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ELECTROCARDIOGRAPHY FINDINGS IN BLUNT CHEST TRAUMA AT TERTIARY CARE HOSPITAL PESHAWAR

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ABSTRACT

Introduction: Blunt chest trauma is a significant cause of morbidity and mortality, often leading to a range of cardiac complications detectable through electrocardiogram (ECG) abnormalities. **Objectives*:*** The primary objective of this research was to identify the early onset of myocardial damage in patients with acute blunt chest injuries using ECG. The secondary objective is being to compare the ECG changes between paediatric and adult trauma patients. **Methodology*:*** This cross-sectional study was conducted in the Emergency department (ED) and patients admitted with acute blunt chest trauma were included in the current study. A total of 281 patients were included based on the following inclusion criteria: patients of all ages with blunt chest trauma. Exclusion criteria included preexisting cardiac and neurological conditions, penetrating chest injuries, pregnant women and incomplete medical records. Demographic and clinical data were collected, and a standard 12-lead ECG was performed and analyzed for abnormalities. Statistical analysis was done using SPSS version 26, where chi square test was applied to identify factors that may be associated with ECG abnormalities and assess age-related differences in ECG findings. **Results:** ECG findings in patients with blunt chest trauma, recorded in 30.9% of the total sample. Sinus arrhythmia's,

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particularly sinus tachycardia were the most common findings in both adults (6.2%) and pediatrics (8.1%). In adult's sinus tachycardia was followed by ST segment changes and atrial fibrillation. In pediatrics, sinus tachycardia was accompanied by PVCs and supraventricluar tachycardia. **Conclusion:** Sinus arrhythmias were the most common findings in both group, followed by ST segment changes and atrial fibrillation in adults while in pediatrics, followed by PVCs and SVT.

Key Words: Chest trauma, blunt chest trauma, ECG findings, arrhythmia, chest blow.

INTRODUCTION

Trauma is mainly divided into blunt and penetrating trauma, blunt chest trauma are those in which a force is propelled onto the chest wall and they don't leave any open wound while penetrating trauma when an object penetrate the skin and underlying tissue, leaving a open wound. Motor vehicle accident represent up to 90% of all blunt chest trauma, falls, crush injuries, violence and sports injuries can be other possible causes of blunt chest trauma (1). Each year 5.8 million deaths occurs as a result of traumatic injuries accounting for ten percent of world's deaths (2). low income countries like Pakistan bear 90% of traumatic injury burden, making injuries top ten contributor of motility and morbidity. Highest death rates from injuries likes RTAs are seen in the eastern Mediterranean region of world health organization (WHO) which also includes Pakistan, while according the most recent report of PDS (Pakistan Health and Demographic Survey) trauma causes forty-two deaths per one lac population majorly involve young populations. (3)

Chest trauma is account for twenty-five percent of the traumatic fatalities while blunt chest trauma represents more than fifteen percent of emergency department admission around the globe (4,5).

Chest trauma can lead to various condition ranging from minor to life threatening like obstruction of the airway, Air accumulation in the pleural cavity (open & tension pneumothorax), blood accumulation in the pleural cavity (massive hemothorax), flail chest and

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pericardial tamponade (6). Myocardial injury and injury to the great blood vessels during non-penetrating chest trauma frequently result from the effect of external blunt force applied to the thoracic while some other recognized mechanisms such as indirect forces on lower limbs and the abdomen may also result in cardiac and great blood vessels damages, death may be the result as consequences of blunt cardiac injuries, which may occur at the scene of trauma immediately or may occur days after injury.

The cardiac involvement incidence in trauma has been reported to range from 6% to 76% and this may represent the most frequent most frequent unsuspected visceral injury that causes death in fatally injured accident victims. (7).

Frequently blunt force to chest lead to arrhythmias which are nonspecific, and range from sinus tachycardia and various degree of conduction blocks to ventricular fibrillation and asystole even with mild chest blow. It has been noted that usually innocent-appearing chest blows during various sports activities can lead to various types of dysrhythmias, even without causing damage to the ribs, sternum, or heart, and in the absence of any preexisting cardiovascular disease (8).

