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"Relationship Of Platelet Distribution Width And White Blood Cell Count On Admission With St-Segment Resolution In Patients With St-Elevtion Myocardial Infarction Thrombolysed With Streptokinase"

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Abstract : *There is an alarming rise in the incidence and mortality of myocardial infarction. In the context of management of myocardial infarction there are few strategies and indicators to risk stratify patients. Taking the hypothesis that platelets produced during an acute thrombotic event is larger and aggressive we studied the relationship between platelet distribution width (which is a more specific marker of platelet size variation) and the success of thrombolysis in patients with STEMI treated with streptokinase as evidenced by ST segment resolution in ECG after thrombolysis (an ST segment resolution of more than 50% after 60 minutes of thrombolysis is taken as successful thrombolysis). We found that more the Platelet Distribution Width (cut off taken as 12.85) there is more chance of failed thrombolysis. We also studied the relationship between WBC count and ST segment resoulution in the same set of patients and found out that more the WBC count (cut off taken as 12,650 cells per microlitre) at presentation, more is the chance of failure of thrombolysis. Hence these simple markers can be used to prognosticate the treatment and the disease warranting more aggressive and alternative therapies in these set of patients.*

Keywords : *STEMI, Platelet Distribution Width, ST segment Resolution, WBC count , Thrombolysis.*

I. Introduction

Cardiovascular disease is on the rise , accounting for upto 16 million deaths globally in 2010 [1]. Ischemic heart disease (IHD) is a condition which comprises inadequate supply of nutrients to the myocardium and occurs typically when there is mismatch between oxygen supply and demand. Ischemic heart disease can present as the following syndromes : Myocardial Infarction (MI), Angina pectoris, Chronic IHD with heart failure and sudden death. Acute myocardial infarction (AMI), unstable angina (UA) and sudden cardiac death (SCD) are referred to as acute coronary syndromes sharing the pathology of plaque disruption or acute plaque change [2]. The early risk stratification for ST segment Elevation Myocardial Infarction (STEMI) aim to provide early access to known therapies which will improve outcome. The mainstay of treatment in STEMI is fibrinolysis in a patient who presents to the hospital with no Percutaneous Coronary Intervention (PCI) or could not be transferred to a PCI centre and who has no contraindications for thrombolysis [3] .ST segment Resolution(STR) remains a cost effective solution to assess reperfusion after fibrinolysis in STEMI [4] . It is well established that large platelets are involved in the development of atherosclerotic plaques and Acute Coronary Syndrome(ACS) [5] . Studies have shown that patients with elevated White Blood Cell Count (WBC-C) during acute myocardial infarction are at higher risk of mortality and recurrent AMI [6] . Here my study aims on the relationship between platelet distribution width and white blood cell count with ST segment resolution in patients with acute ST elevation myocardial infarction treated with streptokinase.

II. Materials And Methodology

2.1 Study design :

This is a cross sectional study.

2.2 Patient selection

100 patients admitted to Coimbatore Medical College Hospital with ST segment elevation myocardial infarction and who are candidates for thrombolysis during the time period from 1st July 2014 to 30th June 2015.

2.3 Inclusion criteria

- Patients admitted with ST segment elevation myocardial infarction who are treated by streptokinase.
- Presenting within 6 hours of chest pain.

- Without any contraindication for thrombolysis.
- Age group from 20 to 100 years.

2.4 Exclusion criteria

- Previous history of coronary artery heart disease.
- Known case of bleeding diathesis.
- Abnormal platelet counts .
- White blood cell counts more than 25000 cells /microlitre.

2.5 Techniques

2.5.1 History and examination

Patients admitted in the casualty with ST segment elevation myocardial infarction are taken a detailed history to find out the duration of symptoms, any contraindications for thrombolysis, any previous history of coronary artery heart disease and any previous history of bleeding tendencies. Those patients who meet the inclusion criteria are taken up into the study. Patients who present within six hours of myocardial infarction but with contraindications to thrombolysis are not included in the study. A detailed clinical examination of all the systems were done.

2.5.2 Complete hemogram

A blood sample was drawn from the patients and sent for a complete hemogram to find out the platelet distribution width and white blood cell count. The hemogram is done with an automated analyser. Patients with gross abnormalities in the platelet counts and white blood cell counts are not included in the study.

2.5.3 Electrocardiogram

The eligible patients are then thrombolysed with streptokinase. A follow up electrocardiogram was taken to assess the percentage of ST segment resolution on comparison with the first electrocardiogram taken in the casualty before thrombolysis. Patients with more than 50% of ST segment resolution are taken as successful thrombolysis.

2.5.4 Short term follow up

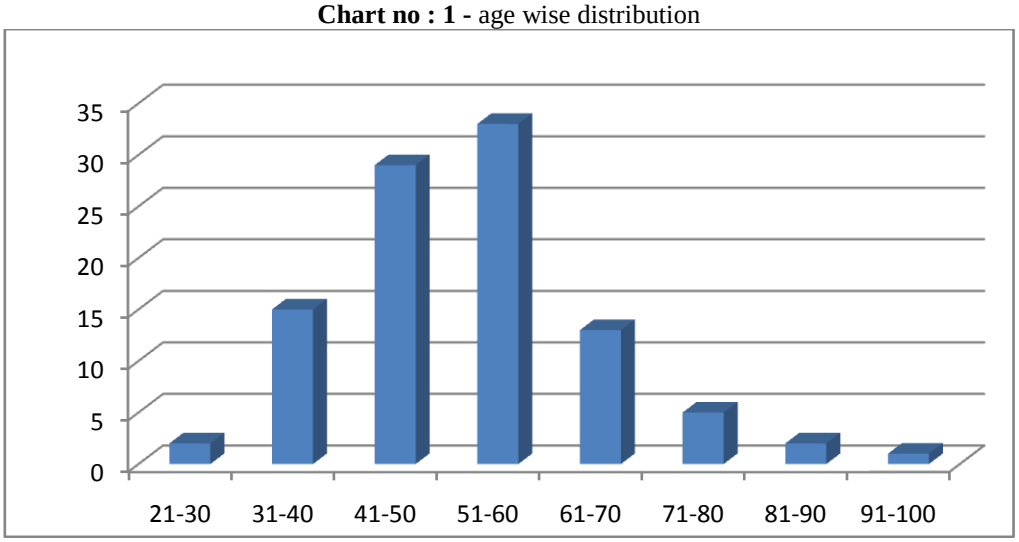
The patients were followed up during their hospital stay until they get discharged. They are also followed up till 30 days of the event to asses their short term mortality .

III. Results

Table no : 1 - age wise distribution

Age (years)	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Frequency	2	15	29	33	13	5	2	1

Chart no : 1 - age wise distribution

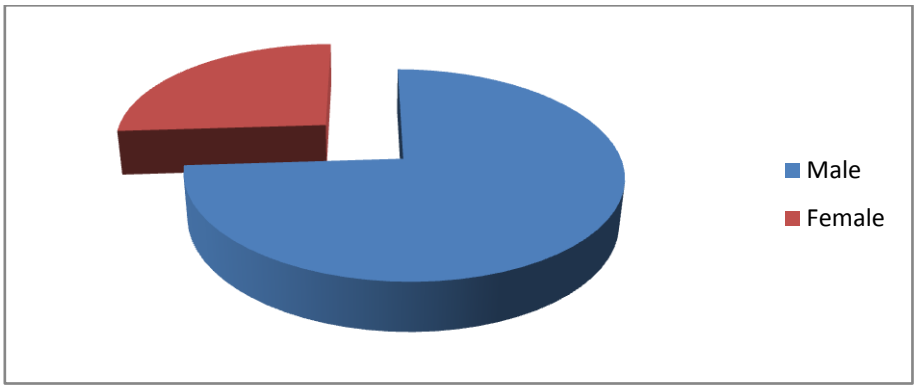


In this study, the age of patients ranged from 30 years to 91 years with majority of the patients in the fifth and sixth decades and the mean age was 52.95.

Table no : 2 - sex distribution

SEX	NO. OF PATIENTS
MALE	74
FEMALE	26

Chart no : 2 - sex distribution

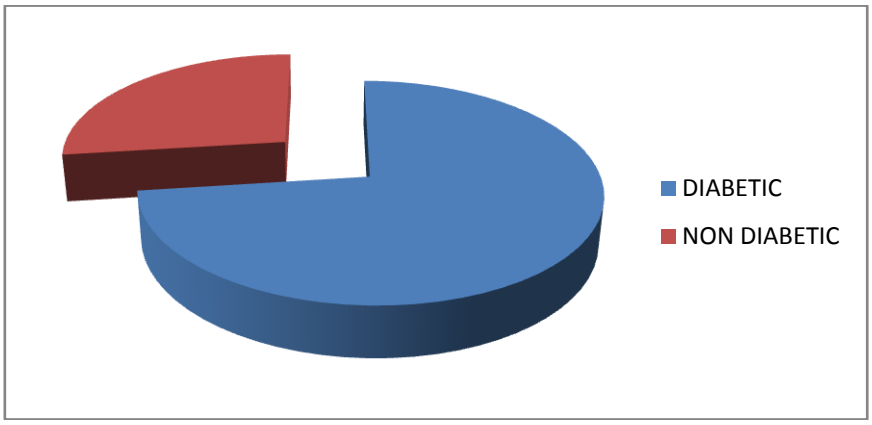


Among the 100 patients in the study, 74 patients were male and 26 were female .

Table no : 3 - Diabetes mellitus

DIABETES MELLITUS	NO. OF PATIENTS
DIABETIC	**73**
NON-DIABETIC	27

Chart no : 3 – Diabetes Mellitus

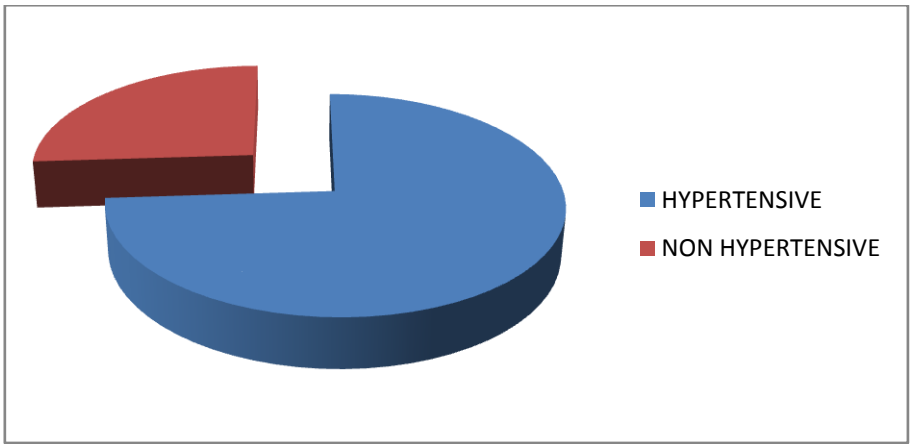


Among the patients in the study, 73 patients had diabetes mellitus and 27 patients did not have diabetes mellitus.

