v. 3, n. 51, 2023

International Journal of Health Science

ANALYSIS OF DRUG INTERACTIONS AND THEIR IMPLICATIONS FOR LABORATORY TEST RESULTS

Gustavo Fernando Adriano dos Santos
Department of Biomedicine – Institution:
`` Centro Universitário das Faculdades Integradas de Ourinhos`` – Unifio/FEMM
Ourinhos, SP, Brazil
ORCID: 0009-0002-4064-8242

Luciano Lobo Gatti
`` Centro Universitário das Faculdades Integradas de Ourinhos`` – Unifio/FEMM
Ourinhos, SP, Brazil
ORCID: 0000-0003-2723-3173

Gabriel Vitor da Silva Pinto
`` Centro Universitário das Faculdades Integradas de Ourinhos`` – Unifio/FEMM
Ourinhos, SP, Brazil
ORCID: 0000-0003-4630-9057

Douglas Fernandes da Silva
`` Centro Universitário das Faculdades Integradas de Ourinhos`` – Unifio/FEMM
Ourinhos, SP, Brazil
ORCID: 0000-0002-0252-1112

Roberto Venerando
`` Centro Universitário das Faculdades Integradas de Ourinhos`` – Unifio/FEMM
Ourinhos, SP, Brazil
ORCID: 0000-0002-1937-0517

Abstract: Drug interactions represent a significant challenge in clinical practice, as they can influence therapeutic efficacy and patient safety. In addition, these interactions can lead to changes in the results of laboratory tests, compromising the correct interpretation of these tests and the making of appropriate clinical decisions. The consequences of drug interactions on laboratory tests vary widely, as some drugs can cause increases or decreases in test results, while others can interfere with the analytical methods used. This work highlighted the importance of laboratory tests in the health area, as well as incorrect or misleading information reported by patients that lead to wrong diagnoses.
Keywords: Drug interference, laboratory tests and biomarkers.

INTRODUCTION

In the health area, laboratory tests play a key role in obtaining an accurate diagnosis. The relevance of these exams stems from the wide range of information provided through laboratory analysis. However, it is important to note that this information may occasionally be inaccurate, which can be caused by a variety of factors (1).

Souza et al. (2) state that the consequences of drug interactions in laboratory tests vary widely. Some medications can cause increases or decreases in test results, while others can interfere with the analytical methods used. Thus, according to the same authors, these alterations can lead to erroneous diagnoses, inadequate adjustments of drug doses and unnecessary clinical complications.

These drug changes manifest themselves in different ways, and can be *in vivo*, *in vitro* or both, which can generate different alterations in laboratory tests (3,4). The *in vitro* effects demonstrate alterations in the analytical part directly linked to laboratory tests, such as a false increase in the values of fructosamine in the serum of patients who use captopril; as well as the drug enalapril, it can alter tests as *in vivo* in serum uric acid dosages (5).

According to Oliveira et al. (6), health professionals aim to minimize these effects as much as possible. These professionals must show a high level of vigilance in relation to drug interference, since these can be responsible for several clinical complications.

This way, healthcare professionals use Standard Operating Procedures (SOP's) and regulations as mechanisms to establish standards and ensure greater control over the patient's medical condition. The administration of drugs can have significant effects on the results of laboratory tests. It is common for certain medications to promote changes in function or in the levels of substances present in the blood, resulting in abnormal laboratory findings (7). Clinical laboratory technicians, therefore, will be able to take into consideration, possible drug interference in test results, promoting the achievement of more accurate and relevant diagnostic results to support medical decisions.

In this context, it is essential that health professionals have full knowledge about the drugs administered to patients and incorporate this information into laboratory analysis requirements. And, considering the relevance of laboratory tests in the diagnosis and the resulting impact of the complications that occur in these procedures, the present study was conducted with the purpose of helping laboratory and health professionals in understanding the changes in laboratory tests caused by the use of drugs.

PRE-ANALYTICAL, ANALYTICAL AND POST-ANALYTICAL EXAMS

Laboratory tests, as previously discussed, play a key role in clinical practice, providing essential information for the diagnosis, monitoring, and treatment of a variety of

medical conditions. However, to guarantee the reliability and precision of the results, according to Souza et al. (2), it is necessary to consider the pre-analytical, analytical and post-analytical processes, which comprise crucial stages of the laboratory workflow.

