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Monitoring Arrhythmia and ECG Changes Due to Drugs in ICU Patients

Ms. Bombale Prachi Dattatraya[1], Mr. Pawal Rohit Vijay[2], Mr. Kharat Ashok Siddheshwar[3], Dr. Trupti Tuse[4], Dr. Shital Dhawane[5]

Doctor of Pharmacy, Abhinav Education Society, Collage of Pharmacy, Haveli Pune, India[1,2,3,4]

Sahyadri Multi-Speciality Hospital, Pune, India[5]

Abstract: *Identify and analyze ECG changes associated with the use of multiple drugs, such as QT interval prolongation, ST-segment deviations, and other cardiac conduction abnormalities. Arrhythmia Assessment: Systematically monitor and record the occurrence of various arrhythmia, including atrial fibrillation, ventricular tachycardia, and bradycardia, among ICU patients receiving multiple medications. Investigate the correlation between the number and types of medications administered to ICU patients with the ecg changes occurring. Examine patient-specific risk factors, including age, comorbidities, electrolyte imbalances, and concomitant drug interactions, that contribute to drug-induced arrhythmia and ECG alterations. Assess the severity of ECG changes and consequences on length of ICU stays. A prospective observational study was carried out in the inpatient in ICU department of a tertiary care hospital. Total 200 patients were studied over a period of 6 months for monitoring arrhythmia and ECG changes due to drugs. ADRs were assessed using WHO causality scale and Hartwig severity scale.*

Keywords: ECG

I. INTRODUCTION

Monitoring the heart in seriously sick patients is more important in intensive care. This is because the medicines they get can really affect how their heart works and ICU patients have really complicated medical problems as well as they are at high risk. As ICU, patients often need to take different medicines at the same time to deal with their complicated health problems. This can cause big changes in their heart's electrical activity and can make their heartbeat irregular. The heart problems in the ICU happen because of how medicines interact, taking in consideration about polypharmacy effect as well as disease of each patient, and how sick they are. It is really important to understand these changes so we can give the best treatment, make patients better, and stop DDI and arrhythmia induced disorders.

Arrhythmia means the heart beats in an unusual way. The usual way is called normal sinus rhythm. In this rhythm, a signal starts in the sinoatrial (SA) node, travels through, and slows down a bit in the atrioventricular (AV) node. Antiarrhythmics are medicines that help control abnormal heartbeats. They work by either stopping extra electrical signals in the heart or slowing down fast ones. These medications are important for managing symptoms and preventing serious heart problems. The antiarrhythmics drug like amiodarone, lidocaine, procainamide, quinidine, metoprolol, telmisartan, propranolol and other antiemetic drugs like ondansetron, antibiotics like ceftriaxone, cefuroxime, doxycycline etc are given.

A less serious type of heart rhythm problem is called a premature ventricular contraction (PVC). This means the heart's lower chambers contract too early, not following the regular heartbeat pattern. Patients having heart disease or a past with ventricular tachycardia, then PVCs can lead to a more serious heart rhythm problem and they can also be triggered by caffeine found in coffee, tea, sodas, and chocolate as well as Certain over-the-counter (OTC) cough and cold medications.

Supraventricular Arrhythmias

Supraventricular arrhythmias start in areas above the lower chambers of the heart, like the upper chambers (atria) or the pathways in the atria. These are usually less serious than ventricular arrhythmias. Sometimes, majorly they do not need any treatment. Just like PVCs, atrial arrhythmias can occur due to various factors like smoking, drinking alcohol,

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consuming caffeine, or taking cough and cold medications. They can also be caused by conditions like rheumatic heart disease or an overactive thyroid gland.

Atrial fibrillation

Atrial fibrillation is when your heart beats fast and irregularly because tiny muscle fibres get twitch in heart which causes strokes in elder people. Patient with atrial fibrillation, where blood gets gather in the top chambers of heart, forming clumps called blood clots. If one of these clots travels to brain and blocks a small artery which leads to stroke.

Wolff-Parkinson-White (WPW)

Wolff-Parkinson-White (WPW) syndrome happens because there are extra pathways in the heart between the top and bottom chambers. These pathways make electrical signals get to the bottom chambers too quickly and then bounce back to the top chamber. This makes the heart beat really fast. People with WPW might feel dizzy, and can feel heart fluttering in their chest, or faint sometimes.