Table no : 4 - systemic hypertension

SYSTEMIC HYPERTENSION	NO. OF PATIENTS
HYPERTENSIVE	74
NON-HYPERTENSIVE	26

Chart no : 4 - systemic hypertension

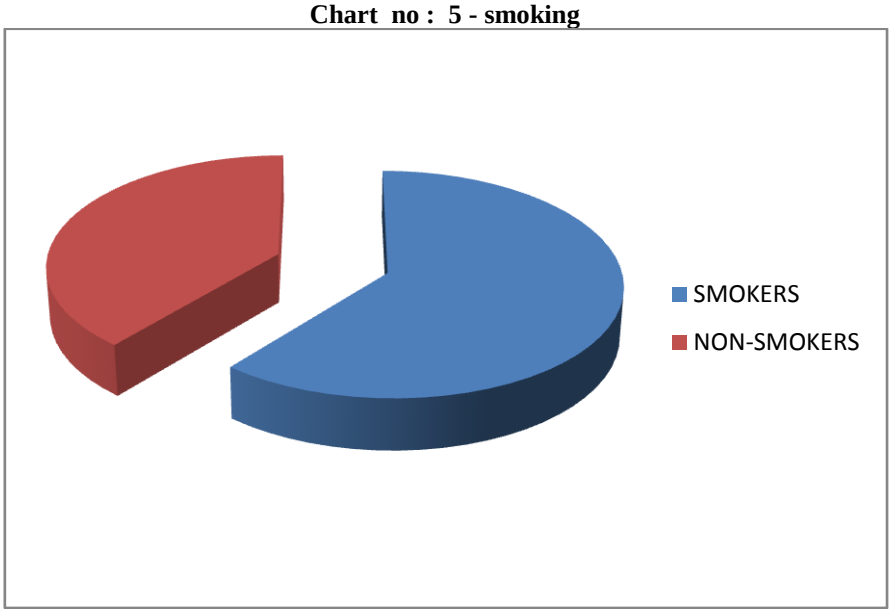


Among the patients, 74 % had hypertension and 26% did not have hypertension.

Table no : 5 - smoking

STATUS OF SMOKING	NO. OF PATIENTS
SMOKERS	61
NON-SMOKERS	39

Chart no : 5 - smoking

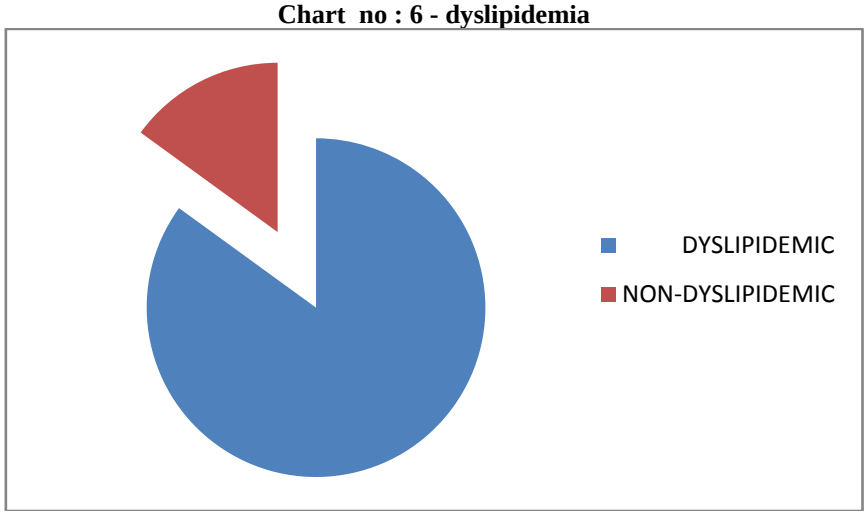


Among the patients, 61 % were smokers and 79 % were non-smokers.

Table no : 6 - dyslipidemia

STATUS OF DYSLIPIDEMIA	NO. OF PATIENTS
DYSLIPIDEMIC	85
NON-DYSLIPIDEMIC	15

Chart no : 6 - dyslipidemia

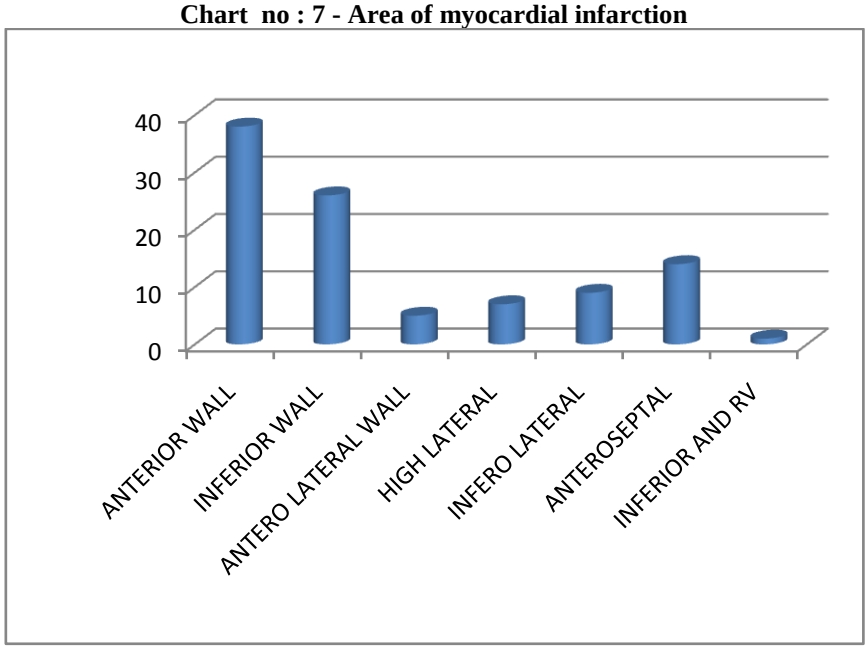


Among the study group 85% had dyslipidemia and 15% did not have dyslipidemia.

Table no :7 - Area of myocardial infarction

AREA OF MYOCARDIAL INFARCTION	FREQUENCY
ANTERIOR	38
INFERIOR	26
ANTEROLATERAL	5
HIGH LATERAL	7
INFERO LATERAL	9
ANTERO SEPTAL	14
INFERIOR AND RIGHT VENTRICLE	1

Chart no : 7 - Area of myocardial infarction

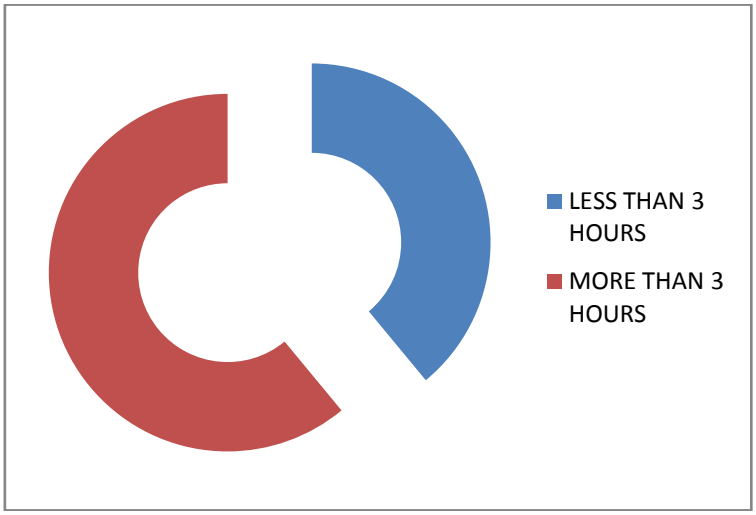


This chart shows the frequency of involvement of myocardial wall in the study group.

Table no :8 - Duration of myocardial infarction

DURATION OF MYOCARDIAL INFARCTION	NO. OF PATIENTS
LESS THAN 3 HOURS OF PRESENTATION	39
MORE THAN 3 HOURS OF PRESENTATION	61

Chart no : 8 - Duration of myocardial infarction :

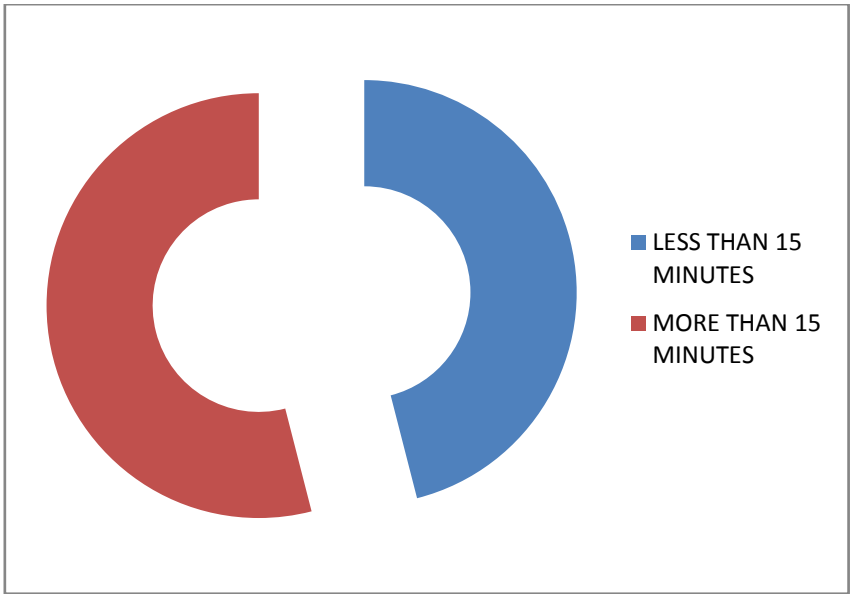


In the study group, 39% of patients presented within 3 hours of symptoms and 61% of patients presentedafter 3 hours.