The pre-analytical phase encompasses all steps from ordering the test to preparing the sample for laboratory analysis. It comprises the correct identification of the patient, the adequate collection of biological material, the appropriate handling, transport and storage. Errors at this stage can lead to inaccurate results and misinterpretations. Some critical factors include the influence of medications, fasting conditions, dietary interference and interference from other clinical procedures (7). Thus, it is the phase with the highest occurrence of intercurrences, as they depend on the response of patients who may hide information. Specific guidelines and protocols, such as Standard Operating Procedures (SOP's), are essential to minimize these errors and ensure the quality of the collected samples.

The analytical phase comprises the activities performed in the laboratory for sample analysis; which included sample preparation, application of analytical methods and techniques, equipment calibration, result validation and quality assurance. At this stage, it is essential that laboratory professionals are properly trained, follow good laboratory practices and use properly calibrated and controlled equipment. Method validation and participation in external quality control programs are essential to ensure the reliability and accuracy of analytical results. The analytical phase can also be affected by previous actions performed by the patients, such as the use of medication, which can affect physiological aspects of the body and, consequently, change the biochemical reactions of the sample (2).

The post-analytical phase refers to the interpretation, release and communication of laboratory test results. Thus, it involves reviewing the results, correlating them with clinical data, preparing reports and communicating with the health professionals responsible for patient care (6). According to the same authors, at this stage, errors may occur due to lack of understanding of the results, failures in communication or delays in the delivery of reports.

For this purpose, it is essential that clinical laboratory professionals have adequate clinical knowledge to interpret the results and provide relevant data to support medical decisions. The adoption of efficient information management systems and clear communication between health professionals are crucial to avoid failures in this step.

DRUGS AND INTERFERENCE IN LABORATORY EXAMINATIONS

Drug interference in laboratory tests can lead to inaccurate or falsely elevated or decreased results, compromising the correct clinical interpretation and decision-making adopted (8).

Several categories of drugs, according to Silva et al. (9), have the potential to interfere with the results of laboratory tests, such as drugs that impact liver function assessment tests, such as hepatotoxic drugs, capable of promoting the performance of liver enzymes, such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST), generating false positive results for liver damage.

Certain drugs can also influence renal function tests by altering serum creatinine levels, such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin II receptor blockers (ARB), which can cause an apparent reduction in levels. of creatinine and, consequently, mask the renal dysfunction.

Coagulation tests can also be altered by

Anticoagulants, such as warfarin, can interfere with coagulation tests, resulting in prolonged values of prothrombin time (PT) and activated partial thromboplastin time (aPTT). As well as hormone analysis, as certain substances, such as corticosteroids, can suppress endogenous hormone production, resulting in decreased levels of cortisol, for example.

The detection of these interferences is of paramount importance for health professionals, who must be aware of these adverse effects for the correct interpretation of test results.

ANALGESICS

Analgesics are drugs commonly used for pain relief and fever control. The leaflets for Acetylsalicylic Acid (10) and Dipyrone (11) are important sources of information about this class of drugs (8,12). Table 1 presents updated and accurate information on the interference of these drugs in laboratory tests.

ANTICONVULSANT

Medications belonging to the class of antiepileptics are used to treat different types of seizures, including epilepsies, as well as some neurological diseases (13). Table 2 provides updated and accurate data about the interference of these drugs in laboratory tests.

SUPPLEMENTS

Vitamin supplements are drugs formulated with vitamins, used to supply nutritional deficiencies or supplement the diet. Iron supplements are indicated to treat iron deficiency in the body. It is essential to emphasize that the excessive use of these supplements can lead to iron intoxication, a serious and potentially fatal condition, especially in children (14). Table 3 presents information on supplements in laboratory tests".

ANTBIOTICS

Health professionals play a significant role in providing guidance to patients about the importance of adhering to the instructions for using antibiotics, respecting the recommended doses and times, in order to ensure the effectiveness of the treatment (9,13). Yeah, they are medicines used to fight bacterial infections; however, it is crucial to avoid the indiscriminate use of these drugs, which can lead to the development of bacterial resistance.

Oliveira et al. (6) states that the unnecessary use of these drugs can increase bacterial resistance, cause unwanted side effects and interfere with the results of diagnostic tests.

Therefore, it is essential that these drugs are prescribed only when necessary, taking into consideration, the type of infection and the sensitivity of the causative bacteria. Table 4 summarizes up-to-date information about antibiotics and their effects on treatments, as well as affected exams.

BETA-BLOCKERS

Beta-blockers are drugs that are widely used to treat a variety of conditions, including high blood pressure, heart disease, and migraines. These drugs work by blocking beta-adrenergic receptors, which results in a reduction in heart rate and blood pressure, providing significant benefits to patients (PRODOCTOR, 2023).