Paroxysmal supraventricular tachycardia (PSVT)

Paroxysmal supraventricular tachycardia (PSVT) which causes heart beat fasting. Atrial flutter occurs when the top chambers of the heart beat really fast, which makes the bottom chambers beat in a less efficient way. Premature atrial contractions (PACs), also known as "premature atrial contractions", occur when the top chambers of the heart contract too early, causing the heart to beat in the irregular pathway.

Heart block

Heart block happens when the SA node sends its electrical signal correctly, but that signal doesn't travel through the atrioventricular (AV) node or lower pathways as fast as it should. This usually occurs because of aging or because the heart's arteries get narrowed or damaged from coronary artery disease.

Cardiac Amyloidosis

Cardiac Amyloidosis is caused when protein deposits replace normal heart muscle.

II. METHODOLOGY

Study site- Sahyadri Super Specialty Hospital, Nagar Road Pune.
Study design- Prospective Observational Study
Study duration- 6 months Number of subject- Approximately 200
Study criteria :-

Inclusion

ICU patients being monitored with ECG.
Patients with minimum ICU stay of 24h.

Exclusion

Non-ICU patient.
Patients without ECG monitoring during their ICU stay.
Patients with missing or incomplete ECG data.
Patients with on ICU stay of less than 24 hours.
Patients who are pregnant and paediatrics.

Result

The study was done in 200 inpatients of medicine department in a tertiary care hospital. Out of 200 patients, 136 were males and 64 were females

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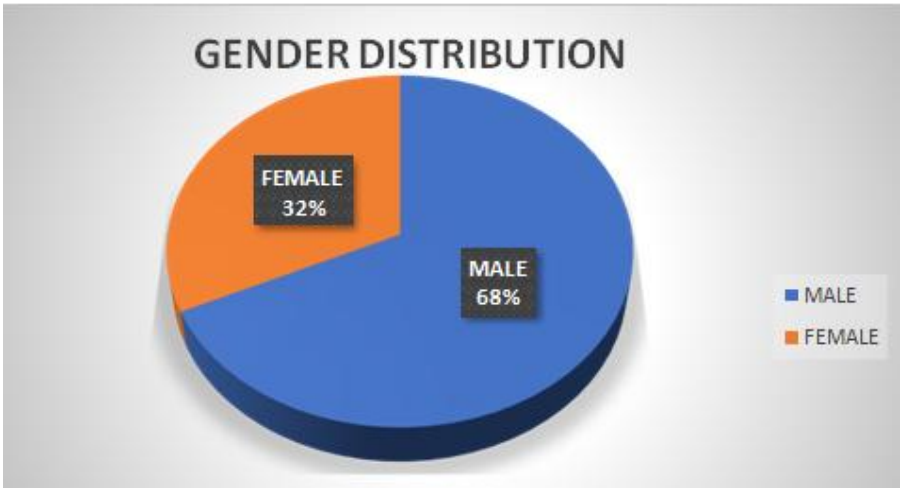
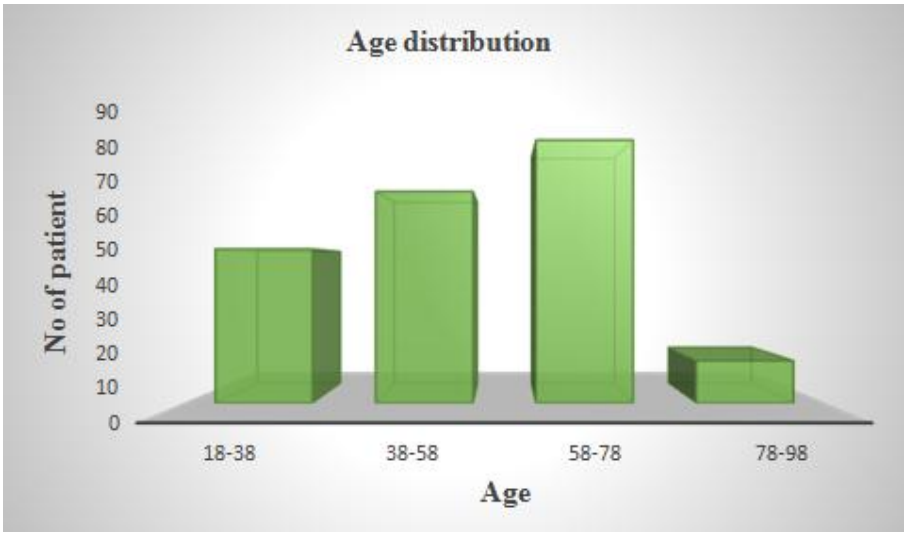


