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Original article

Identification and Evaluation of Drug-Related Problems in Patients with Reduced Kidney Function: A Retrospective Study

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Abstract
Patients with reduced kidney function are at an increased risk for complex drug-related problems due to altered drug pharmacokinetics and the presence of multiple comorbidities. This study aimed to identify and evaluate drug-related problems (DRPs) in this vulnerable patient population to enhance pharmacotherapy management. A retrospective analysis was performed on a cohort of 60 patients with reduced kidney function. Demographic and clinical data, including age, gender, and the number of comorbidities, were collected. Medication-related issues were categorized and quantified, focusing on unnecessary drug therapy, dosage concerns, the need for additional therapy, ineffective drugs, adverse drug reactions (ADRs), and drug-drug interactions (DDIs). In this study, a total of 60 patients with low kidney function were evaluated, whose average age was 63 ± 2.39 years. The most frequently represented age groups were 60–69 and 70–79 years (each 13 patients), followed by the 80–89-year-old group (10 patients). The study consisted of 23 males (38.3%) and 37 females (61.7%), with an average of 3.4 Comorbidities per patient. A detailed analysis of the drug-related issues was conducted, in which several notable conclusions were detected. First, unnecessary drug therapy was identified in five cases (4.35%). Secondly, dosage-related issues were important, with 23 examples where the dose was too high (20%) and 10 examples where the dosage was very low (8.70%). Third, an additional drug therapy requirement was noted in 26 cases (22.61%). Finally, ineffective drugs were identified in 12 cases (10.43%). 16 examples (13.91%) reported adverse drug reactions (ADRs), while drug-drug interactions (DDIs) were seen in 23 examples, accounting for 20% of the total incidents. The study emphasizes considerable proliferation of drug complications among patients with low renal function, mainly due to dosage-related issues and the need for additional medications. Conclusions emphasize the importance of individual and careful drug management in this demographic, which aims to reduce deformed results and to improve medical efficacy.
Keywords. *Chronic Kidney Disease, Comorbidities, Drug-Related Problems, Polypharmacy.*

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Introduction

Kidney dysfunction appears in many forms, especially in the form of acute renal injury (AKI) or chronic kidney disease (CKD) [1,2]. These conditions form important global health challenges. The approximate global spread of CKD is 13.4%, and it is predicted to become the fifth largest cause of mortality by 2040 [3,4]. Management of drugs in patients with CKD is a complex venture, mainly due to the important role of the kidney in drug metabolism and elimination [5]. Consequently, individuals with low kidney function are at a high risk of experiencing drug-related problems (DRP), which may be adverse drug reactions, medical failures, hospitalization, and can increase the cost of health care.

The prevalence of DRP among CKD patients is a significant concern, which has a reported circulation rate ranging from 12% to 87% [6]. In clinical settings, the frequency and severity of DRP are extended by factors such as the presence of converted pharmacokinetics, polypharmacy, and more than one comorbidity. For example, a study of hospitalized CKD patients found that at least one DRP experienced about three-fourths [7]. Along with other studies, the current research identifies similar conclusions in internal medical wards and intensive care units [8]. The most common DRP doses identified in these settings are issues of inappropriate drug selection and efficacy. It is important to note that improper selection of drugs and dosage, especially renal dose adjustment, is a common issue [9]. It is shown to be correlated with nephrotoxicity, adverse drug events (ADES), and an increased risk of medical failures. A recent study found that up to 71% of antimicrobial and CKD patients were given more than three-fourths of the prescribed drugs [10], and people with older patients, as well as many other commodities, were particularly weak [11].

Polypharmacy, often a result of managing several chronic conditions in CKD patients, further reduces the risk of DRPs [12]. Research has indicated that the prevalence of polypharmacy in CKD patients often exceeds 80% [13]. Previous studies have established a correlation between polypharmacy and a high risk of mortality, a decline in kidney function, and a decline in quality of life [13,14].