The diagnosis of blunt chest trauma is particularly challenging due to the wide range of clinical manifestations and potential injuries it can cause (4). Electrocardiography (ECG) has been the most widely used test for the diagnosis of injury of the heart (9). We aimed to identify the early onset of myocardial damage in patients with blunt chest trauma using ECG. And to compare ECG changes of paediatrics and adult traumatic patients with blunt chest trauma.

METHODOLOGY

This cross sectional study was conducted at tertiary care hospitals Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan (Khyber Teaching hospital) over a period of six months. A total Sample size of 281 was Calculated through OpenEpi (http://www.openepi.com), based on anticipated prevalence 24.6% of ECG findings at confidence level of 95%. All blunt chest trauma patients visiting to ER who fulfilled the inclusion criteria were included in the study and participants were selected using a convenient sampling technique. Inclusion criteria included all adults and pediatrics patients presented to Emergency department with blunt chest trauma. Demographic and clinical data were collected, and a standard 12-lead ECG was

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performed and analyzed for abnormalities. Pregnant women and patients with known cardiac and neurological diseases were excluded.

Statistical Analysis: Continuous variables, such as age, blood pressure, heart rate. spO_2 and respiratory rates were analyzed using means and standard deviations. Adults and pediatric findings of ECG in blunt trauma were assessed in cross tabulation with chi square test utilization for their categorical comparison and finding association among age groups and ECG findings at confidence level of 95% and alpha level of 0.05 where p value less than 0.05 was considered as a significant association between age group and the ECG findings with in them after blunt chest trauma. Descriptive statistics were also applied for all categorical variables including gender distribution, ECG Findings, age category (adults and Pediatrics) and cause of the trauma, and all the observed cases. Data analysis was conducted using SPSS version 26.

RESULTS

Out of 281 patients evaluated, 195 were adults (≥18 years) and 86 were pediatric patients (<18 years). The mean age recorded was 26.16 years with standard deviation of 12.51 years in total sample age distribution. while the mean age for adults was 32.6 ± 9.24 years, and the mean age for pediatric patients was 11.56 ± 3.12 years**. (**Figure I**)**

A total of 281 patients with blunt chest trauma visiting ER were included in the current study. Out of which n=198 (70.46%) were male and n=83 (29.53%) were female. The majority of the patients (43.4%) were admitted following road traffic accidents, while 29.8 were % falls injuries, 14 % motor vehicle accident, 8.9 % physical assault and 3.9 % experienced sport injuries. (Table I)

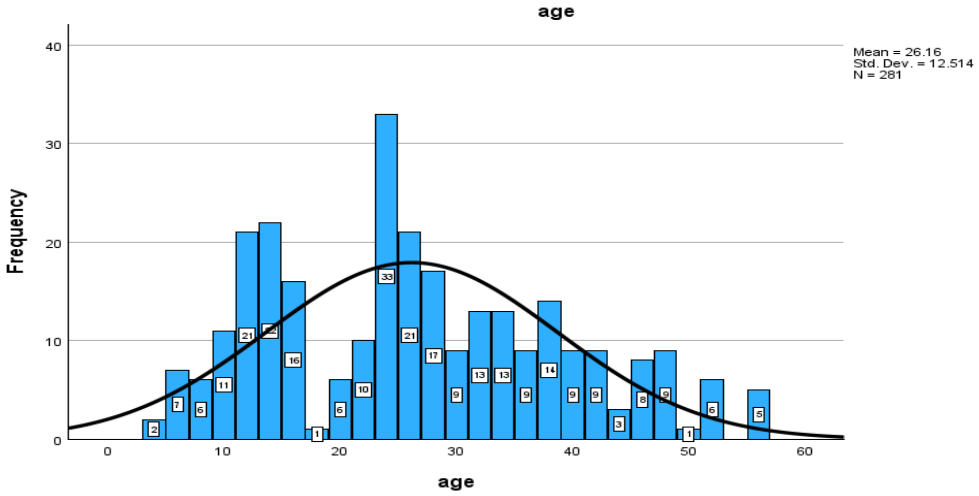

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Figure I: Age Distribution Normal Curve