Patient awareness of the possible effects of beta-blockers on laboratory tests is essential. Following medical guidelines and fully and accurately informing the use of these drugs is crucial to obtain accurate laboratory results, thus ensuring the safety and efficacy of the treatment (9). The table below (Table 5) presents drug information about beta-blockers.

ANTI-HYPERTENSIVE AGENTS

Antihypertensives are the main form of

Medicine	Therapeutic function	Adverse effects	Exam altering mechanism of action	Affected exams
Acetylsalicylic acid	Analgesic, anti-inflammatory, antiplatelet	Gastrointestinal bleeding, ulcer, dizziness, tinnitus, kidney failure	Inhibits COX, decreasing production	Bleeding time, coagulation, kidney function, blood glucose
Dipyrone	Analgesic, antipyretic	Agranulocytosis, Hemolytic anemia, Allergic reactions	It may interfere with glucose dosage, indicating false results of hyperglycemia.	Glucose dosage
Ibuprofen	Analgesic and anti-inflammatory	Gastritis, ulcer, gastrointestinal bleeding, fluid retention	May interfere with blood clotting tests	blood clotting tests
Morphine	Opioid analgesic	Nausea, vomiting, constipation, sedation	May increase amylase and lipase levels	Amylase, lipase
Oxycodone	Opioid analgesic	Nausea, vomiting, constipation, sedation	May increase amylase and lipase levels	Amylase, lipase
Paracetamol	Analgesic, antipyretic	Allergic reaction, jaundice, liver failure	May interfere with blood glucose measurement	blood glucose

Table 1: Analgesics

Medicine	Therapeutic function	Adverse effects	Exam altering mechanism of action	Affected exams
Valproic acid	Anticonvulsant, mood stabilizer	Nausea, vomiting, drowsiness, dizziness, weight gain	Increases gamma-aminobutyric acid	Ammonia, liver enzymes, bilirubin
Carbamazepina	Anticonvulsant, mood stabilizer	Dizziness, drowsiness, nausea, double vision	May cause false positive on pregnancy test	Pregnancy test
Diazepam	Anticonvulsant, anxiolytic, sedative	Drowsiness, Mental confusion, Ataxia, Respiratory depression	It can cause false negatives in toxicological tests due to its effect of masking the use of other drugs.	Toxicological tests
Phenytoin	Anticonvulsant	Nystagmus, ataxia, vertigo, gingival hyperplasia	Cytochrome P450 Enzyme Induction	Serum levels of thyroid hormones, theophylline, digoxin, among others
Sodium valproate	Anticonvulsant	Drowsiness, dizziness, nausea	May increase ammonia levels	Ammonia level

Table 2: Anticonvulsant

Medicine	Therapeutic function	Adverse effects	Exam altering mechanism of action	affected exams
Ascorbic acid	vitamin supplement	Nausea, diarrhea, abdominal pain, insomnia, headache	Increased absorption of iron in the intestine and interference with blood glucose measurement by the enzymatic method.	Ammonia, liver enzymes, bilirubin
Iron chelate	Iron Supplement	Nausea, diarrhea, constipation, abdominal pain	Interference with the absorption of other minerals	Serum levels of iron, calcium, zinc and magnesium
Ferrous sulphate	Iron Supplement	Constipation, nausea, abdominal pain	May interfere with the dosage of zinc, calcium and phosphorus	Zinc, calcium and phosphorus

Table 3: Supplements.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Amoxicillin	Antibiotic	Diarrhea, nausea, vomiting, skin rash, anaphylaxis	Inhibits cell wall synthesis	Complete blood count, liver function, creatinine
Benzylpenicillin	Antibiotic	Allergic reactions, diarrhea, nausea, vomiting, pseudomembranous colitis	Inhibits cell wall synthesis	Complete blood count, liver function, creatinine
Cephaclor, cephalexin, Cefadroxil, Ceftriaxone	Antibiotic of the cephalosporin family	Diarrhea, nausea, abdominal pain	May interfere with results of urine glucose tests using Benedict's or Fehling's reagent	Urine glucose test
Ciprofloxacin	Antibiotic of the fluoroquinolone family	Nausea, diarrhea, abdominal pain	May interfere with results of urine glucose tests using Benedict's or Fehling's reagent	Urine glucose test
Doxycycline	Antibiotic	Nausea, Vomiting, Diarrhea, Photosensitivity	It may interfere with the measurement of serum creatinine, indicating a false decrease in values.	Creatinine dosage
Erythromycin	Antibiotic	Abdominal pain, diarrhea, nausea, vomiting, hepatotoxicity, QT prolongation	Cytochrome P450 enzyme inhibition	Liver function test, creatinine, bilirubin
Levofloxacin	Antibiotic	Nausea, diarrhea, headache, dizziness	May interfere with blood glucose tests	Blood glucose tests
Nitrofurantoin	Antibiotic	Nausea, vomiting, diarrhea, abdominal pain	May interfere with the measurement of blood glucose and protein in the urine	Blood glucose, protein in urine
Sulfamethoxazole	Antibiotic	Nausea, vomiting, diarrhea	May interfere with total and direct bilirubin measurement	Total and direct bilirubin
Rifampicin	Antibiotic	Nausea, vomiting, abdominal pain	May interfere with total and direct bilirubin measurement	Total and direct bilirubin
Tetracycline, Trimethoprim	Antibiotic	Nausea, vomiting, diarrhea	May interfere with total and direct bilirubin measurement	Total and direct bilirubin