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The risk of drug-drug interactions (DDIs) is also dangerous, in which research suggests that more than 80% of CKD outpatients are in contact with potential DDIs, most of which are of moderate severity [15]. The number of prescribed drugs and the complexity of the regimens have been shown as important predictors of both DRPs and DDIs.
Pathophysiological changes associated with CKD, which include impaired drug absorption, distribution, metabolism, and elimination, require vigilance and adjustment of drug residence [16]. Changes of pharmacokinetics and pharmacodynamics can cause drug accumulation, long life can occur, and increase sensitivity to drugs [17]. These phenomena require careful management to avoid poisoning and sub -medical results. It has been displayed that those issues, such as underdosing, which can be held responsible for the wrong classification of kidney function, are associated with an increased incidence of adverse drug reactions, associated with sub-regional clinical consequences, prevailing hospitalized and high healthcare use [18].
According to the Pharmaceutical Care Network Europe Association (PCNE), a drug-related problem is "defined as an event or situation related to drug therapy that interferes with really or potentially desired health results" (reviewed in [19]). DRPS includes several issues, including drug-drug interactions, adverse drug events, and drug errors.
The timely identification and management of the DRP is mandatory for the patient's safety and adaptation of the patient [20,21], especially in areas such as Libya, where CKD creates a sufficient public health concern, and the data on DRP remains rare.
In view of the anticipated positive impact of such interventions on logic drug use and clinical results, it is mandatory to examine the current status of drug-related problems among patients with low kidney function. The purpose of this study is to detect the prevalence and types of DRPs in CKD patients and examine the factors associated with their occurrence. The final goal of this study is to identify the strategies targeted for safe and more effective pharmacotherapy.

Methodology

Study Design

In patients with decreased kidney function, a retrospective analysis was done to identify and evaluate DRPs. It was obtained by reviewing the existing medical records from the hospital.

Study Setting

The study was conducted with a dedicated nephrology department at Sebha Medical Center, using manual health records for data collection.

Study Population

Inclusion Criteria

Adults over 18 years of age have been found to have chronic kidney disease (CKD). The patient was admitted to the hospital in 2023. Documentation of drug use and assessment of renal function (e.g., serum creatinine (SrCr)) are essential components of clinical evaluation.

Exclusion Criteria

Medical records are incomplete; the patient was not given any medicine during the hospitalization period.

Data Collection

The data collected included demographic information (age, gender), clinical characteristics (comorbidities), medication lists, doses, frequencies), and laboratory results (serum creatinine, electrolytes). A trained research team was responsible for the data extraction process, using a standardized form, and carefully reviewed all the data for accuracy. Anomalies were solved by consensus or senior researcher reviews. The approval for the study was provided by the Faculty of Pharmacy, Sebha University Ethics Committee, and the Director of Sebha Medical Center. It is mandatory to note that all the patient's information was handled with strict privacy and was used only for this study.

Identification of Drug-Related Problems

Data review focuses on the identification of DRP, such as unnecessary pharmacotherapy, ineffective drugs, improper doses, and potential ADRS. Each patient's drug regimens were evaluated against optimal results and current guidelines for safety.

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DRPs were classified as: Inappropriate drug selection (drug contraindicated in CKD), dosage errors (not adjusted to renal function), drug-drug interactions (clinically important), and adverse drug reactions

Evaluation Process

The clinical pharmacist worked with the responsibility of reviewing and classifying DRPs, for the purpose of assessing clinical importance based on the established criteria.

Statistical Analysis

The analysis of the data was conducted using the IBM SPSS Statistics version 27.0. The application of descriptive data compiled a summary of demographic and clinical characteristics. The prevalence of DRP was calculated as a percentage of the total number of patients. Chi-square testing was used to evaluate associations between a range of variables, while the correlation analysis (Pearson's correlation) was employed to detect constant variable relationships. Logistic regression was used to identify independently associated factors with DRPs, controlled for confounders (age, gender, comorbidities, and medicine burden).

Result and Discussion

Baseline demographic characteristics of the patients

The current study included a total of sixty patients, whose average age was 63 ± 2.39 years. The boundaries of 60–69 and 70–79 years (every 13 patients) were seen to be a major age group, followed by the cohort of 80–89 years. Demographic distribution revealed a male-to-female ratio of 0.8 1, with a population of 23,38.3% males and 37,61.7% of the population is female (Figure 1). The average number of comorbidities per patient was found to be 3.4, which is characterized by high proliferation of multiple diseases such as hypertension and diabetes, which are associated with chronic kidney diseases.