Table I: causes of injuries to the study participant

Causes of Injury	No. of cases	Percentage (%)
Road traffic accident	122	43.4
Fall	84	29.9
Motor Vehicle Accident	41	14.6
Physical Assault	23	8.2
Sports Injury	11	3.9
Total	**281**	**100**

Vital signs were recorded for all 281 patients at the time of admission. A total of 208 patients had Oxygen saturation above 95%, accounts for 74.1%, 51 patients had 92-94.9%, which represents 18.15% and 22 patients had saturation below 92% (7.83%). 136 adults and 92 pediatrics patients had oxygen saturation above 95%. Oxygen saturation between 92-94.9% was recorded in 38 adults and 13 pediatrics patients. Below 92% was recorded in 21 adults and 1 pediatric patients.

A Chi square of age group against oxygen saturation in patients with blunt chest trauma results in a significant p-value of 0.01 ($\alpha = 0.05$, 95% CI), indicating a strong association. Notably, adults were more likely than pediatric patients to present with a marked drop in oxygen saturation at the ED.

Normal Respiratory rates were present in 175 patients, 118 were adults and 57 were pediatrics), tachypnea being the most common presenting sign in 66 patients, accounts for 23.4 % of all presenting respiratory vitals. Among 66 patients with tachypnea, 41 adults and 25 pediatric. Tachypnea was followed by dyspnea, noted in 26 patients, represents 9. 25%, 25 were adults and 1 was pediatric and bradypnea in 14 patient (4.98%), 11 were adults patient and 3 were

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pediatrics.

Chi-square analysis of age group versus respiratory rate in blunt chest trauma patients showed a significant association ($p = 0.01$, $\alpha = 0.05$, 95% CI). Adults exhibited greater respiratory rate changes than pediatric patients, indicating higher physiological impact on respiratory function. Normal heart rate was recorded in 179 patients, 119 were adults and 60 were pediatrics, heart rates between 100 to 120bpm was the most frequently recorded heart rate and were present in 59 patient, Among them 49 were adults and 10 pediatrics, HR between 121 to 140bpm in 9 patients, 5 adults and 4 pediatrics, 141 to 160bpm in 11, 9 adult and 2 pediatric , above 160bpm in 7 (7 adult) and heart rate below 60 were present in 16 (13 adult and 3 pediatric) (Figure II)

