes:
* Overdose toxicity, 12 (36.4%) cases
† Non-compliance, 3 (9.1%) cases
‡ Drug interactions, 6 (18.2%) cases
The present study also found similar drugs to be the major cause of DRPs. Besides these drugs, antiepileptic and antihypertensive agents were also involved, which were being prescribed for the treatment of seizures due to trauma, stroke and various types of epilepsies, perhaps related to the high incidence of road side accidents, epilepsy and hypertension in Saudi Arabia.

As mentioned above, the administration of complex drug regimens increases the chances of drug interactions. Out of 33 DRPs, 6 (18.2%) were, most probably, due to drug interactions. Heparin, warfarin and aspirin are well known to cause drug interactions because of a low margin of safety. In this study also, half of the drug interactions (3 out of 6) were related to these drugs. Achlorhydra due to Proton Pump Inhibitors (PPIs) is reported to cause many complications, including increased chances of super infection. In cohort and controlled studies conducted in a tertiary hospital in Montreal to examine the risk for Clostridium difficile (C. difficile) diarrhea among hospital inpatients prescribed PPIs, the relative risk of C. difficile diarrhea was higher among the patients who were on PPIs than among those who were not prescribed these drugs. The risk further increased in patients taking antibiotics along with PPIs\(^{(20)}\). Similarly, greater risk of C. difficile infection with acid suppressing drugs (PPIs) and antibiotic combination have been reported as compared to PPIs alone in a more recent meta-analysis of controlled observational studies published in MEDLINE and EMBASE from inception to December 2011\(^{(20)}\). Gastric acid suppression has also been associated with the development of both community-acquired and nosocomial pneumonia\(^{(14,31)}\). Combination with antibiotics would further increase the risk of pneumonia. In the present study also there were two cases of drug interactions concerning antibiotic and PPI combination. One, receiving ciprofloxacin and esomeprazole, developed septic shock due to MRSA and the second, receiving tazocin and esomeprazole, suffered from fungal pneumonia (Table 1, Category F).

In addition to health hazards DRPs also cause extra financial burden on the hospitals. A six month study conducted in two large general hospitals of Merseyside, England, found that 6.5% of admissions were due to DRPs. The median bed stay was eight days, accounting for 4% of the hospital bed capacity. The projected annual cost of such admissions to the NHS was £466m (€706m, $847m). Most reactions were either definitely or possibly avoidable\(^{(33)}\). In the present study, the median bed stay was 90 days (1 to 177 days). If the cost for the patient care in the hospital is calculated for the admissions due to DRPs it would also amount to millions of Riyals, and as mentioned above almost 60% of these admissions were preventable.

Many interventions are being suggested to reduce the incidence of MEs and DRPs. The input of a specialist critical care pharmacist in the patient care team resulted in a significant reduction in MEs and led to a safer, more effective use of medicines in a UK Neurosurgical Critical Care Unit\(^{(34)}\). Other studies also demonstrated the benefit of the involvement of a clinical pharmacist or a multidisciplinary patient care team approach for the promotion of patient safety in ICUs\(^{(27,35,36)}\). Education of the prescriber or physician, in the form of tutorials, ward-based teaching and feedback, reduced MEs in intensive care units\(^{(37,38)}\). Moreover, computerized prescription ordering and administration systems, including computerized prescription ordering entry (CPOE), are widely considered the best option to decrease the MEs, but requires careful planning, monitoring and tailoring of the system according to local needs\(^{(39-41)}\). A high rate of adverse events (52 per 100 admissions) continued to occur even after implementation of CPOE and related computerized systems that lacked decision support for drug selection, dosing and monitoring of computerized prescription ordering\(^{(42)}\).

**CONCLUSIONS**

DRPs are a common cause of hospital admissions. In the present study the prevalence of DRPs in the ICU of a tertiary hospital was 17.1%. Commonly involved drugs were anticoagulants, anti-epileptics, immune suppressants, antibiotics and drugs of abuse and dependence. Almost 60% of DRPs were found to be preventable, including those due to overdose toxicity, non-compliance and drug-drug interactions. An insight into the occurrence and causes of DRPs, proper education of prescribers, a multidisciplinary team approach and the introduction of computerized prescription systems are important measures in their prevention.