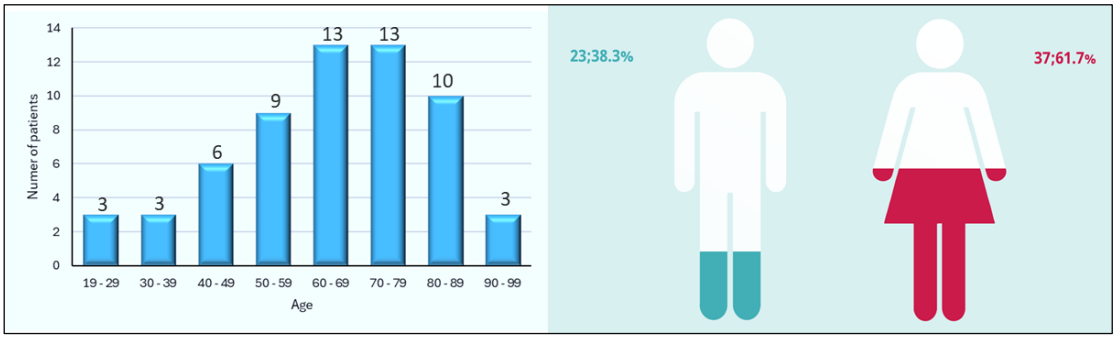

Figure 1. Baseline demographic characteristics of the patients

Prevalence of Drug-Related Problems

The total number of DRPs among the studied patients was 115, with an average of 1.9 DRPs per patient (about 2). An important event of drug-related problems was mentioned among patients, who were from 19 to 97 years, with a majority representation within the elderly (≥70 years). Most often, problems related to medicine are borne are painted in (Figure 2).

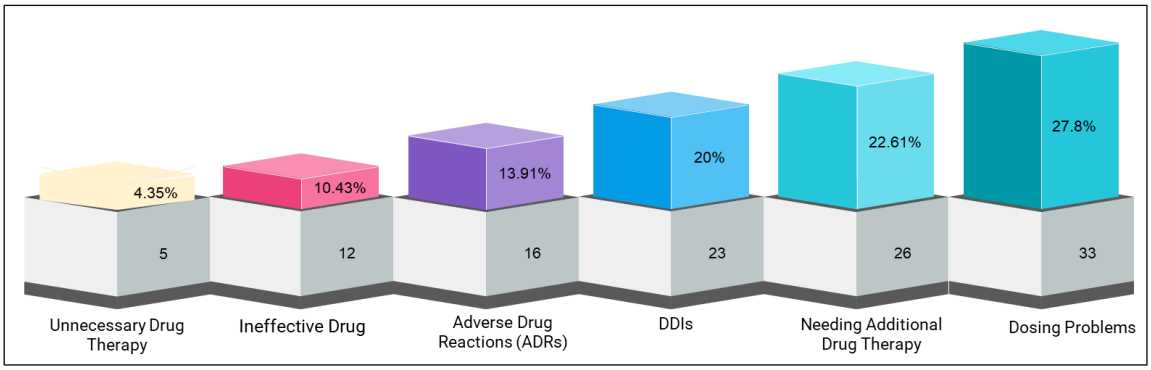

Figure 2: Drug-related problems identified among CKD patients

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These results outline the important role of increasing treatment regimens with a special emphasis on the selection of drugs, dosage, and a special emphasis on the inclusion of targeted therapy.

Common DRPs identified

Unnecessary pharmacotherapy

An analysis of data showed that unnecessary pharmacotherapy (unnecessary drug therapy) was identified in five patients (4.3%) (Figure 2). The prevalence of this phenomenon was found to be significantly higher among the older adults, who were prescribed many drugs (ie, polypharmacy), and they lacked the diagnostic signs documented. A case in point is the concurrent administration of duplicate antihypertensive agents or vitamins, which were determined without a clear medical requirement. It has been exhibited to increase health care expenses and is considered inappropriate to increase the risk of adverse drug incidence [22]. It emphasizes moral and professional obligations for physicians to follow evidence-based prescriptions, review regular drugs, and implement disorganized strategies, where iatrogenic is suitable for reducing damage [23].

Inappropriate Dosing

The study identified problems related to a total of 33 (28.7%) doses (Figure 2). This study found that 23 (69.7%) of 33 patients received medicines at doses that are more often more than those with kidney loss. Especially attention agents included diuretic, some antibiotics, mostly amoxicillin, and insulin. Inadequate dose decreases in the installation of low renal function patients for potential toxicity. The findings of this study were in line with previous studies, indicating that more than 70% of antimicrobials prescribed for patients with chronic kidney disease are not properly dosed [10]. This exercise is associated with an increased risk of adverse drug responses. Patients with low kidney clearance, especially chronic adults, are therefore at increased risk of drug accumulation and toxic effects, which outlines the requirement of regular evaluation of renal function and individual doses.