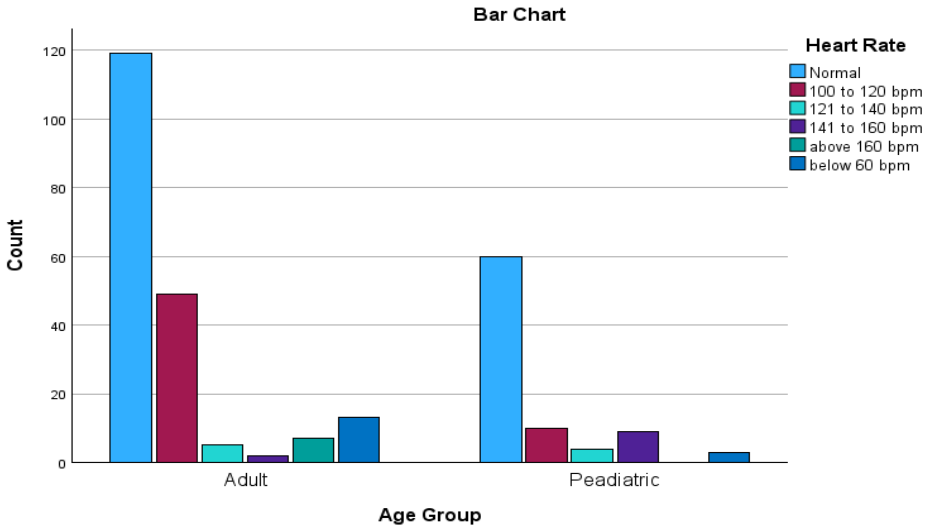

Figure II: age group x heart rate

A Chi-Square test revealed a significant association between heart rate changes and age groups in blunt chest trauma patients ($p < 0.001$). This indicates that heart rate changes are not evenly distributed across age groups. Adults showed a higher prevalence of tachycardia, while pediatric patients were more likely to present with normal heart rates or mild bradycardia.

210 patients with were presented with normal blood pressure, adult patients were 142 and pediatrics were 68. Elevated blood pressure was found in 43 patients, 31 were adult and 12 were pediatric and hypotension was recorded in 28 patients, 22 were adults and 6 were pediatrics.(Figure III)

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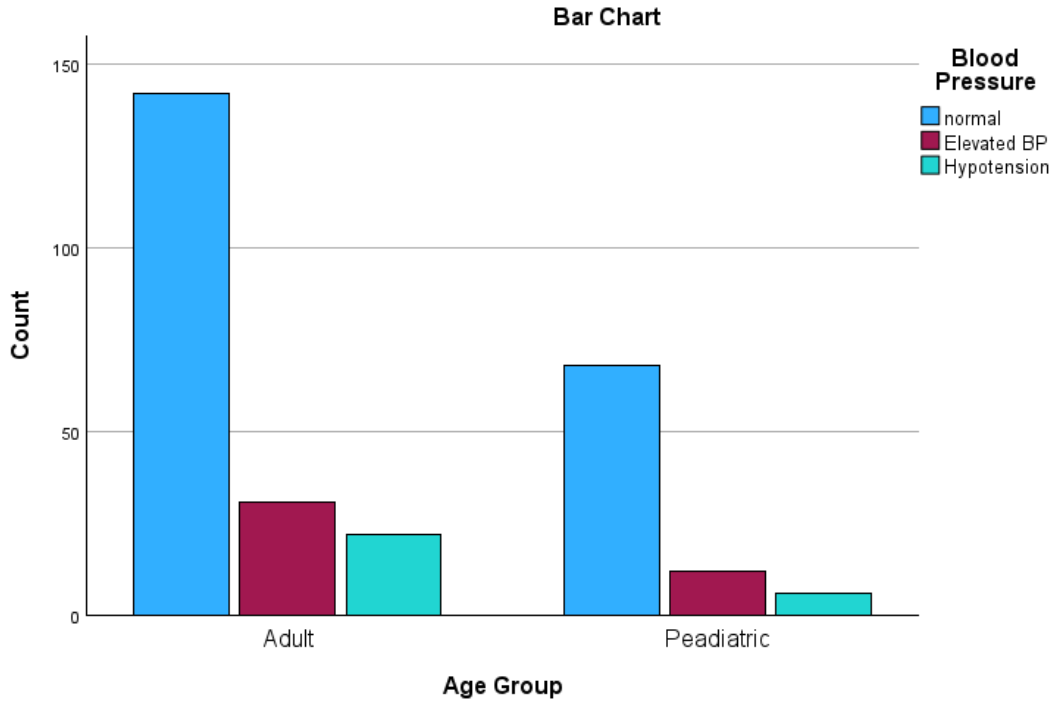

Figure III: Age group x Blood pressure

A Chi-Square test showed no significant association between age group and blood pressure changes in blunt chest trauma patients ($p = 0.456$, $\alpha = 0.05$, 95% CI).

Overall ECG Abnormalities.