Table : 9 - Door to needle time

DOOR TO NEEDLE TIME	NO. OF PATIENTS
LESS THAN 15 MINUTES	46
MOTE THAN 15 MINUTES	54

Chart : 9 - Door to needle time

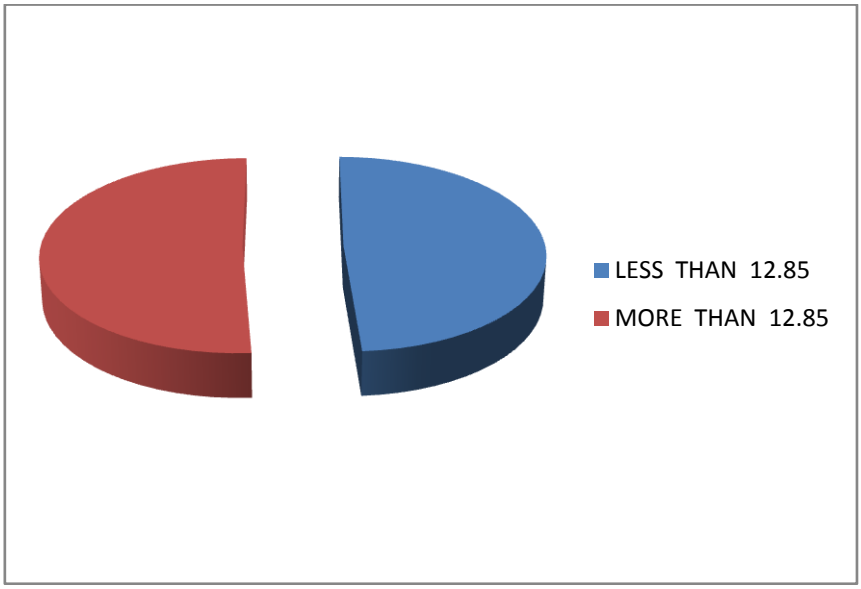


Among 100 patients, the door to needle time was less than 15 minutes in 46% of patients and more than 15 minutes in 54%.

Table no : 10 - Platelet distribution width

PLATELET DISTRIBUTION WIDTH	NO. OF PATIENTS
LESS THAN 12.85	49
MORE THAN 12.85	51

Chart no : 10 - platelet distribution width

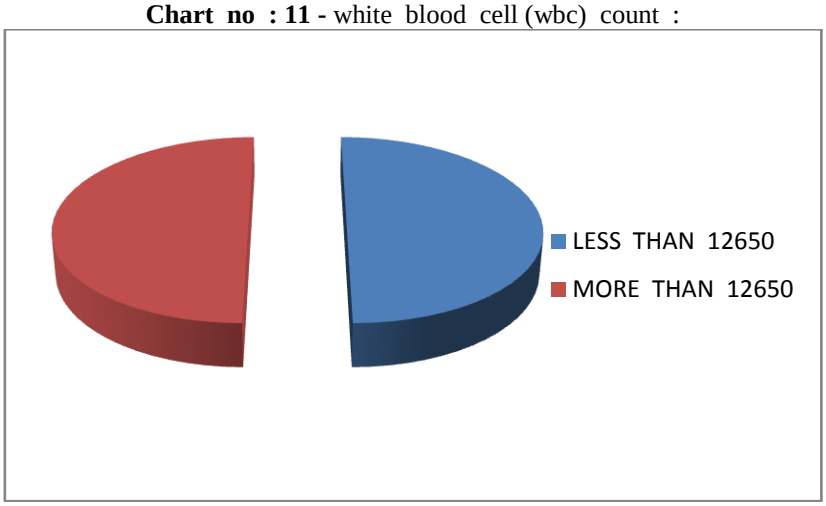


In the study group 49% of patients had platelet distribution width less than 12.85 and 51% of patients had platelet distribution width more than 12.85. Mean platelet distribution width : 12.35

Table no : 11 - white blood cell (wbc) count

WHITE BLOOD CELL COUNT	NO. OF PATIENTS
LESS THAN 12650 CELLS PER MICROLITRE	50
MORE THAN 12650 CELLS PER MICROLITRE	50

Chart no : 11 - white blood cell (wbc) count :



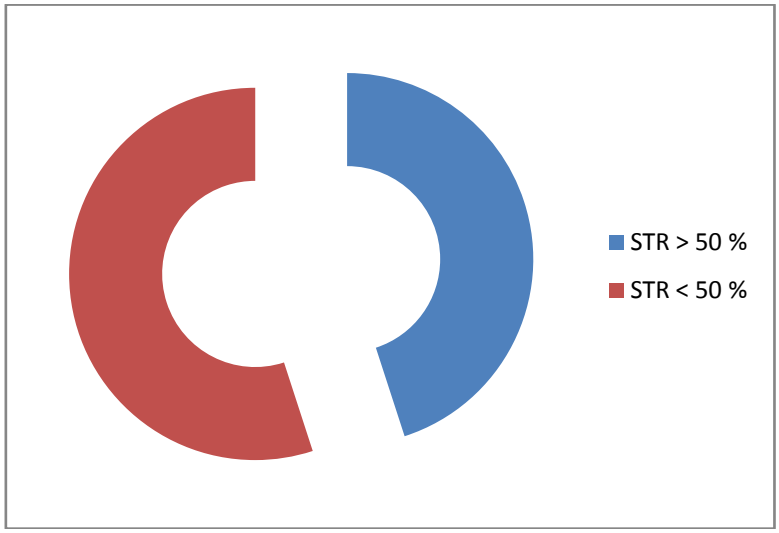
Mean : 10494 cells per microlitre

In the study group 50% of the patients had white blood cell count of less than 12650 per microlitre and 50% had white blood cell count more than 12650 per microlitre.

Table no : 12 - st segment resolution (str)

ST SEGMENT RESOLUTION	**NO. OF PATIENTS**
ST SEGMENT RESOLUTION > 50 %	45
ST SEGMENT RESOLUTION < 50 %	55

Chart no : 12 - st segment resolution (str)

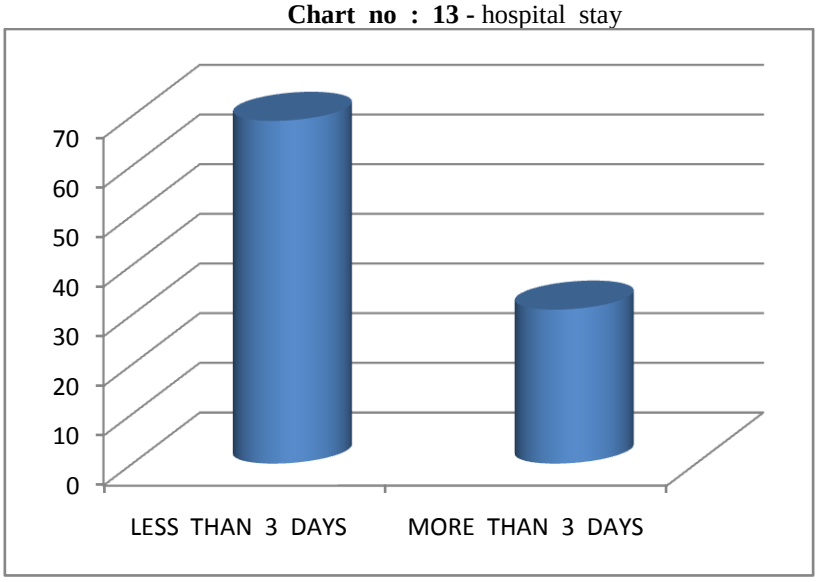


In the study group, 45% of patients had more than 50 % ST segment resolution and 55% of patients had less than 50% ST segment resolution.

Table no : 13 - hospital stay

HOSPITAL STAY	**NO. OF PATIENTS**
LESS THAN 3 DAYS	69
MORE THAN 3 DAYS	31

Chart no : 13 - hospital stay

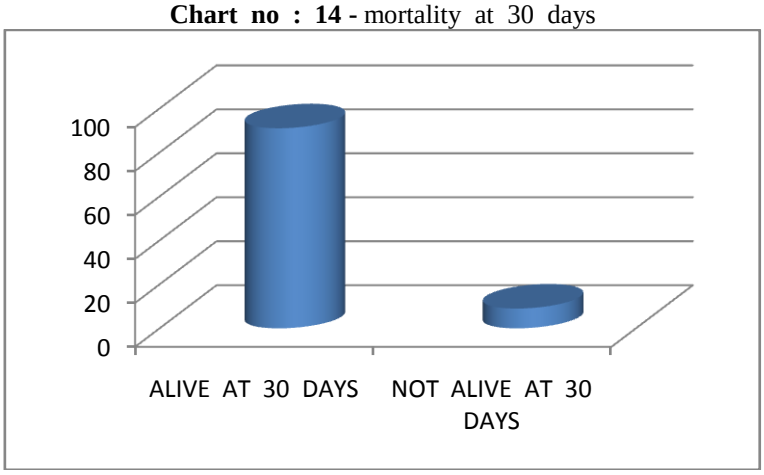


In the study group, 69% of patients had a hospital stay of less than 3 days and 31% of patients had a hospital stay of more than 3 days.

Table no : 14 - mortality at 30 days

MORTALITY AT 30 DAYS	**NO. OF PATIENTS**
ALIVE AT 30 DAYS	91
NOT ALIVE AT 30 DAYS	9

Chart no : 14 - mortality at 30 days

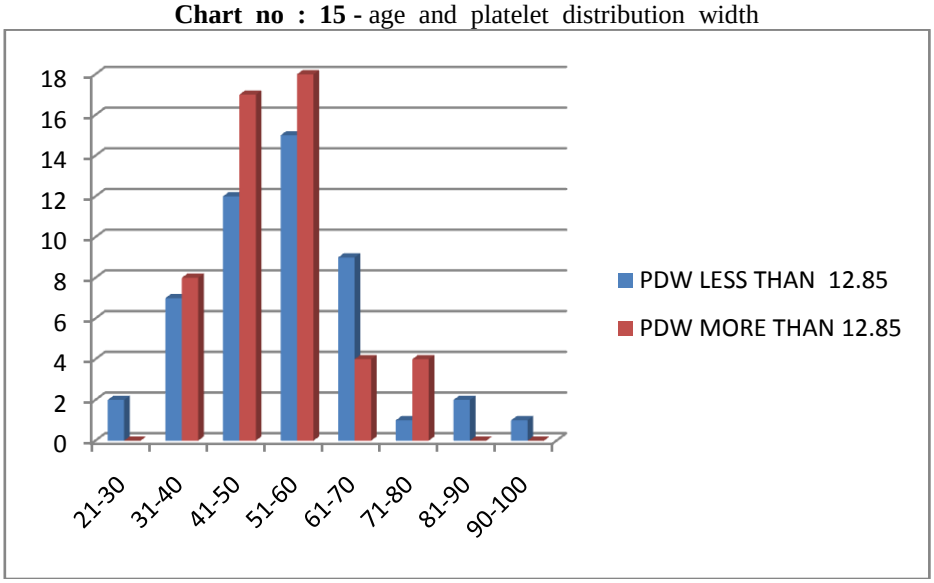


In the study group 91% of patients were alive at 30 days and 9% of patients were not alive at 30 days.