**Aknowledgements**

The authors are grateful to the Deanship of Research, University of Dammam, Saudi Arabia for the financial support (Grant No. 2012095) for the study. They are also extremely thankful to the staff of the ICU, the computer department and the record office of the King Fahd Hospital of the University, Alkhobar, Saudi Arabia for their help in finding the written files of patients admitted to the ICU.

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المشكلات المتعلقة باللدوية بقسم العناية المركزية في مستشفى جامعي بالمملكة العربية السعودية

Hazem Omran Qutub, وماريا حيدر الغامدي، ومحمد إكرم رثنها، ووراني علي الجبراني، ورياض يعقوب مشتاق، ومحمد جمال أكبر

قسم العناية المركزية، كلية الطب، جامعة الدمام، الدمام – المملكة العربية السعودية
قسم علم الأدوية، كلية الطب، جامعة الدمام، الدمام – المملكة العربية السعودية
قسم علم الأدوية، كلية الطب، جامعة الدمام، الدمام – المملكة العربية السعودية (سابقا)
قسم علم الأدوية، كلية الطب، جامعة الحدود الشمالية، عرعر – المملكة العربية السعودية (حاليا)

المتخصص.

خلفية: إن الأخطاء الدوائية يمكن أن تكون سببا للمشاكل المتعلقة باللدوية، هذه المشكلات المتعلقة باللدوية قد تكون أحيانا غير متوقعة و يمكن ظهورها في غياب الأخطاء الدوائية، إلا أن التعرف عليها وتحديد المشكلات المتعلقة باللدوية و الاخطاء الطبية يمكن من اتخاذ التدابير اللازمة لوقفها منها وعلاجها.

الهدف: تهدف هذه الدراسة إلى معرفة مدى انتشار المشكلات المتعلقة باللدوية في وحدة العناية المركزية بمستشفى الملك فهد الجامعي، بالخبر، المملكة العربية السعودية.

الأساسيات: تم تجميع وتدقيق البيانات، من تقارير المرضى بالوحدة للقرة من يناير إلى ديسمبر 2012.

النتائج: بعد مراجعة 193 حالة، منها 171 (17,1%) حالة تعتبر التأثيرات الجانبية فيها بسببية إلى خطيرة، بما في ذلك (4,1%) حالة وفاة، وكانت أكثر الأدوية شيوعا تلك التأثيرات الجانبية هي مضادات التخثر (الوارفارين، النيبردين، متفرد أو بالإضافة إلى الأسيتامينوفن أو الكلوهيد أو غلوكور، 8 حالات، 4.2%)، مضادات الصرع (الكاربامازين، الكليتيتوينين 6 حالات، 3,2%)، مضادات المناعة (الإيزوبلوربين، بيديسولون، 4 حالات، 2.1%), مضادات الحيوية (السيرولوتكساس، أمبيبين، كازوسن، الفانكومياسين، 4 حالات، 2.1%), المعادين (اللحوامل، المواد الأفيونية والقنب، 4 حالات، 2.1%), من بين التأثيرات الجانبية للأدوية والتي تم الكشف عنها، كانت 6 حالات (3,2%) مرتبطه بالتفاعلات بين الأدوية، حيث وجدنا أن ما يقرب من 6% من المشكلات المتعلقة باللدوية يمكن الوقاية منها، بما فيها تلك التي تتعذر على جراحات زائدة، أو عدم الامثال للتعليمات أو التداخلات بين الأدوية.

الاستنتاجات: أوضحت الدراسة أنه توجد مشكلات متعلقة باللدوية متوسطة إلى خطيرة، وأن أكثر من النصف من هذه الحالات يمكن الوقاية منه، تأمل أن تكون دراستنا هذه محفزه للواعي بالمشاكل المتعلقة باللدوية وأن تساعد على تحسين الرعاية بالمرضى.