Overall, ECG abnormalities were observed in 87 patients (30.9%), 64 were adult which account for 22.77% in total sample and approximates about 73.56% of total recorded abnormalities and 23 were pediatric patients which account for 8.18% in total sample and approximates about 26.43% of total recorded findings. The ECG findings was nonspecific ranging from sinus arrhythmia's, ST changes, conduction block, bundle branch block, to atrial and ventricular fibrillation.

Sinus arrhythmia's were most common finding and was observed in 34 cases (6.76% sinus tachycardia and 5.34% sinus bradycardia) followed by ST segment changes in 18 cases representing 6.40% of total sample and 20% of total recorded ECG findings, among ST segment changes (elevation) 77.7% ST Elevation presents with normal or no Q wave findings and 22.2% ST Elevation with Q wave abnormality, atrial fibrillation in 6 cases, Supraventricular tachycardia was also detected in 6 case and supraventricular tachycardia with

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premature ventricular contraction was present in 5 cases and only premature ventricular contractions in 5 cases, Right bundle branch block in 4 cases, Normal sinus rhythm with Premature ventricular contractions in 4 cases, left bundle branch block in 2 cases, Additionally ventricular fibrillation, ventricular tachycardia and T wave inversion were recorded in single case each. (Table I)

Common ECG Findings among both adults and pediatrics.

Sinus tachycardia was the most prevalent abnormality in both age groups as noted in 34 cases, In adults 12 patients were noted with sinus tachycardia, accounts for 6.2% (12/195), while sinus tachycardia in pediatrics were recorded in 7 cases, accounts 8.1% (7/86). (
Table ***III***)

Table II: Electrocardiography Finding (In Total sample)

Electrocardiography Findings in total sample		
Electrocardiography Findings	**Total**	
	No. of patients	**Percentage (%)**
Normal sinus rhythm	194	69.0%
Left Bundle Branch Block	2	0.7%
Atrial Fibrillation	6	2.1%
Ventricular Fibrillation	1	0.4%
Ventricular Tachycardia	1	0.4%
Sinus Bradycardia	15	5.3%
ST Elevation with normal Q Wave	14	5.0%
T wave inversion	1	0.4%
premature ventricular contractions	5	1.8%
Supraventricular tachycardia with premature ventricular contractions	5	1.8%
Supraventricular tachycardia	6	2.1%
Right Bundle Branch Block	4	1.4%

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Normal sinus rhythm with Premature ventricular contractions	4	1.4%
Sinus tachycardia	19	6.8%
ST Elevation with Q wave abnormality	4	1.4%
Total	**281**	**100.0%**

Table III: (Electrocardiography Findings in Age Groups)

Electrocardiography Findings * Age Group Crosstabulation				
ECG Findings	**Age Group**			
	Adult		**Peadiatric**	
	No. of cases	Percentage (%)	No. of cases	Percentage (%)
Normal Sinus rhythm	131	67.2	63	73.3
left Bundle Branch Block	1	0.5	1	1.2
Atrial Fibrillation	6	3.1	0	0.0
Ventricular Fibrillation	1	0.5	0	0.0
Ventricular Tachycardia	1	0.5	0	0.0
Sinus Bradycardia	12	6.2	3	3.5
ST Elevation with normal Q Wave	14	7.2	0	0.0
T wave inversion	1	0.5	0	0.0
premature ventricular contractions	1	0.5	4	4.7
Supraventricular tachycardia with premature ventricular contractions	2	1.0	3	3.5
Supraventricular tachycardia	3	1.5	3	3.5
Right Bundle Branch Block	3	1.5	1	1.2
Normal sinus rhythm with Premature ventricular contractions	3	1.5	1	1.2
Sinus tachycardia	12	6.2	7	8.1
ST Elevation with Q wave abnormality	4	2.1	0	0.0
Total	**195**	**100.0%**	**86**	**100.0%**

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Common ECG findings in adults.