Table no : 15 - age and platelet distribution width

AGE	PDW LESS THAN 12.85	PDW MORE THAN 12.85
21-30	2	0
31-40	7	8
41-50	12	17
51-60	15	18
61-70	9	4
71-80	1	4
81-90	2	0
91-100	1	0

Chart no : 15 - age and platelet distribution width



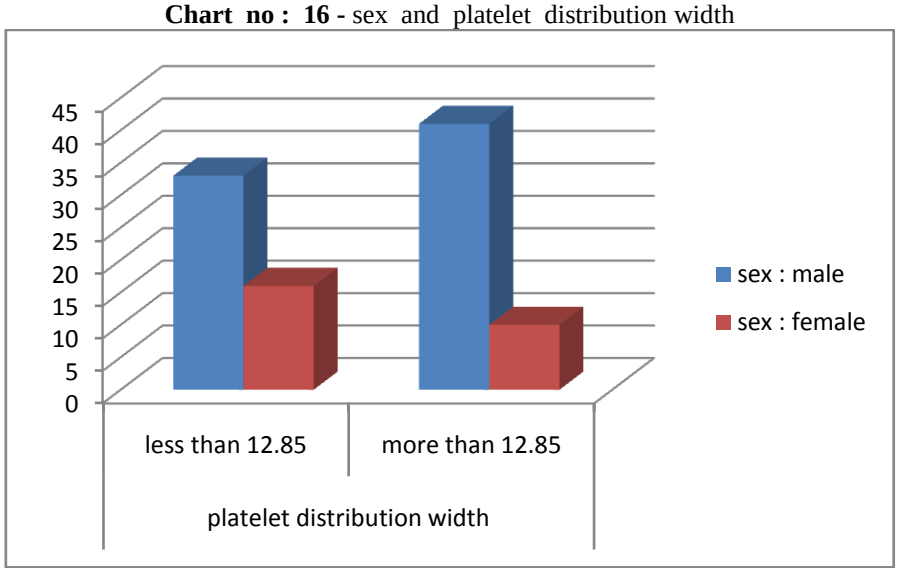
P VALUE : 0.195

The p value in comparing age and platelet distribution width shows that there is no significant association between the two.

Table 16 : - sex and platelet distribution width

SEX	PDW LESS THAN 12.85	PDW MORE THAN 12.85
MALE	33	41
FEMALE	16	10

Chart no : 16 - sex and platelet distribution width



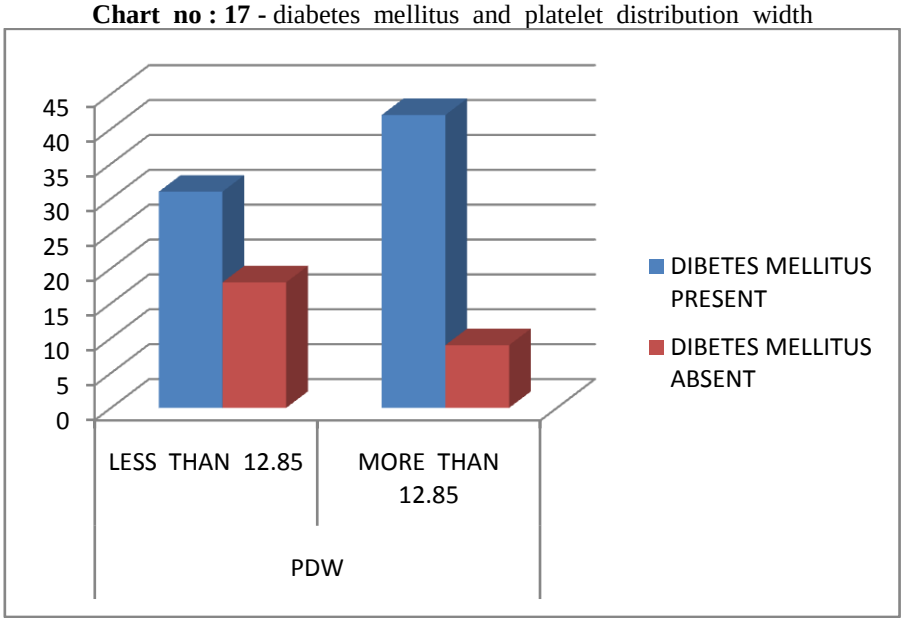
P VALUE : 0.137

The above p value shows that there is no significant association between sex and platelet distribution width in the study.

Table no : 17 - diabetes mellitus and platelet distribution width

DIABETES MELLITUS	PDW LESS THAN 12,85	PDW MORE THAN 12.85
PRESENT	31	42
ABSENT	18	9

Chart no : 17 - diabetes mellitus and platelet distribution width



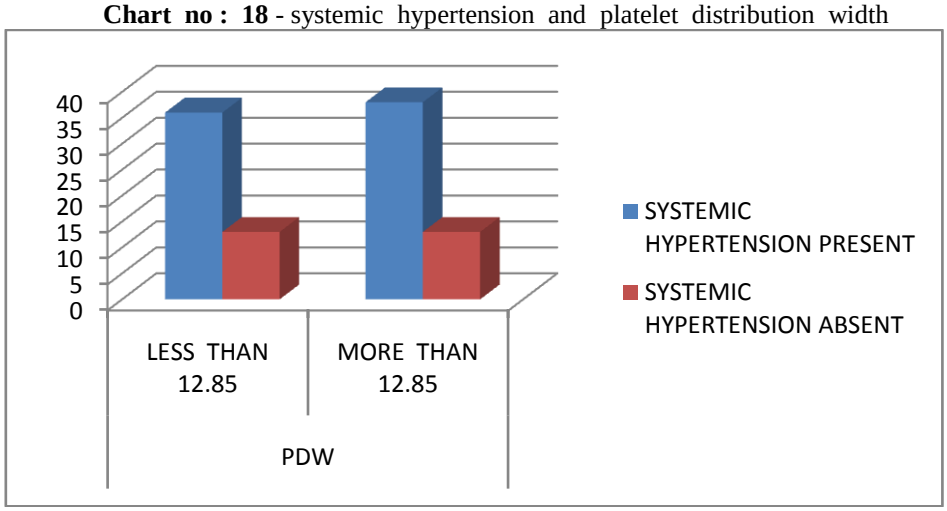
P VALUE : 0.032

The above p value shows that there is no association between diabetes mellitus and platelet distribution width in the study.

Table no : 18 - systemic hypertension and platelet distribution width

SYSTEMIC HYPERTENSION	PDW LESS THAN 12.85	PDW MORE THAN 12.85
PRESENT	36	38
ABSENT	13	13

Chart no : 18 - systemic hypertension and platelet distribution width



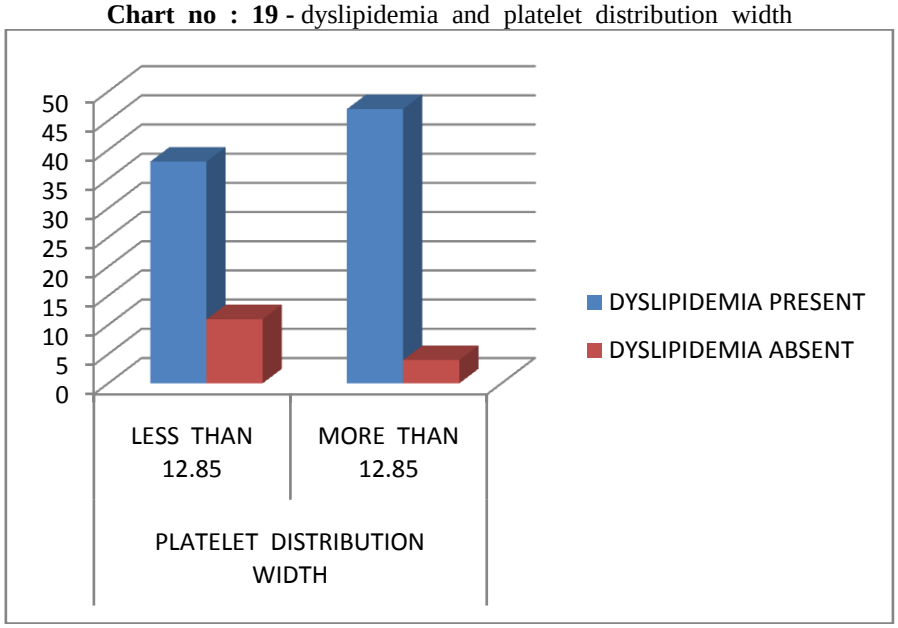
P VALUE : 0.906

The above p value shows that there is no association between systemic hypertension and platelet distribution width.

Table no : 19 - dyslipidemia and platelet distribution width

DYSLIPIDEMIA	**PDW LESS THAN 12.85**	**MORE THAN 12.85**
PRESENT	38	47
ABSENT	11	4

Chart no : 19 - dyslipidemia and platelet distribution width



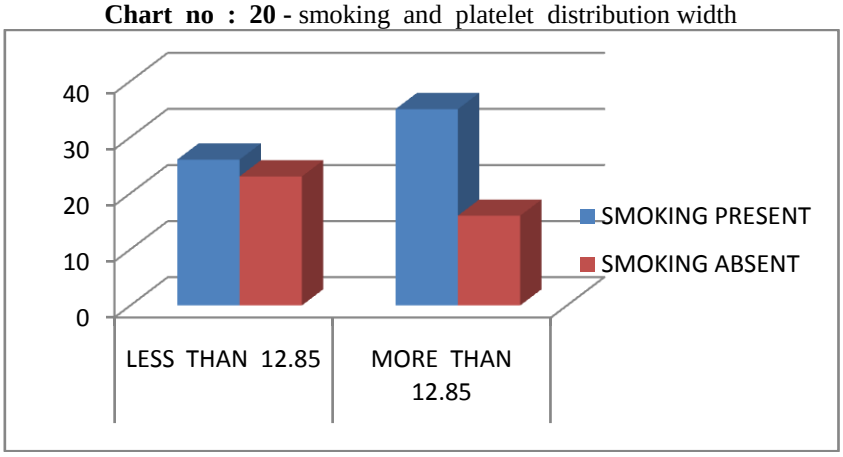
P VALUE : 0.041

The above p value shows that there is no significant association between dyslipidemia and platelet distribution width.