Table 4: Antibiotics.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Atenolol	Beta blocker	Bradycardia, hypotension, fatigue, insomnia, depression	Blocks beta-adrenergic receptors	Blood pressure, heart rate, blood glucose
Bisoprolol	Beta blocker	Bradycardia, hypotension, fatigue, insomnia, depression	Blocks beta-adrenergic receptors	Blood pressure, heart rate, blood glucose
Propranolol	Beta blocker	Fatigue, bradycardia, hypotension	May lower blood glucose levels	blood glucose

Table 5: beta blockers

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Atenolol + Chlorthalidone	Anti-hypertensive	Hypotension, bradycardia, fatigue, impotence, hyperglycemia	Blocks beta-adrenergic receptors	Blood pressure, heart rate, blood glucose
Captopril	Antihypertensive, angiotensin-converting enzyme inhibitor	Cough, hypotension, hyperkalemia, angioedema	Decreased concentration of renin and aldosterone in plasma	Serum potassium, serum sodium
Diltiazem	Antihypertensive, antiarrhythmic	Hypotension, Headache, Dizziness, Peripheral edema	It may interfere with the measurement of serum creatinine, indicating a false decrease in values.	Creatinine dosage
Labetalol	Anti-hypertensive	Bradycardia, hypotension, dizziness, fatigue	It may interfere with catecholamine and cortisol tests	Catecholamine and cortisol tests
Losartan	Anti-hypertensive	Dizziness, hypotension, hyperkalemia, renal failure	It may interfere with plasma renin tests	Plasma renin tests
Methyldopa	Anti-hypertensive	Drowsiness, dizziness, dry mouth, depression	It may interfere with catecholamine tests, may increase AST and ALT levels	Catecholamine, AST, ALT tests

Table 6: Antihypertensives

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Bupropion	Antidepressant	Insomnia, headache, anxiety, dry mouth, nausea	Inhibits noradrenaline reuptake	Blood glucose, electrolytes, liver function
Fluoxetine	Antidepressant	Nausea, insomnia, restlessness, loss of appetite, tremors	Inhibits serotonin reuptake	Blood glucose, electrolytes, liver function
Sertraline	Antidepressant	Diarrhoea, nausea, insomnia, drowsiness, dizziness	Inhibits serotonin reuptake	Blood glucose, electrolytes, liver function

Table 7: Antidepressants

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Chlorpromazine	Antipsychotic, antihistamine	Drowsiness, sedation, dry mouth	May cause false positive on pregnancy test	Pregnancy test
Quetiapine	Antipsychotic	Drowsiness, dizziness, weight gain, dry mouth	May increase prolactin levels	Prolactin level

Table 8: Antipsychotics

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Efavirenz	Antiretroviral	Nausea, Insomnia, Drowsiness, Dizziness	May interfere with corticotropin dosage, indicating false decrease in values	Corticotropin dosage
Tenofovir	Antiretroviral	Nausea, diarrhea, fatigue, headache, kidney changes	Inhibits HIV reverse transcriptase	Kidney function, liver function, electrolytes
Atazanavir	Antiretroviral	Nausea, jaundice, skin rash, changes in lipid metabolism	Inhibits HIV protease	Liver function, lipid profile, blood glucose

Table 9: Antiretrovirals

treatment for high blood pressure, and their main function is to reduce blood pressure, keeping it within healthy levels and preventing cardiovascular complications. (13). These drugs work in different ways, such as blocking angiotensin receptors, inhibiting angiotensin-converting enzyme, and decreasing peripheral vascular resistance. These actions promote blood vessel dilation and reduce the heart's workload, resulting in effective blood pressure control (9).