In 30.3% of cases (10 patients), the dose was found inadequate, a problem especially in the management of diabetes and heart disease. Inadequate management of hypertension and diabetes may be responsible for an antihypertensive agent or insulin dose administration that falls below the recommended medical range.

An international report recently indicated that insufficient pharmacotherapy and incorrect doses represent significant obstacles for effective management of chronic diseases [24]. This is a well-written fact that patients suffering from chronic diseases often experience issues related to their medication. These issues often require changes in the patient's pharmacotherapy. In the current cohort, 26 (22.6%) patients require additional drugs to adapt clinical results, mainly for the treatment of anemia, cerebrovascular accident (CVA) secondary prevention, and diabetes management. It is noteworthy that despite the obvious indication for thromboprophylaxis, many patients diagnosed with atrial fibrillation were not receiving anticoagulation therapy. This failure to follow treatment guidelines puts these patients at a high risk of developing thromboembolic events. Patients with anemia often require iron supplementation, while people with diabetes often require intensity or adaptation of their insulin to obtain acceptable glycemic control.

The prevalence of DRPs is sufficient in the population of chronic diseases. Previous studies report that about 54.67% of patients with chronic conditions experience one or more DRPs, in which polypharmacy and suboptimal are identified as prominent contributors with drug management [25,26]. In addition to undertrials, affected patients may experience adverse drug responses (ADRs) or may come in contact with unnecessary treatments, affecting further care and results affecting results [27].

Adverse Drug Reactions (ADRs)

In this study, 13.9% of patients (16 individuals) experienced adverse drug reactions. The most prevalent ADRs included electrolyte imbalances (6 cases), bleeding (5 cases), hypoglycemia (3 cases), and gastrointestinal effects (2 cases). Notably, in elderly patients, many drugs, particularly anticoagulants and diuretics, were found to have diminished efficacy, especially in those with renal impairment. These results underscore the importance of careful monitoring and proactive management of ADRs, particularly in high-risk populations.

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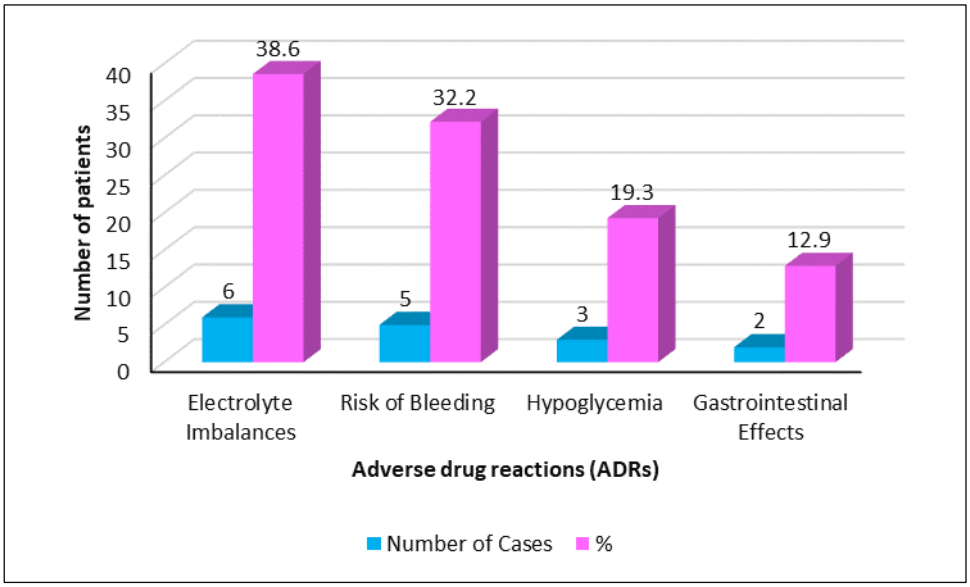

Figure 3. Adverse drug reactions

Drug-drug interactions (DDIs)

Drug-drug interactions (DDIs) were identified in 23 cases (20% of the total), marking them as a significant category of drug-related problems. The most common combinations involved atorvastatin with insulin (8 cases), diuretics with angiotensin-converting enzyme (ACE) inhibitors (6 cases), aspirin with clopidogrel (5 cases), and amlodipine with methyldopa (4 cases) (Figure 4). These findings align with existing literature indicating that elderly patients frequently experience polypharmacy, which contributes to an increased risk of DDIs and subsequent adverse events.