Table no : 20 - smoking and platelet distribution width

SMOKING	**PDW LESS THAN 12.85**	**PDW MORE THAN 12.85**
PRESENT	26	35
ABSENT	23	16

Chart no : 20 - smoking and platelet distribution width

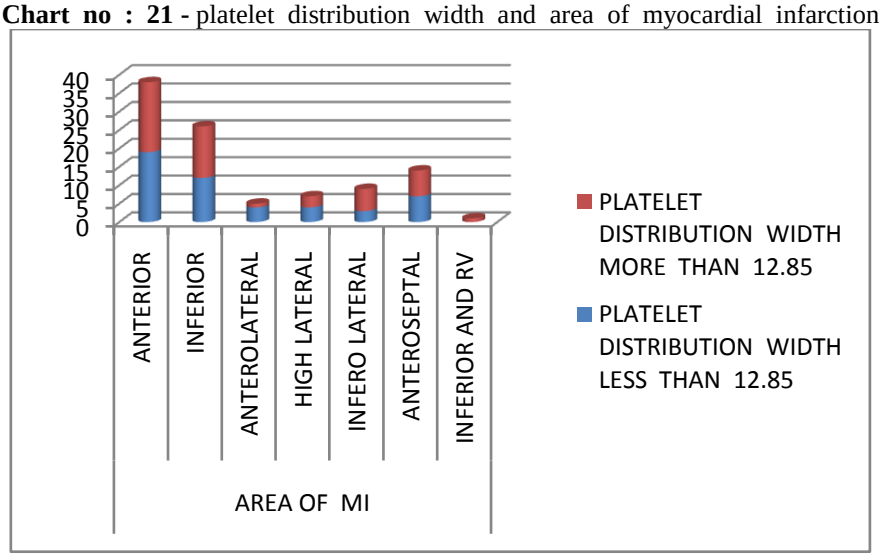


The p value of 0.111 shows that there is no significant association between smoking and platelet distribution width.

Table no : 21 - platelet distribution width and area of myocardial infarction

AREA OF MYOCARDIAL INFARCTION	PDW LESS THAN 12.85	PDW MORE THAN 12.85
ANTERIOR	19	19
INFERIOR	12	4
ANTEROLATERAL	4	1
HIGH LATERAL	4	3
INFERO LATERAL	3	6
ANTERO SEPTAL	7	7
INFERIOR AND RV	0	1

Chart no : 21 - platelet distribution width and area of myocardial infarction



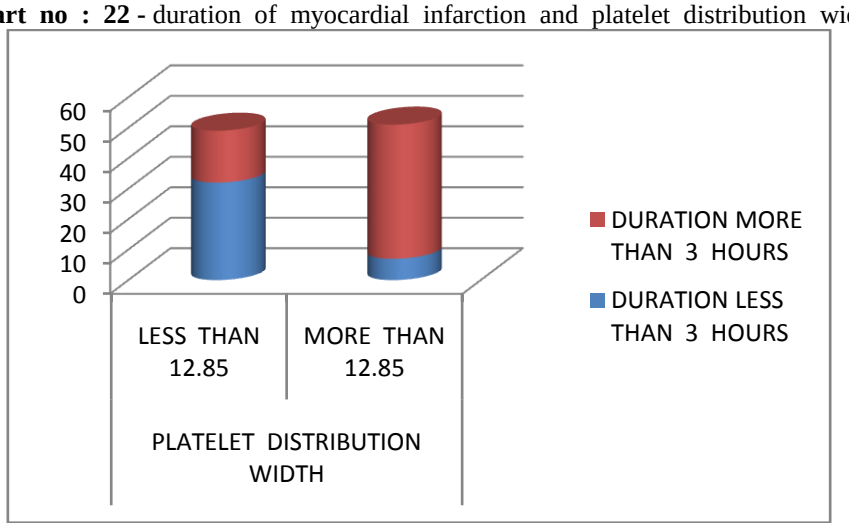
P VALUE : 0.669

The above p value shows that there is no significant association between the area of myocardial infarction and platelet distribution width.

Table no : 22 - duration of myocardial infarction and platelet distribution width

DURATION OF MYOCARDIAL INFARCTION	PDW LESS THAN 12.85	PDW MORE THAN 12.85
LESS THAN 3 HOURS	32	7
MORE THAN 3 HOURS	17	44

Chart no : 22 - duration of myocardial infarction and platelet distribution width

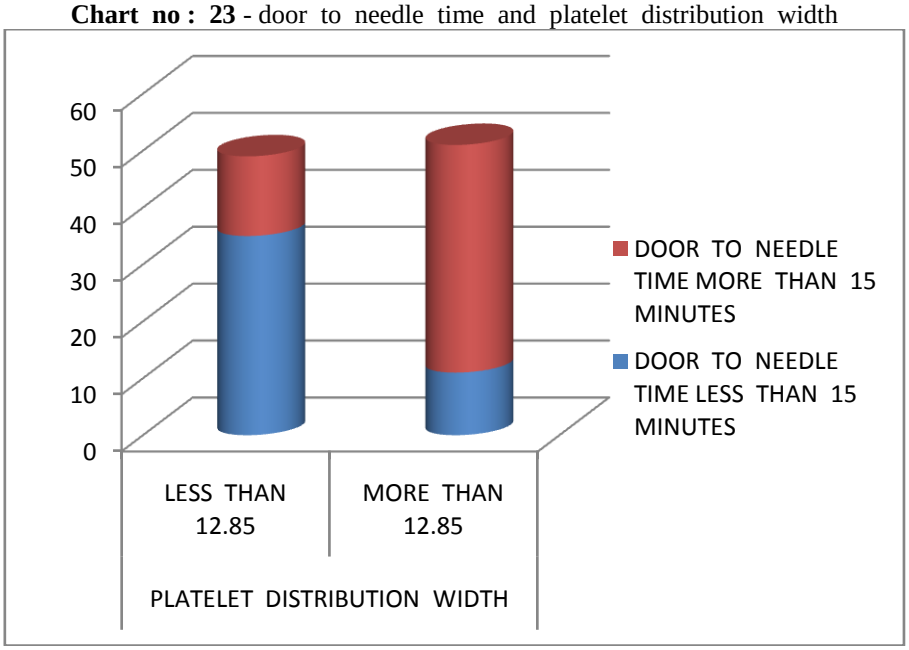


The p value of <0.001 shows that there is significant association between the duration of myocardial infarction and platelet distribution width. More the duration of myocardial infarction, higher the platelet distribution width.

Table no : 23 - door to needle time and platelet distribution width

DOOR TO NEEDLE TIME	PDW LESS THAN 12.85	PDW MORE THAN 12.85
LESS THAN 15 MINUTES	35	11
MORE THAN 15 MINUTES	14	40

Chart no : 23 - door to needle time and platelet distribution width



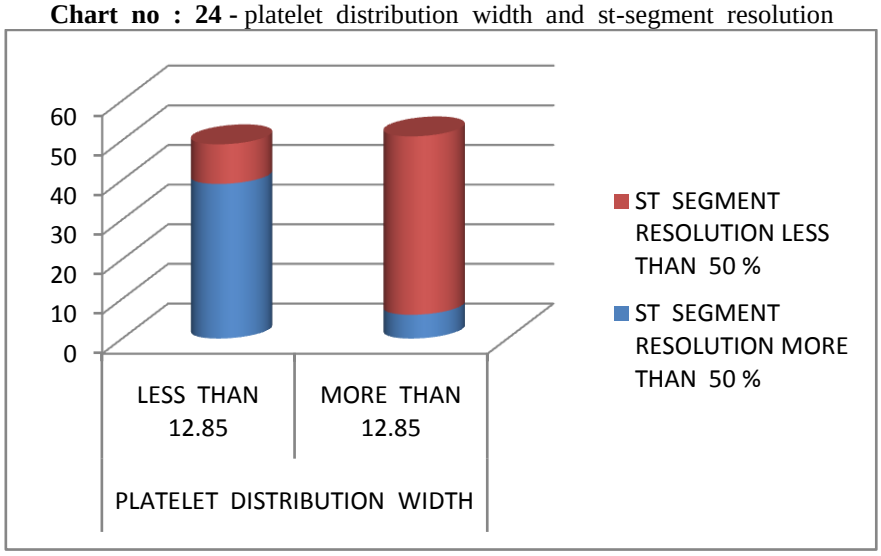
P VALUE : <0.001

The above p value indicates that there is significant association between door to needle time and platelet distribution width. More the door to needle time, higher the platelet distribution width.

Table no : 24 - platelet distribution width and st-segment resolution

ST-SEGMENT RESOLUTION	PDW LESS THAN 12.85	PDW MORE THAN 12.85
MORE THAN 50 %	39	10
LESS THAN 50 %	6	45

Chart no : 24 - platelet distribution width and st-segment resolution



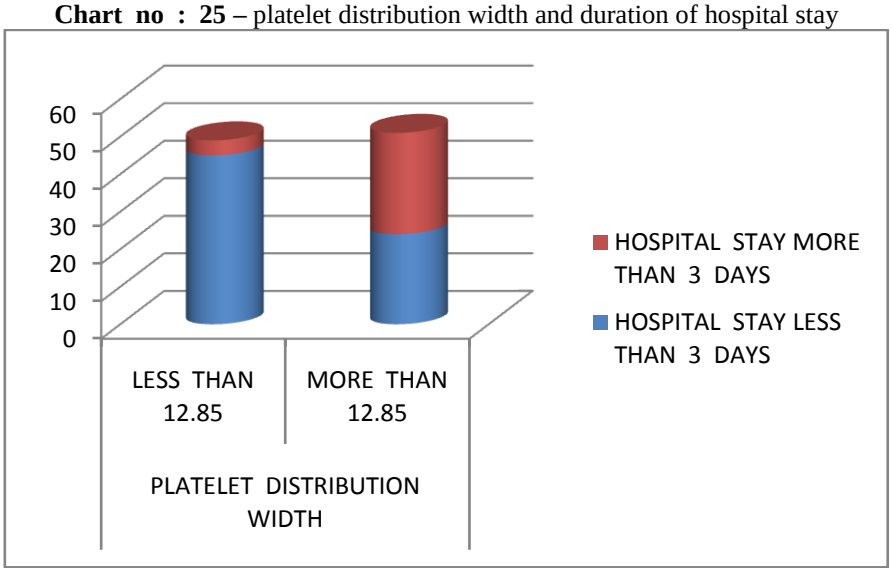
P VALUE : <0.001

The above p value shows that there is significant association between platelet distribution width and ST segment resolution. More the platelet distribution width lesser the success of thrombolysis (ST segment resolution).