It is essential to emphasize that the correct use of antihypertensive drugs is crucial for the success of the treatment. Adherence to prescribed doses, regular administration and open communication with the physician are extremely important aspects. The lack of information about the use of these drugs and the omission of relevant details to the health professional can compromise the results of laboratory tests (15). Table 5 presents information on the use of antihypertensive drugs.

ANTIDEPRESSANTS

Antidepressants play an important role in treating mental disorders such as depression, anxiety and mood disorders. They act on the chemical balance of the brain, increasing the levels of neurotransmitters responsible for mood regulation (13).

To this end, it is essential that patients inform their physicians about their use of antidepressants and any other medication they are taking, including vitamins and supplements; as some antidepressants may interfere with the results of laboratory tests, such as those that measure glucose, lipid or liver enzyme levels (16). Table 7 presents information about antidepressants.

ANTIPSYCHOTICS

Antidepressants play an important role in the treatment of mental disorders such as depression, anxiety and obsessive-compulsive disorder. These medications regulate levels of neurotransmitters in the brain, such as serotonin, norepinephrine, and dopamine, which play a crucial role in regulating mood and emotions. By balancing these neurotransmitters, antidepressants help alleviate depressive symptoms, reduce anxiety, and stabilize mood (13).

Some antidepressants have the potential to cause changes in the values of certain biochemical markers, such as liver enzymes, electrolytes and lipids. These changes can be misinterpreted if the physician is not aware of the use of these drugs, leading to incorrect diagnoses or ordering unnecessary additional tests (17). Table 8 is an up-to-date summary of antipsychotics and their drug actions.

ANTIRETROVIRALS

Antiretrovirals are essential in the treatment of HIV infection and in the prevention of progression to AIDS, among others. They have the function of suppressing virus replication, reducing its viral load and preserving the immune function of patients (13). It is important to emphasize that the inappropriate use or interruption without medical advice of antiretrovirals can compromise their effectiveness and lead to the development of viral resistance (18). These medications can affect laboratory test results and interfere with parameters such as CD4 cell count, viral load, and liver enzyme levels (8). Relevant information about antiretrovirals is presented in table 9.

INHIBITORS

Inhibitors are essential in several areas of medicine, such as cardiology, neurology and psychiatry; blocking or modulating specific enzymes, receptors or physiological processes (13). The therapeutic function of inhibitors varies according to their class and target of

action.

Angiotensin-converting enzyme (ACE) inhibitors are widely used in the treatment of arterial hypertension and heart failure, blocking the enzyme responsible for converting angiotensin I into angiotensin II, a potent vasoconstrictor (9). Some inhibitors may affect laboratory parameters such as liver enzyme levels, blood glucose and electrolytes. Table 10 presents relevant information about inhibitors and various drug interactions, such as adverse effects and affected exams.

DIURETICS

Diuretics are used to treat conditions such as high blood pressure, heart failure, and edema; The therapeutic function is to promote the elimination of fluids and salts from the body, which helps to control blood pressure and reduce the accumulation of fluids in tissues (13).

However, it is important to be aware of the possible effects of diuretics on laboratory test results. Thus, these drugs can affect the values of some parameters, such as electrolytes, kidney function and glucose levels. Diuretics also increase potassium excretion can lead to hypokalemia, while those that retain potassium can cause hyperkalemia (9). Table 11 summarizes information about these drugs.

REDUCERS

Reducers are drugs that control high levels of substances in the body, such as cholesterol or triglycerides (13). The use of these reducers may affect the results of certain laboratory parameters, such as levels of total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides. The use of these drugs can result in a reduction in total and LDL cholesterol levels, indicating the effectiveness of the treatment.

Test results can be misinterpreted, leading to an incorrect assessment of lipid control and the possibility of inappropriate adjustments in therapy (9). In table 12 several functions and effects are presented on the reducers.

ANTIFUNGAL

Antifungals control fungal infections by fighting the proliferation of pathogenic fungi in the body. Its therapeutic function is to eliminate or inhibit the growth of fungi, allowing the patient to recover (13). Proper use of antifungals is essential for successful treatment and eradication of fungal infection. Table 13 summarizes up-to-date antifungal information.

ANTI-ALLERGIC

Antiallergic relieve the symptoms of allergic reactions, their therapeutic function is to block or reduce the effects of substances responsible for allergic reactions, such as histamine, reducing symptoms such as itching, sneezing, runny nose and redness (13). These drugs can interfere with the results of certain laboratory parameters, such as immunoglobulin levels and inflammatory markers. Table 14 summarizes up-to-date information on antiallergics and their effects on treatments, as well as affected exams.