Age distribution of patients revealed that maximum patients that is 87 belong to the age group of 58-78 years (43.50%) followed by 70 in age group of 38-58 years (35%), 51 in18-38 (20.50%), 14 in 78-98 years (7%). The average age of patient was 55.69 years ±17.52.



The patients were diagnosed with different type of diseases as Acute Coronary Syndrome ,Anterior Wall Myocardial Infraction ,Lower Respiratory Tract Infection ,Thromboembolism ,pancreatic, Myocardial Infraction ,Coronary Heart Diseases ,Supraventricular Tachycardia, Congenital Heart Block etc. With reference to age distribution 58 to 78 age people showed shortening of QRS complex with sinus tachycardia, patient age between 18 to 38 showed sinus tachycardia, 38 to 58 age category people showed ST segment depression and T wave abnormality and the last age category 78 to 98 showed ECG changes prominent in bradycardia with prolonged QT interval.

Through this study we came to know that the cases emerging with the risk factors of diabetes were 44 (22%) and with hypertension were 49 (24.50%).the patient were diagnosed with different types of diseases which were related to arrythmia like ACS with 33 (15.5%), patients AWMI with 19 (9.55%),LRT with 12 (6%), AGE with AKI were 10 (5%), CHB with 8 (4%) ,pulmonary embolism with 4 (2%),SVT with 1 (0.5%), IWMI with 1 (0.5%).The most cases were of ACS and least were of AF, the distribution of abnormal condition is shown below.

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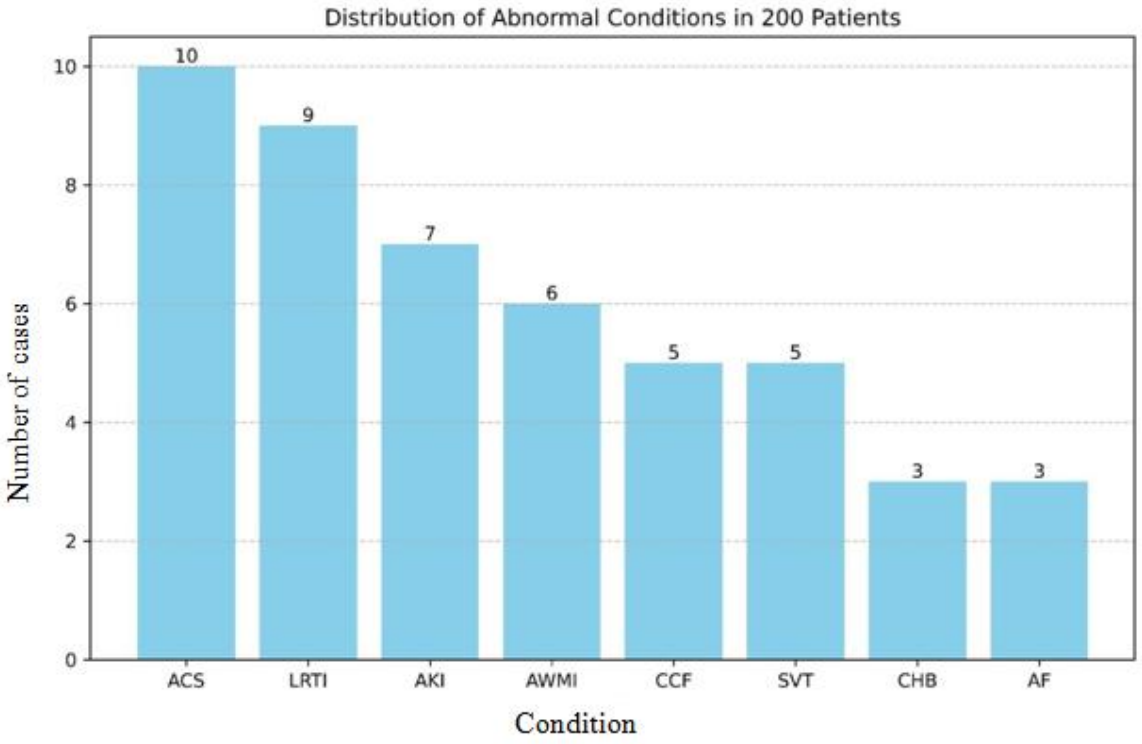
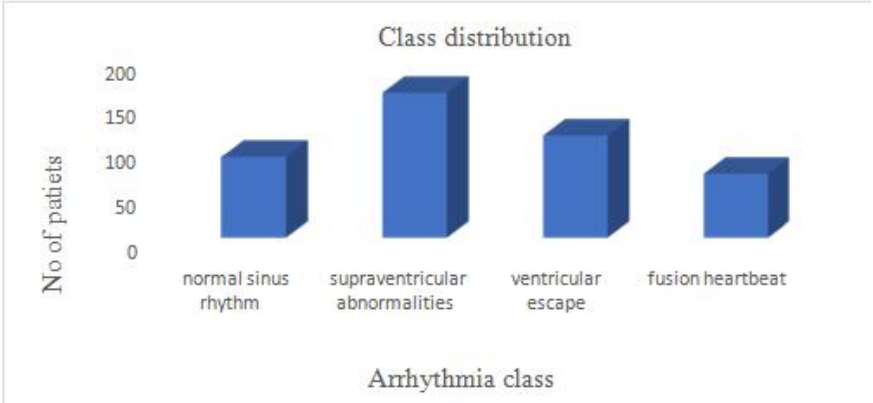