Table no : 25 - platelet distribution width and duration of hospital stay

HOSPITAL STAY	**PDW LESS THAN 12.85**	**PDW MORE THAN 12.85**
LESS THAN 3 DAYS	45	24
MORE THAN 3 DAYS	4	27

Chart no : 25 – platelet distribution width and duration of hospital stay

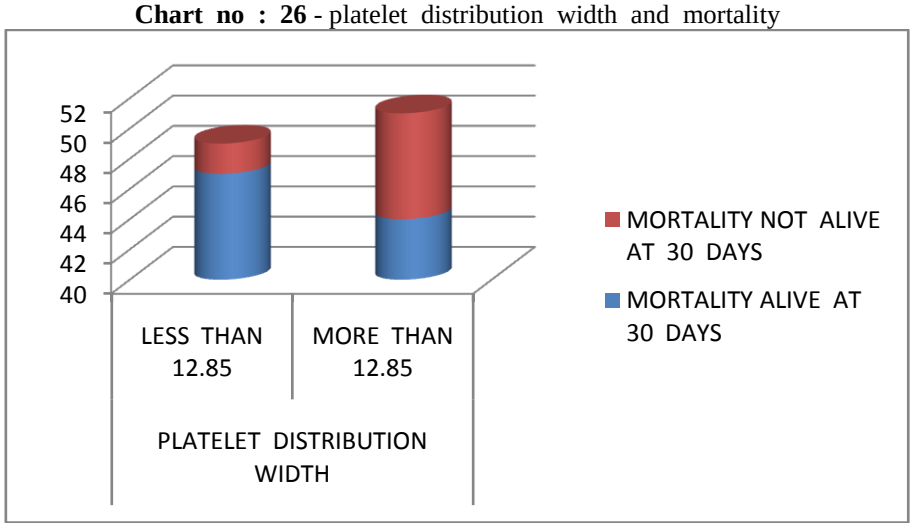


The p value of <0.001 shows that there is significant association between platelet distribution width and duration of hospital stay. More the platelet distribution width, longer the duration of hospital stay.

Table no : 26 - platelet distribution width and mortality

MORTALITY	**PDW LESS THAN 12.85**	**PDW MORE THAN 12.85**
ALIVE AT 30 DAYS	47	44
NOT ALIVE AT 30 DAYS	2	7

Chart no : 26 - platelet distribution width and mortality



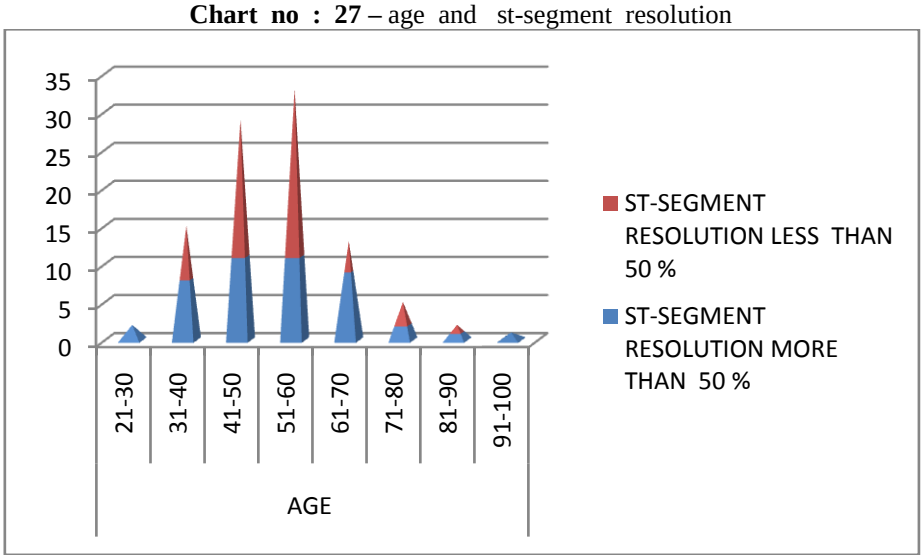
P VALUE : 0.092

The above p value shows that there is no significant association between platelet distribution width and mortality at 30 days.

Table no : 27 - age and st-segment resolution

AGE (YEARS)	ST-SEGMENT RESOLUTION MORE THAN 50 %	ST- SEGMENT RESOLUTION LESS THAN 50 %
21-30	2	0
31-40	8	7
41-50	11	18
51-60	11	22
61-70	9	4
71-80	2	3
81-90	1	1
91-100	1	0

Chart no : 27 – age and st-segment resolution

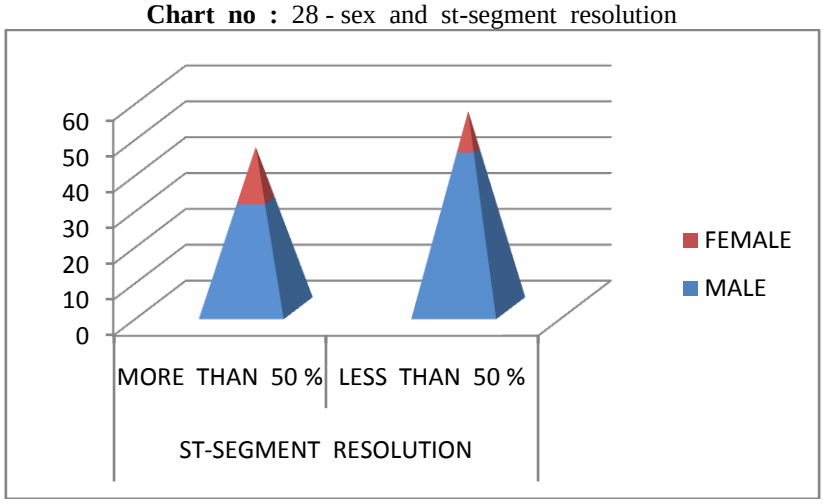


The p value of 0.210 shows that there is no significant association between age and platelet distribution width.

Table no 28 : - sex and st-segment resolution

SEX	STR MORE THAN 50 %	STR LESS THAN 50 %
MALE	30	44
FEMALE	15	11

Chart no : 28 - sex and st-segment resolution



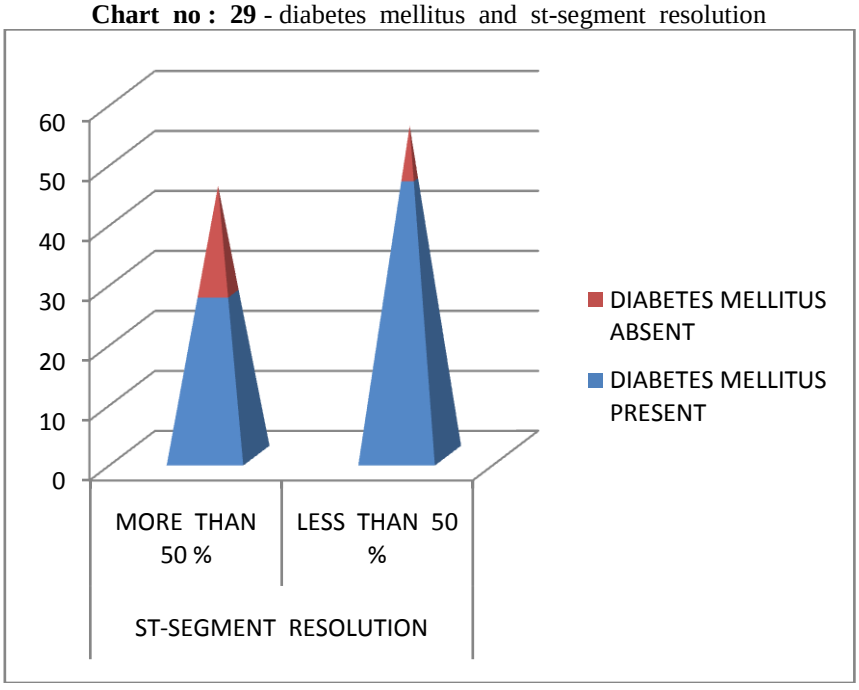
P VALUE : 0.0130

The above p value shows that there is no significant association between sex and ST segment resolution.

Table no : 29 - diabetes mellitus and st-segment resolution

DIABETES MELLITUS	STR MORE THAN 50 %	STR LESS THAN 50 %
PRESENT	27	46
ABSENT	18	9

Chart no : 29 - diabetes mellitus and st-segment resolution



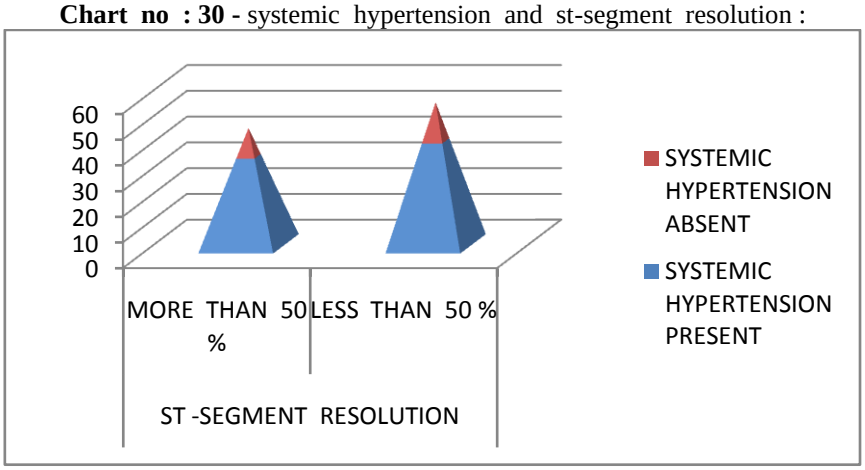
P VALUE : 0.008

The above p value shows that there is no significant association between diabetes mellitus and ST segment resolution.