GLUCOSE CONTROL

Insulin controls blood glucose levels and in the treatment of diabetes, the therapy has to regulate the amount of sugar present in the bloodstream, allowing better control of the disease and preventing long-term complications (13). However, blood glucose control medications can impact certain laboratory parameters such as glycated hemoglobin (HbA1c) and fasting glucose levels.

Use information allows for proper interpretation of results and accurate monitoring of treatment efficacy, helping to

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Enalapril	Angiotensin converting enzyme inhibitor	Cough, Hypotension, Hyperkalemia	It may interfere with the measurement of serum creatinine, indicating a false decrease in values	creatinine dosage
Omeprazol	proton pump inhibitor	Headache, diarrhea, nausea, vomiting	It may increase gastrin and chromogranin A levels	Gastrin, chromogranin A
Ranitidina	proton pump inhibitor	Headache, diarrhea, mental confusion	It may cause false positives in free plasma metanephrine and urinary catecholamine tests	Testing for free plasma metanephrine and urinary catecholamines

Table 10: Inhibitors.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Spironolactone	Diuretic, Aldosterone Antagonist	Hyperkalemia, Gynecomastia, Amenorrhea	It may interfere with the dosage of luteinizing hormone, indicating a false decrease in values.	Luteinizing hormone dosage
Furosemide	Loop Diuretic	Hypotension, dehydration, hypokalemia, ototoxicity	Inhibition of ion reabsorption in the renal tubule	Serum levels of electrolytes (sodium, potassium, calcium, magnesium)
Hydrochloro-thiazide	Diuretic	Hypokalemia, hyponatremia, hypomagnesemia, hyperuricemia, hyperkalemia, hypercalcemia, hyperglycemia, increased creatinine and uric acid, vertigo, headache, nausea, vomiting, constipation, skin rash, sexual impotence	It may decrease renal excretion of potassium and magnesium, increasing their serum concentrations; may increase renal excretion of calcium and decrease uric acid	Blood glucose, creatinine, uric acid, potassium, magnesium, calcium, urine (proteins and sugars)

Table 11: Diuretics.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Statins (Atorvastatin, Rosuvastatin, Simvastatin)	cholesterol reducer	Myalgia, weakness, rhabdomyolysis, hepatotoxicity	Cytochrome P450 enzyme inhibition	Serum levels of creatine kinase (CK)
Fenofibrate	Triglyceride reducer	Abdominal pain, nausea, vomiting, cholecystitis, pancreatitis	Cytochrome P450 Enzyme Induction	Serum levels of creatine kinase (CK)

Table 12: Reducers.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Fluconazole	Antifungal	Nausea, diarrhea, abdominal pain, hepatotoxicity	Cytochrome P450 enzyme inhibition	Serum levels of theophylline, carbamazepine, digoxin, among others
Amfotericina B	antifungal	Nephrotoxicity, fever, chills, anemia	Interacts with fungal membrane sterols	Kidney function, electrolytes, liver function
Itraconazol	antifungal	Nausea, vomiting, abdominal pain, hepatotoxicity	Inhibits ergosterol synthesis in the fungal cell wall	Liver function

Table 13: Antifungal.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Hydroxyzine	Antiallergic and anxiolytic	Drowsiness, dry mouth, dizziness, headache	It may cause false positives for methamphetamine in urine tests	Urine drug tests
loratadine	Antiallergic	Drowsiness, dry mouth, headache	It may interfere with skin allergy tests	skin allergy tests

Table 14: Antiallergic.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Insulin	Glycemic control in diabetes mellitus	Hypoglycemia, weight gain, allergic reactions	It may interfere with blood glucose and fructosamine tests	Blood glucose and fructosamine tests
Metformin	Glycemic control in diabetes mellitus	Diarrhea, nausea, vomiting, hypoglycemia	It may interfere with serum creatinine tests	Serum creatinine tests

Table 15: Glycemic control.

Medication	therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Prednisone	Corticosteroid	Weight gain, acne, emotional changes	It may lower potassium and calcium levels	Potassium, calcium
Prednisolone	Corticosteroid	Weight gain, acne, emotional changes	It may lower potassium and calcium levels	Potassium, calcium

Table 16: Corticosteroids.