In adults the most common abnormalities were Sinus Tachycardia and ST Elevation. ET Elevation were present in 18 adult cases, representing 9.2 % (18/195) ECG abnormalities in adult. Among ST elevations, ST elevation with normal Q waves were the most frequent, occurring in 14 cases, represented 77.7% (14/18) of ST segments elevation. and ST elevation with abnormal Q wave were present in 4 cases, accounts for 22.2% (4/18) of ST segment elevation. Atrial fibrillation was the third common finding in young adult, occurred in 6 cases (3.1%).

Common ECG findings in pediatrics.

In pediatrics sinus tachycardia was followed by high prevalence of premature ventricular contractions and supraventricular tachycardia and. PVCs in pediatrics were found in 4 patients contributing for 4.7% of pediatrics ECG abnormalities. While supraventricular tachycardia were detected in 3 patients represented for 3.5% of pediatrics ECG findings.(***Figure***)

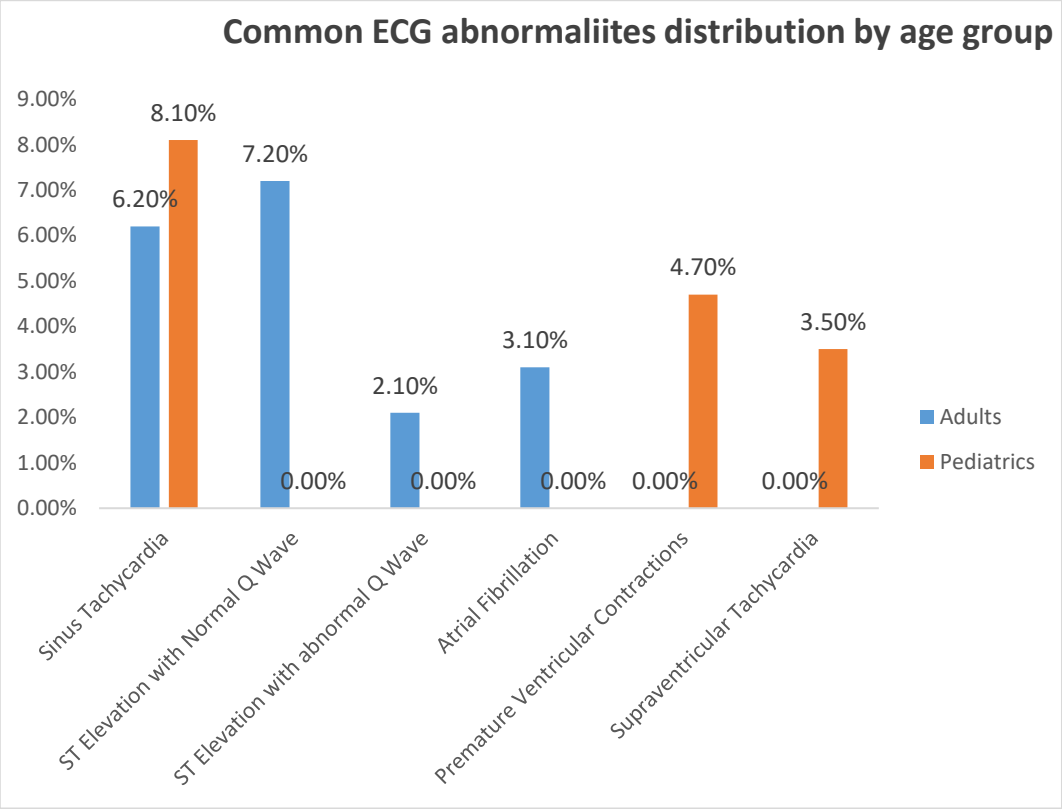

Figure IV: Common ECG abnormalities of the pediatrics and adult patients.

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The Chi-Square analysis was conducted to assess the association between age group and ECG findings, yielding mixed results. p valve is slightly above the the significance threshold (α=0.05), this suggesting that there is not much of a significant association between ECG finding and age group in blunt chest trauma as the ECG finding vary greatly in both age groups. (Table IV)

Table IV: Association between ECG findings and Age groups

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	22.683[a]	14	.066
Likelihood Ratio	29.703	14	.008
Linear-by-Linear Association	.000	1	.992
No. of Valid Cases	281		
a. 24 cells (80.0%) have expected count less than 5. The minimum expected count is .31.			