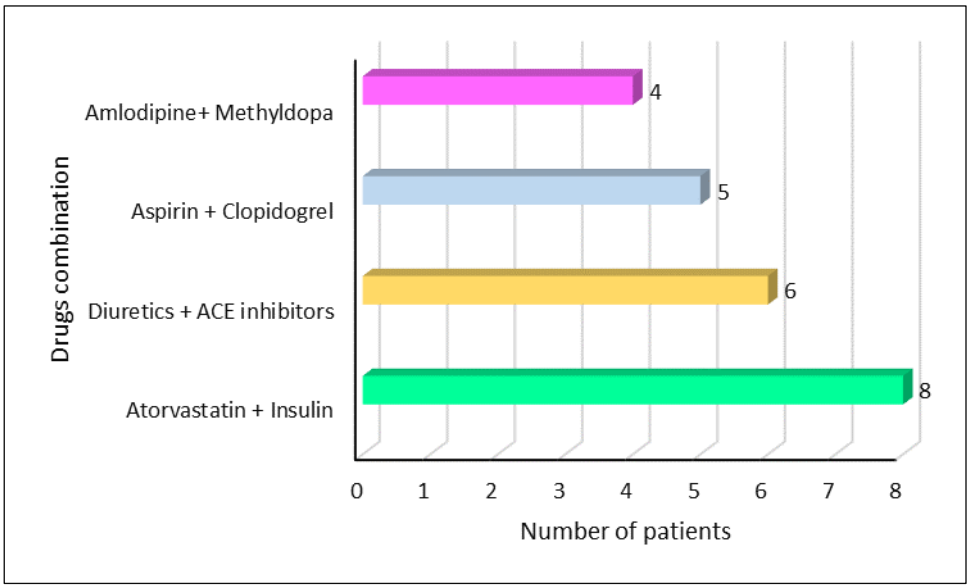

Figure 4. Drug combinations are frequently associated with complications in patients with CKD

Elderly patients, particularly those with multiple comorbidities, are at heightened risk for ADRs and DDIs due to polypharmacy and age-related changes in pharmacodynamics and pharmacokinetics [28]. Significant concerns include an elevated risk of bleeding, hypotension, and kidney impairment [29,30].

Correlation analysis revealed strong associations between patient characteristics and ADRs: age showed a strong positive correlation ($R = 0.60$), followed by additional therapy ($R = 0.50$) and high drug doses ($R = 0.45$). Gender had minimal impact on ADR occurrence. These findings underscore those older patients requiring higher doses or additional therapies are particularly vulnerable to adverse effects.

The regression analysis identified age, the need for additional therapy, and high doses as significant predictors of ADRs, explaining 86% of the result variation ($R^2 = 0.865$, $P < 0.001$). This suggests that clinicians should prioritize monitoring

these high-risk patients and adjust treatments as necessary. Moreover, polypharmacy is very common among the elderly, exacerbates the risk of ADRs and DDIs [31,32], leading to increased hospitalization and mortality rates [33].
The findings align with existing literature, indicating that as patients age, physiological changes, including declines in kidney and liver function, increase the likelihood of drug accumulation and toxicity [34]. Therefore, implementing structured interventions to reduce polypharmacy and ensure careful monitoring of drug efficacy and safety is crucial, especially for patients with reduced kidney function [35,36]. Regular medication reviews and patient education on the risks of polypharmacy are essential to mitigate these issues [37, 38].
The current study is subject to several limitations. First, the sample size is small, which can limit the generality of the study. Secondly, the retrospective design carries the risk of incomplete records and documentation bias. Third, a single-center setting prohibits the generalization of conclusions for other populations or health care systems. Conclusions are informative, but are not certain, and they will require more comprehensive studies to confirm.

Conclusion

This study provides compelling evidence of high proliferation of drug-related problems in elderly patients suffering from many comorbidities, including CKD. Improper doses, requirement for additional drug therapy, and adverse drug reactions are prevalent and contribute to sub-optimal results. The study recommended the following: It is mandatory to prioritize regular kidney function assessment and implementation of comprehensive drug reviews. It is important to educate patients on their condition and follow the drug. In addition, participation of health care providers, including pharmacists, is necessary for adaptation of patient care. The CKD dose guidelines are paramount for adherence to the guidelines, and to ensure the safety of the patient, careful documentation and analysis of drug-related issues is necessary. In addition, it is important to support the ongoing research and professional training initiatives to increase drug safety in patients with CKD and other comorbidities.

Conflict of interest. Nil

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