Table no : 30 - systemic hypertension and st-segment resolution

SYSTEMIC HYPERTENSION	STR MORE THAN 50 %	STR LESS THAN 50 %
PRESENT	34	40
ABSENT	11	15

Chart no : 30 - systemic hypertension and st-segment resolution :



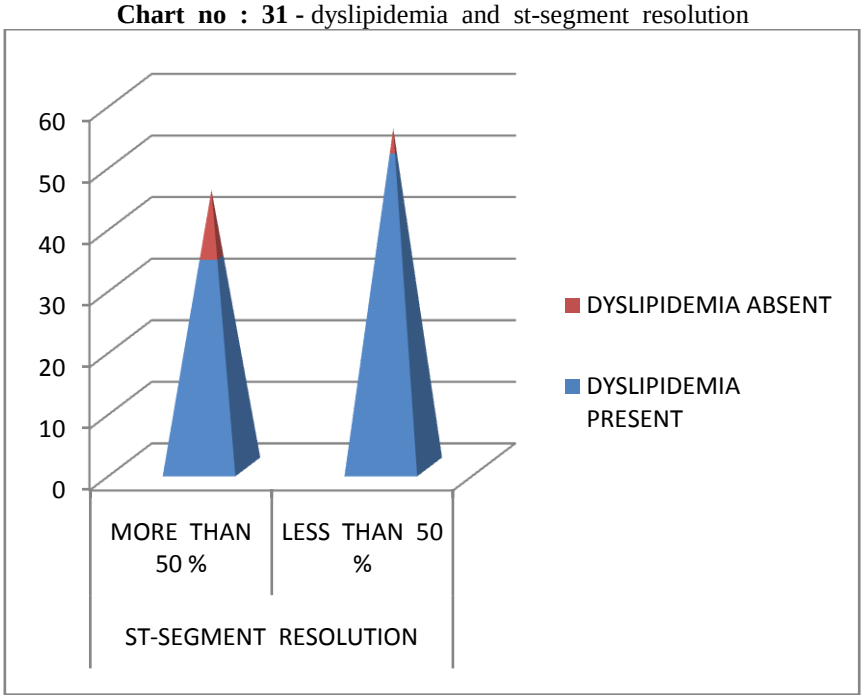
P VALUE : 0.748

The above p value shows that there is no significant association between systemic hypertension and ST segment resolution.

Table no : 31 - dyslipidemia and st-segment resolution

DYSLIPIDEMIA	**STR MORE THAN 50 %**	**LESS THAN 50 %**
PRESENT	34	51
ABSENT	11	4

Chart no : 31 - dyslipidemia and st-segment resolution



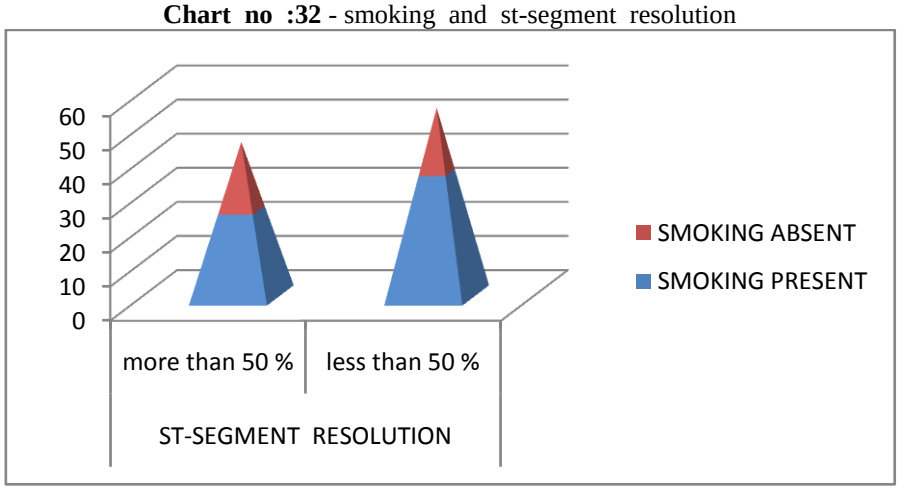
P VALUE : 0.017

The above p value shows that there is no significant association between dyslipidemia and ST segment resolution.

Table no : 32 - smoking and st-segment resolution

SMOKING	STR MORE THAN 50 %	STR LESS THAN 50 %
PRESENT	25	36
ABSENT	20	19

Chart no :32 - smoking and st-segment resolution

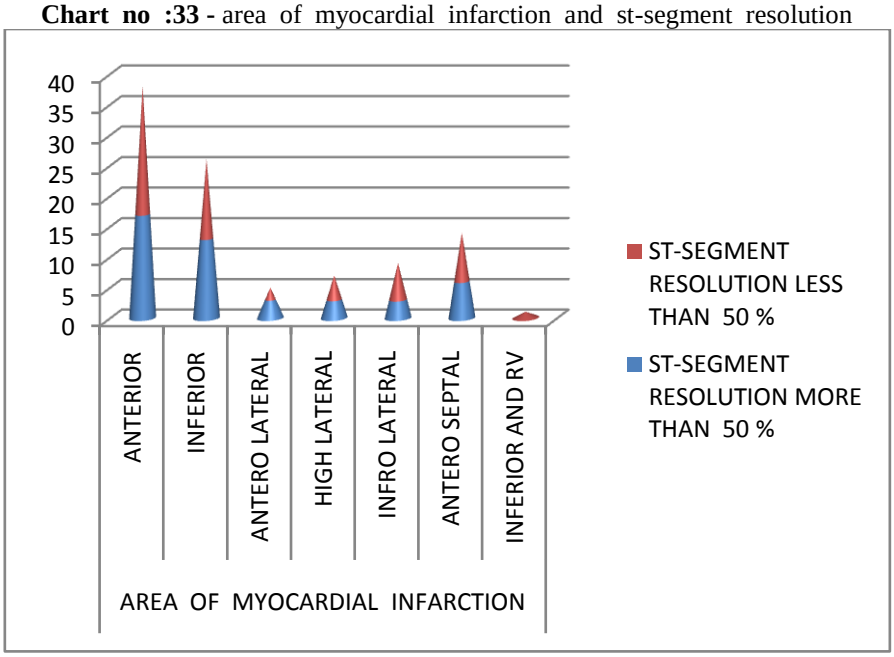


The p value of 0.313 shows that there is no significant association between smoking and ST segment resolution.

Table no :33 - area of myocardial infarction and st-segment resolution

AREA OF MYOCARDIAL INFARCTION	STR MORE THAN 50 %	STR LESS THAN 50 %
ANTERIOR	17	21
INFERIOR	13	13
ANTEROLATERAL	3	2
HIGH LATERAL	3	4
INFERO LATERAL	3	6
ANTERO SEPTAL	6	8
INFERIOR AND RV	0	1

Chart no :33 - area of myocardial infarction and st-segment resolution

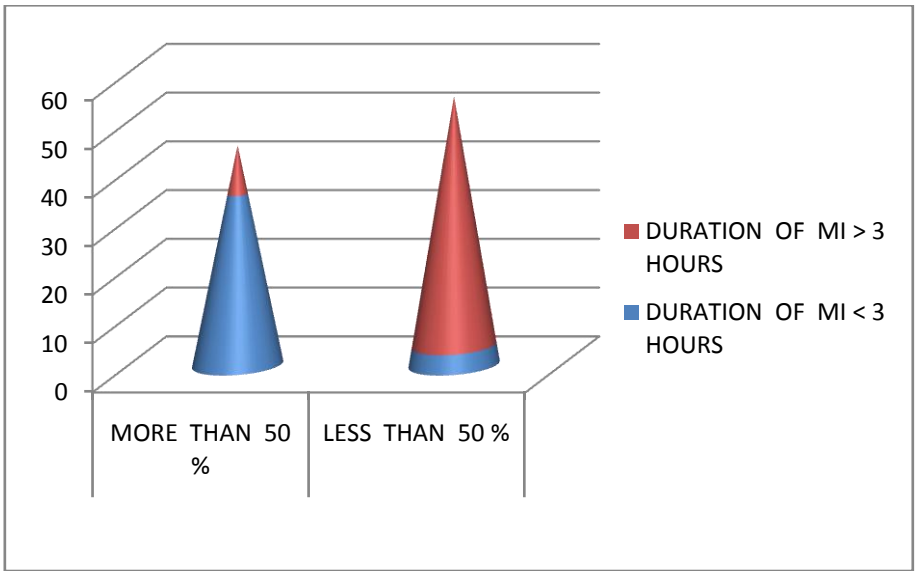


The p value of 0.913 shows that there is no significant association between area of myocardial infarction and ST segment resolution.

Table no : 34 - duration of myocardial infarction and st-segment resolution

DURATION OF MYOCARDIAL INFARCTION	**STR MORE THAN 50 %**	**STR LESS THAN 50 %**
LESS THAN 3 HOURS	35	4
MORE THAN 3 HOURS	10	51

Chart no : 34 - duration of myocardial infarction and st-segment resolution



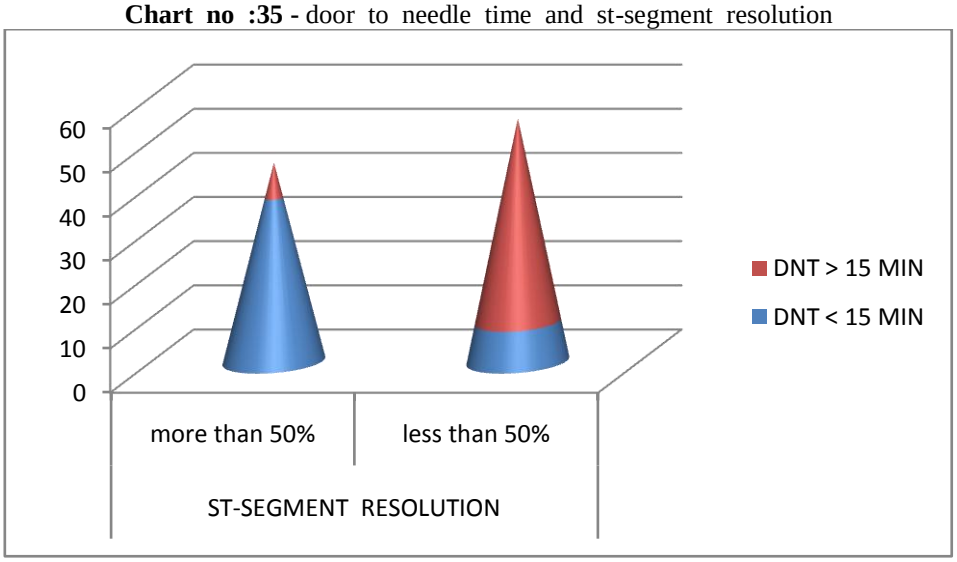
P VALUE : <0.001

The above p value shows that there is significant association between the duration of myocardial infarction and ST segment resolution. More the duration of myocardial infarction lesser the ST segment resolution.