The ECG of the patients are as following: -

The abnormal patients ECG were 48, and the normal patients ECG were 152, this result is out of 200 patients. The abnormalities were based on the ECG findings. The abnormal values including patient number are as follows.

ECG complex	No of patient (abnormal value)
QRS	36
Qt/Qtcbz	30
PR	26
RR	28
P/QRS/T	82

The patient were categorized according to arrythmia class of ECG where normal sinus rhythm was seen in 45.50% patients, supraventricular abnormalities which were commonly seen in 81.50% patients, whereas ventricular escape were seen in 57.50% patients and fusion heartbeat were seen in 36% patients



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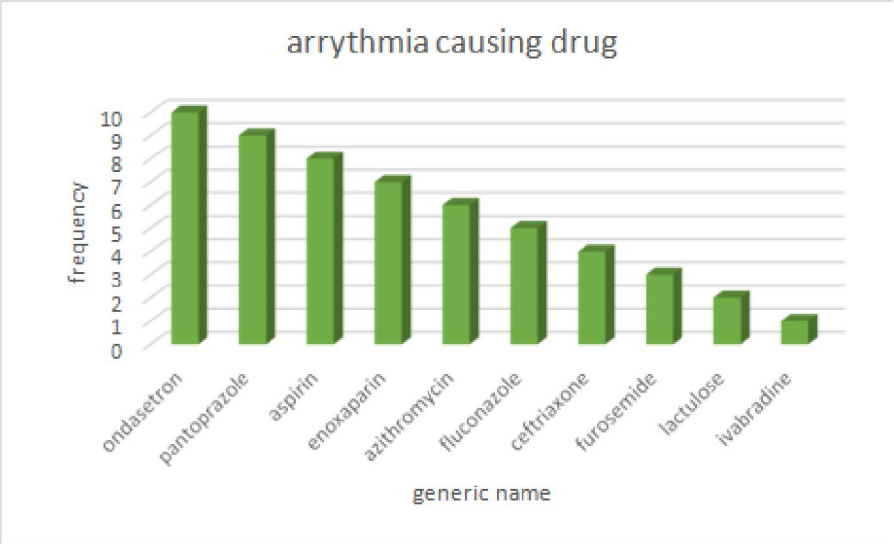
Many drugs were induced in the patient to give the optimum therapeutic efficacy to the patient where antiarrythmatic drugs, antiemetic drugs, antibiotic drugs etc were given



In 48 abnormal cases the drugs which can make ECG changes are as follows. The more highly number of patient and high percentage were found commonly in enoxaparin, carbapenem, torsemide, amlodipine, norepinephrine, acetyl cysteine and least were found in carvedilol and febuxostat.