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DISCUSSION

Chest trauma causes a significant death, responsible for about twenty-five percent of the traumatic fatalities while 15% of emergency department admission worldwide are due to blunt chest trauma which may occur following road traffic accidents, vehicles collision, fall from height physical assault, sports injury. Among all these causes Motor vehicle accident represent upto 90% of all blunt chest trauma. Injury to a great blood vessels and heart in blunt chest trauma may be due to deceleration force mostly with anterior chest wall, putting heart and great blood vessels at a risk of developing variety of complication (10). Each year 5.8 million deaths occurs as a result of traumatic injuries accounting for ten percent of world's deaths, according to report there is trauma related death every 1.9 minutes in India (2) low income countries like Pakistan bear 90% of traumatic injury burden, making injuries top ten contributor of motility and morbidity.

This study found that most blunt chest trauma cases were due to road traffic accidents (43.4%), followed by falls (29.8%), motor vehicle accidents (14%), physical assaults (8.9%), and sports injuries (3.9%). On admission, 74% of patients had oxygen saturation >95%, while 23.4% experienced tachypnea and 28.1% tachycardia, the most common clinical manifestations. These findings align with prior studies, such as those by Pranav Chandrakant et al., reporting higher proportions of road traffic accidents (76%) and Salama et al., highlighting dyspnea, chest pain, and tachypnea as common presentations, though proportions vary.

Current study identified ECG findings in 87 patients (30.9%), with 64 adults, accounting for 22.77% of the total sample and approximately 73.56% of all recorded abnormalities. In comparison, 23 pediatric patients constituted 8.18% of the total sample and about 26.43% of all recorded findings. The ECG findings of this study was nonspecific and varied, including sinus arrhythmia's, ST segment changes, conduction blocks, bundle branch blocks, to atrial and ventricular fibrillation. In current study findings, Sinus arrhythmias were the most frequently observed abnormality, recorded in 34 cases, comprising 6.76% sinus tachycardia and 5.34% sinus bradycardia. This finding of the current study is supported by Gilles Orliague *et al*., highlighted that various complications could arise from blunt myocardial damage, with arrhythmias being the most common complication. Notably, the study emphasized that even minor blunt myocardial damage can result in arrhythmias (11). Nagy *et al*., also had the same

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findings, ST segment changes were noted in 8 individuals, followed by the arrhythmias in 6 individuals. the current study has more arrhythmia's because of more pediatric sample, pediatrics is more prone to developed arrhythmia's while adult to ST segment changes (12). According to the work of Ryaan EL-Andari *et al.*, arrhythmias with leading sinus tachycardia are the most common complication occurring in up to 70% of hospitalized patients secondary to blunt chest trauma (13).

In the current study sinus arrhythmia is followed by the ST segment changes (Elevation), noted in 18 patients, accounts for 6.40% of the total sample and 20% of the all ECG recorded findings. Among the ST segment changes, the majority (77.7%) patients exhibited ST elevation with normal or no Q wave findings, in contrast, 22.2% of the patients showed ST elevation with Q wave abnormality both cases indicate myocardial injury or infarction. All the patients with ST segments changes were adults. Ralph T. Potkin et al., studied 100 adult patient presented with blunt chest trauma, reported that the majority of the observed ECG findings in patients were non-specific, ST and T wave changes being the most common accounting for 58% of all abnormalities (14). These findings aligned with this study finding. The higher ST segment changes were because of mainly adults sample. One more study about ECG abnormalities in children with blunt chest trauma also highlights that chest trauma may result in temporary disruptions of heart electrical activity, which are typically reversible and don't lead to long term complication more specifically myocardial infarction, this supported the current study finding which is the extremely low prevalence of MI in pediatrics patients (15). Atrial fibrillation was observed in 6 cases, while supraventricular tachycardia was also detected in 6 cases. Additionally, supraventricular tachycardia with premature ventricular contractions was present in 5 cases, and isolated premature ventricular contractions were identified in another 5 cases. Different studies reported that atrial fibrillation and supraventricular tacycardia secondary to blunt chest trauma, Alkhamisi A *et al*. noted that a chest trauma can results in atrial fibrillation, particularly the onset of AF are directly linked with chest blow or force, which affects the cardiac muscle, or sudden vagal stimulation triggered by the trauma can results in AF (16). A study by Kyle and Andras bratincsak also reported atrial fibrillation after sport related blunt chest force in otherwise healthy individuals or without any preexisting cardiovascular disease (17). Both of these study supported the finding of current study. Other