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Tenofovir	Antiviral	Headache, diarrhea, nausea	It may increase creatinine levels	Creatinine level
Oseltamivir	Antiviral for influenza	Nausea, vomiting, headache, dizziness	Inhibition of viral neuraminidase	Liver function, kidney function
Aciclovir	Antiviral for herpes	Nausea, vomiting, diarrhea, headache	Inhibition of viral replication by incorporation into viral DNA	kidney function

Table 17: Antiviral

Medication	Therapeutic function	Adverse effects	Exam-changing mechanism of action	Affected exams
Metronidazole	antimicrobial	Nausea, vomiting, diarrhea, metallic taste in the mouth	It may interfere with blood glucose measurement	blood glucose
Ciprofloxacin	antimicrobial	Nausea, diarrhea, abdominal pain, allergic reactions	Inhibition of bacterial DNA gyrase	Liver function tests, electrolytes
Clindamycin	antimicrobial	Diarrhoea, nausea, skin rashes, allergic reactions	Inhibition of bacterial protein synthesis	Complete blood count, liver function

Table 18: Antimicrobial.

adjust therapy as necessary to ensure effective diabetes control (15). Table 15 presents updated and accurate information on the interference of these drugs in laboratory tests.

CORTICOSTEROIDS

Corticosteroids have anti-inflammatory and immunosuppressive properties, playing a crucial role in the treatment of various inflammatory and immunological conditions, are able to reduce inflammation, control allergic reactions and modulate the body's immune response (13).

Its therapeutic function, according to MELLO et al. (15), is directly related to its ability to inhibit the production of inflammatory substances, such as prostaglandins and cytokines, in addition to suppressing the activity of the immune system. This provides symptom relief in conditions such as asthma, arthritis, autoimmune diseases and dermatitis.

However, corticosteroids can affect the results of certain laboratory parameters, such as blood cell counts, glucose and electrolyte levels, and markers of liver function (9). In table 16 the corticosteroids are presented.

ANTIVIRAL

Antivirals play a crucial role in treating a variety of viral infections such as the flu, herpes, hepatitis C and HIV. These drugs have the therapeutic function of inhibiting the replication of the virus, reducing its viral load in the body and controlling the progression of the disease (13). By sharing all the details about using antivirals, the patient and doctor can work together to achieve the best results in treating the viral infection. Table 17 summarizes and updates several antiviral drugs and their adverse effects and affected exams.

ANTIMICROBIALS

Antimicrobials fight infections caused by microorganisms such as bacteria, viruses, fungi, and parasites (13). These drugs can affect the results of certain laboratory parameters, such as blood cell counts, inflammatory markers and specific tests for the detection of microorganisms (8). Table 18 presents several antimicrobials and their drug reactions.

CONCLUSION

The analysis of drug interactions and their consequences in laboratory tests is extremely important to ensure a safe clinical practice and the correct interpretation of laboratory results. Awareness of these interactions and the development of appropriate strategies are essential to minimize risks to patients and promote the quality of medical care. Thus, this work presented several information based on the literature to be used as strategies to minimize the effects of drug interactions in laboratory tests. A careful review of the lists of medications used by patients stands out in this work, and with this, to allow effective communication between health professionals and laboratory technicians. The information presented allows health professionals to always be up to date with the information provided by drug manufacturers and seek expert guidance in case of doubts.

THANKS

The authors thank `` Centro Universitário das Faculdades Integradas de Ourinhos`` (Unifio), Ourinhos, SP, Brazil.

REFERENCES

1. Barros ER de, Vasconcelos EEC, Carvalho D da S, Torres AE de A, Santos MCS dos, Ferreira J erson AG, et al. A IMPORTÂNCIA DOS EXAMES LABORATORIAIS PARA A SAÚDE. In: Barbosa ayse de F, editor. DEBATES INTERDISCIPLINARES EM SAÚDE [Internet]. 3rd ed. João Pessoa - PB: Editora Acadêmica Periodicojs; 2023. p. 14–24. Available from: https://periodicojs.com.br/index.php/easn/issue/view/127/71

2. Souza AS, Santiago EC, Almeida LC de. INTERFERÊNCIAS NOS EXAMES LABORATORIAIS CAUSADOS PELOS ANTI-HIPERTENSIVOS USADOS NO BRASIL. Rev Eletrôn Atualiza Saúde [Internet]. 2016;3(3):101–13. Available from: http://atualizarevista.com.br/wp-content/uploads/2016/01/Interferências-nos-exames-laboratoriais-causados-pelos-anti-hipertensivos-usados-no-Brasil-v-3-n-3.pdf

3. Yao H, Rayburn ER, Shi Q, Gao L, Hu W, Li H. FDA-approved drugs that interfere with laboratory tests: A systematic search of US drug labels. Crit Rev Clin Lab Sci. 2017;54(1):1–17.