Name of drug	No of patients	Percentage
Enoxaparin	33	69.55%
Carbapenem	27	56.25%
Torsemide	25	52.08%
Amlodipine	22	71.53%
Norepinephrine	21	44.55%
Alprazolam	17	35.41%
Oseltamivir	14	29.26%
Diclofenac	13	27.08%
Caffeine	11	23.51%
Sildenafil	7	14.28%
Potassium chloride	6	12.50%
Febuxostat	2	4.16%

The study revealed the common drugs given were ondansetron, pantoprazole, aspirin, enoxaparin etc among which the ondansetron given as IV, use as antiemetic to reduce emesis caused by drugs, therapy as well as by disease. Ondansetron showed the maximum DDI with other drug as well as its own self causing increase in QTc interval, QT wave prolongation, CHF and Bradyarrthymias.

In the study we came to know that there were various DDI among the induced drug to the patient and the below table shows the DDI and consequences with patient's numbers.

Consequences of DDIs	Name of Interacting Drugs	No
Non-Q-wave MI, STEMI, unstable angina	Enoxaparin and aspirin	42
Increases QTc interval, prolong QT interval, CHF, Bradyarrthymias.	Azithromycin and ondansetron	25
	Ranolazine and ondansetron	6
	amiodarone and ondansetron	4
	Fluconazole and ondansetron	3

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	Escitalopram and ondansetron	1
Increases QTc interval	Amiodarone and fluconazole	3
	Escitalopram and ranolazine	1
	fluconazole and levosalbutamol	1
Congential long QT syndrome	metronidazole and ondanseteron	3
Increase blood pressure and tachycardia	Norepinephrine and midodrine	1
Bradycardia increases	Ivabradine and carvedilol	1
Ventricular arrthymias associated with QT prolongation, torsade de pointes, sudden death	azithromycin and metronidazole	1

The causality assessment was done and study showed that 47 patients fall in possible with 23.50% and 1 patient in unlikely with 0.50%. After applying Hartwig severity scale to access the severity of the ADRs and showed 52.50% , where the 105(52.50%) had DDI and 95(47.50%)people with no interaction. The average hospital stay of patient were 6.22 days±5.5

The Hartwig severity scale used to assess the severity of the ADRs and the 200-patient showed that 105 ADRs were mild in nature (52.50%) without any severe ADRs.

III. DISCUSSION

Our study conducted a comprehensive assessment of adverse drug reactions (ADRs) in a cohort of 200 patients, utilizing both causality assessment and the Hartwig severity scale. The results revealed a significant proportion of patients experiencing ADRs, with 47 individuals (23.50%) categorized as having possible ADRs and 1 patient (0.50%) deemed unlikely to have an ADR. When assessing the severity of ADRs using the Hartwig severity scale, we observed that 52.50% of patients experienced mild ADRs, with no cases of severe ADRs identified.Additionally, our study revealed a noteworthy finding regarding drug-drug interactions, with 105 patients (52.50%) experiencing such interactions. This proportion is higher than the 10.7% reported by Zeinab Hossein et al. In their study on arrhythmias caused by drug interactions. There are several potential reasons for the higher rate of ADR severity and drug interactions observed in our study.

IV. CONCLUSION

This study highlights the critical need for vigilant cardiac monitoring in ICU patients, particularly those receiving medications known to affect heart rhythms. By understanding and mitigating the risks of drug-induced arrhythmias, healthcare providers can improve patient outcomes and enhance the safety of pharmacotherapy in critically ill populations. The findings advocate for a multidisciplinary approach to patient care, integrating advanced monitoring techniques, personalized medicine, and comprehensive clinical education to address the complexities of drug-induced cardiac risks.

In summary, the research underscores the importance of a proactive and informed approach to managing arrhythmias in ICU settings, ultimately contributing to better patient care and reduced incidence of adverse cardiac events.

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