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abnormalities that were found in the current study includes right bundle branch (RBBB) block in 4 cases, normal sinus rhythm with premature ventricular contractions in 4 cases, and left bundle branch block in 2 cases. Finally, ventricular fibrillation, ventricular tachycardia and T wave inversion were recorded in single case each. Gilles Orliaguet *et al*. conducted a study on the cardiac complications secondary to non-penetrating or blunt trauma chest trauma. The study was conducted on 134 patients who sustained non-penetrating trauma, with a particular focus on the impact of myocardial damage caused by blunt chest trauma. The most common conduction abnormalities observed were right bundle branch block (RBBB) and atrioventricular (AV) blocks. Same study also noted that ventricular tachycardia and ventricular fibrillation were rarely observed abnormalities in these patients (11). In the current study RBBB was also the most common noted conduction abnormalities findings, VT and VF were rarely occurred abnormalities. Nagy *et al.* also studied 315 patients with blunt chest trauma and found that the were only 8 patients experienced conduction abnormalities (12). In the current study we compared the ECG findings between adult and pediatrics, to find out the most common ECG findings in adult and pediatrics, we found that Sinus tachycardia was the most prevalent abnormality in both age groups as noted in 34 cases, in adults 12 patients were noted with sinus tachycardia, accounts for 6.2% (12/195) while sinus tachycardia in pediatrics were recorded in 7 cases, accounts 8.1% (7/86). Our findings align with those of Ryaan EL-Andari *et al.*, who reported that arrhythmias were common in patient with blunt chest trauma, sinus tachycardia are the most common complication occurring in up to 70% of hospitalized patients secondary to blunt chest trauma (13). In adults the most common abnormalities were ST Elevation and Sinus Tachycardia. ST Elevation were present in 18 adult cases, representing 9.2 % ECG abnormalities in adult. Among ST elevation, ST elevation with normal Q wave were the most frequent and was presents in 14 cases, represented 77.7% (14/18) of ST segments elevation. and ET elevation with abnormal Q wave were present in 4 cases, accounts for 22.2% (4/18) of ST segment elevation. These results are consistent with those reported by Ralph T. Potkin *et al.*, studied 100 patients presented with blunt chest trauma and found that the majority of the recorded ECG findings were non-specific. Notably, ST and T wave changes were the most common abnormalities, accounting for 58% of all findings (18). Pediatrics showed a higher prevalence of sinus tachycardia, premature ventricular contractions and supraventricular.

PVCs in pediatrics were found in 4 patients contributing for 4.7% of pediatrics ECG abnormalities. While supraventricular tachycardia was detected in 3 patients represented for 3.5% of pediatrics ECG findings. Our results corroborate the conclusions of Singh S *et al*., highlighted that blunt chest trauma can lead to BCI, encompassing a range of myocardial injuries from minor contusions to severe cardiac dysfunction. Arrhythmia's, including sinus tachycardia being the most common which may occur as part of the body response to such injuries (19). While Alemayehu and Hanna mentioned in their study that Premature ventricular contractions (PVCs) can occur in pediatric patients following blunt chest trauma are rare ranging from 0.3% to 4.6% which is align with the current study findings (20).

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