4. de Cordova CMM, Nogara MS, de Cordova MM. Interference on the laboratory measurement of bilirubin: The effect of in vitro interactions. Clin Chim Acta [Internet]. 2009 Sep;407(1–2):77–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0009898109003507

5. Santos SLF dos, Borges RN, Barros KBNT. Drugs that interfere with the results of laboratory tests: an integrative review of the literature. Rev Bras Análises Clínicas [Internet]. 2018;50(2):105–10. Available from: http://www.gnresearch.org/doi/10.21877/2448-3877.201800581

6. Oliveira TS de, Bandeira DM, Batista E, Menezes P. Interferências do gel separador em análises bioquímicas e possíveis soluções: uma revisão bibliográfica. Rev Bras Análises Clínicas [Internet]. 2021;53(4):368–74. Available from: http://www.rbac.org.br/artigos/interferencias-do-gel-separador-em-analises-bioquimicas-e-possiveis-solucoes-uma-revisao-bibliografica/

7. Da Costa VG, Moreli ML. Principais parâmetros biológicos avaliados em erros na fase pré-Analítica de laboratórios clínicos: Revisão sistemática. J Bras Patol e Med Lab. 2012;48(3):163–8.

8. Rapkiewicz JC, Zaros KJB, Grobe R. Interação de fármacos com exames de laboratório. Informativo CIM/CRF-PR [Internet]. 2018;1–10. Available from: https://www.crf-pr.org.br/uploads/revista/35428/BFtOSB44cJW25q_WSqPV8rq3vZJ_1Y2_.pdf

9. Silva RS, Domingueti CP, Tinoco MS, Veloso JC, Pereira ML, Baldoni AO, et al. Interference of medicines in laboratory exams. J Bras Patol e Med Lab [Internet]. 2021;57:1–15. Available from: http://www.gnresearch.org/doi/10.5935/1676-2444.20210014

10. Consultas - Agência Nacional de Vigilância Sanitária - Ácido acetilsalicílico [Internet]. [cited 2023 Jun 20]. Available from: https://consultas.anvisa.gov.br/#/medicamentos/25351460828201982/

11. Consultas - Agência Nacional de Vigilância Sanitária - DIPIRONA [Internet]. [cited 2023 Jun 21]. Available from: https://consultas.anvisa.gov.br/#/medicamentos/25351644140202178/

12. Duarte LTD, Fernandes M do CCB, Fernandes MJ, Saraiva RÂ. Analgesia peridural contínua: análise da eficácia, efeitos adversos e fatores de risco para ocorrência de complicações. Rev Bras Anestesiol. 2004;54(3):371–90.

13. ProDoctor Software S/A. ProDoctor Medicamentos: Bulas [Internet]. 2023. Available from: https://prodoctor.net/medicamentos

14. Yamagishi JA, Alves TP, Geron VLMG, Lima RRO. Anemia ferropriva: diagnóstico e tratamento. Rev Científica da Fac Educ e Meio Ambient. 2017;8:99–110.

15. Mello PA, Rocha BG, Oliveira WN, Mendonça TS, Domingueti CP. Interferência in vivo e in vitro de medicamentos na avaliação da glicemia: uma revisão da literatura. Rev Bras Análises Clínicas [Internet]. 2022;54(2):111–8. Available from: https://www.rbac.org.br/artigos/interferencia-in-vivo-e-in-vitro-de-medicamentos-na-avaliacao-da-glicemia-uma-revisao-da-literatura/

16. Moreno RA, Moreno DH, Soares MB de M. Psicofarmacologia de antidepressivos. Rev Bras Psiquiatr [Internet]. 1999 May;21(suppl 1):24–40. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-44461999000500006&lng=pt&tlng=pt

17. Teixeira PJR, Rocha FL. Efeitos adversos metabólicos de antipsicóticos e estabilizadores de humor. Rev Psiquiatr do Rio Gd do Sul [Internet]. 2006 Aug;28(2):186–96. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-81082006000200011&lng=pt&tlng=pt

18. Aquino E dos S, Neto IF da S, Mendes R de C. OS EFEITOS ADVERSOS DA TERAPIA ANTIRRETROVIRAL EM PACIENTES COM HIV/AIDS: UMA REVISÃO INTEGRATIVA THE. Rev Ciência Cena. 2022;1(15):1–12.