Table no :35 - door to needle time and st-segment resolution

DOOR TO NEEDLE TIME	**STR MORE THAN 50 %**	**STR LESS THAN 50 %**
LESS THAN 30 MINUTES	37	9
MORE THAN 30 MINUTES	8	46

Chart no :35 - door to needle time and st-segment resolution

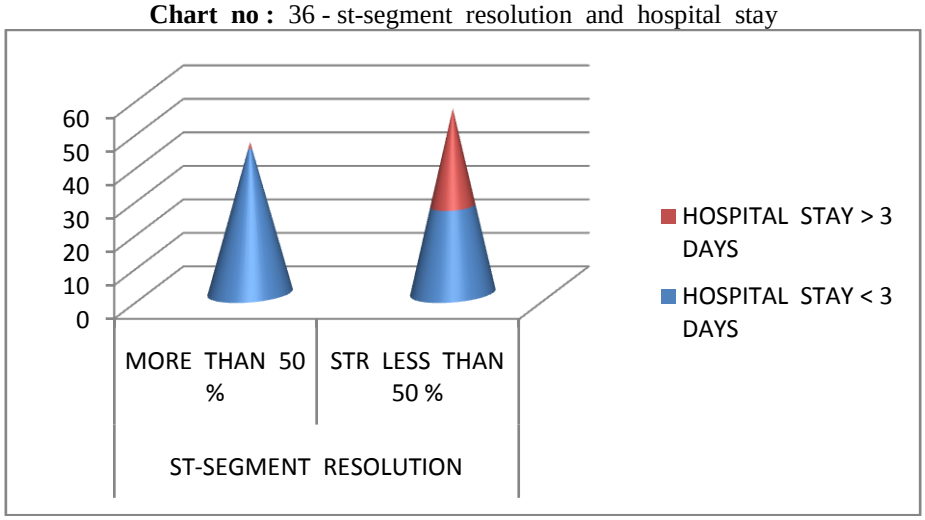


The p value of <0.001 shows that there is significant association between door to needle time and ST segment resolution. More the door to needle time, lesser is the ST segment resolution.

Table no : 36 - st-segment resolution and hospital stay

HOSPITAL STAY	**STR MORE THAN 50%**	**STR LESS THAN 50 %**
LESS THAN 3 DAYS	43	26
MORE THAN 3 DAYS	2	29

Chart no : 36 - st-segment resolution and hospital stay

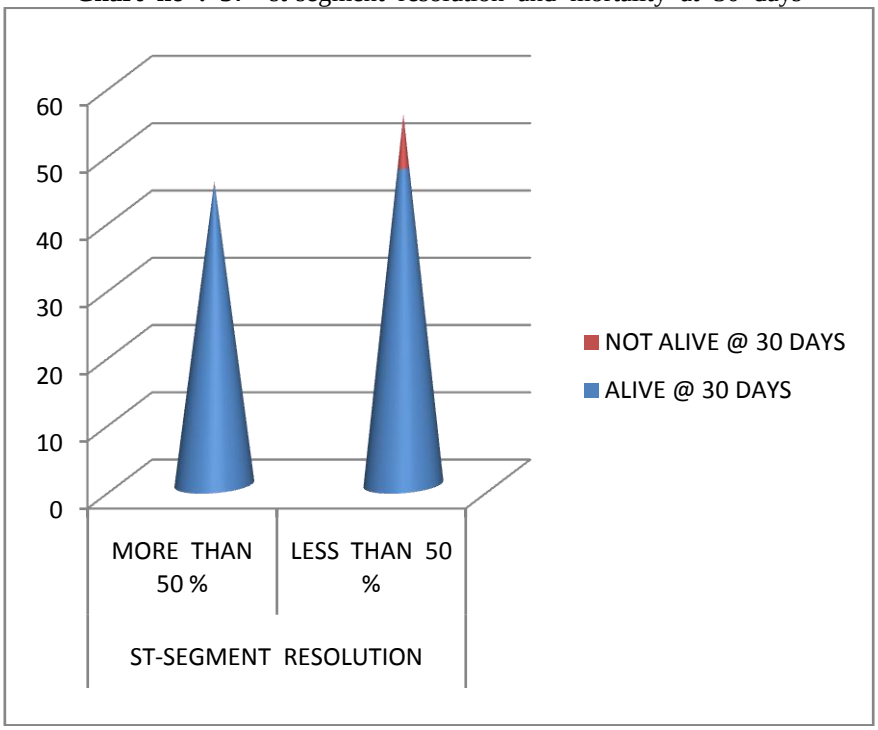


The p value of <0.001 shows that there is significant association between ST segment resolution and hospital stay. Patients with more than 50% resolution had a lesser hospital stay than those patients who had less than 50% resolution.

Table no : 37 - st-segment resolution and mortality at 30 days

MORTALITY AT 30 DAYS	STR MORE THAN 50 %	STR LESS THAN 50 %
ALIVE	44	47
NOT ALIVE	1	8

Chart no : 37 - st-segment resolution and mortality at 30 days

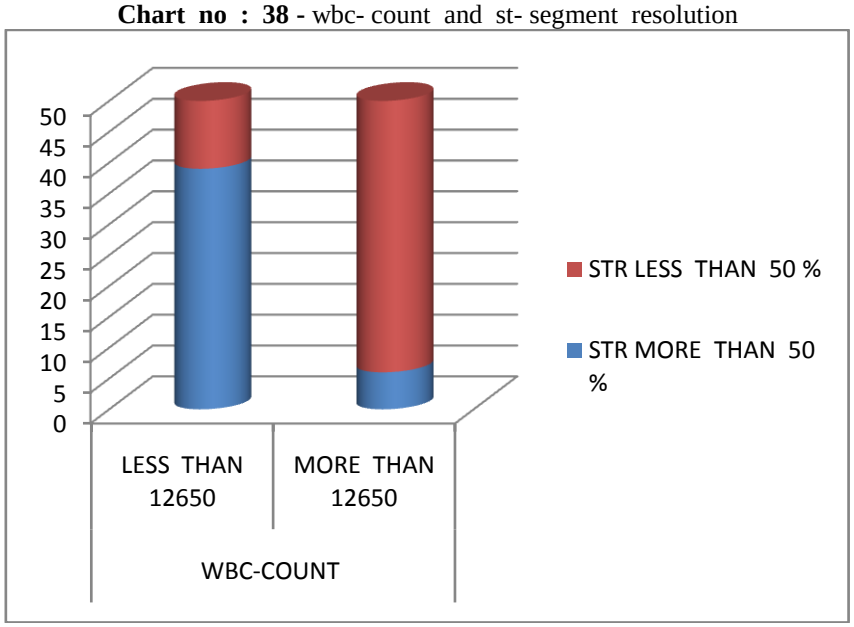


The p value of 0.032 shows that there is no significant association between ST segment resolution and mortality at 30 days.

Table no : 38 - wbc- count and st- segment resolution

ST-SEGMENT RESOLUTION	WBC COUNT LESS THAN 12650	WBC COUNT MORE THAN 12650
MORE THAN 50 %	39	6
LESS THAN 50 %	11	44

Chart no : 38 - wbc- count and st- segment resolution



The p value of <0.001 shows that there is significant association between white blood cell count and ST segment resolution. Higher the white blood cell count, lower the ST segment resolution.

IV. Discussion

Coronary thrombosis is a known cause of mortality since the beginning of 19th century. Eletrocardiography (ECG) created by Einthoven in 1902 is the major diagnostic tool for acute myocardial infarction until the present time .The reperfusion era was in the 1950s and 1960s when Fletcher and Verstraete, experimentally were pioneers in the use of thrombolytic agents [7]. The criteria for diagnosing STEMI is ST elevation of more than or equal to 0.1 mV in more than or one inferior or lateral leads or ST elevation of more than or equal to 0.2 mV in more than or one anteroseptal precordial leads [8] .

Management of STEMI includes pre-hospital management , effective transport to a medical centre with facility, management of immediate complications like arrhythmias by defibrillation by the transport personnel. In hospital management includes management of the airway, breathing, circulation and simultaneously assessing the patient to formulate a management strategy. Patients are immediately treated with antiplatelets, nitrates, morphine and beta blockers [9].

STEMI in a patient indicates reperfusion therapy. But it also depends upon the time of presentation. In 1957, Tony Fletcher, Sherry and Norma Alkjaersig defined a loading infusion of streptokinase followed by a continuous dose for the demonstration of fibrinolysis by intravenous route. These studies led to the first study in humans for the fibrinolysis in Acute Myocardial Infarction using intravenous infusion of Streptokinase. They also found that early use of streptokinase increases myocardial salvage and reduced the infarct size which helped in decreasing the in-hospital mortality [10]. It was also demonstrated that use of early reperfusion strategy helped in re-establishment of patency in the coronary artery, reduction in the infarct size, improvement in the ventricular wall motion abnormality, relief of patient's symptoms, resolution in the ECG changes and improvement in overall cardiac functions. The research was followed by the discovery of several new thrombolytic agents like tenecteplase (TNK), reteplase (r-PA) and lanetoplase (n-PA) but t-PA proves to be the most efficient drug of them all [11, 12] .Inspite of the popularity and the mortality benefit of tissue plasminogen activator in developed nations like the United States, streptokinase still continues to be the life saving drug for millions of patients who sustain Acute Myocardial Infarction in developing countries like India. This is mainly because of the cost of tissue plasminogen activator which is 10 fold more than that of streptokinase which is not affordable to most people who face the unanticipated event of Acute Myocardial Infarction [13].

4.1. Markers of thrombolytic success

The main goal of thrombolysis in Acute Myocardial Infarction is to recanalise the occluded coronary artery which gives better results in terms of mortality [14] .Early invasive strategy is essential for patients whose coronaries are not recanalized which is termed thrombolytic failure indicating the importance of the identification of patients with thrombolytic failure. Several clinical and investigational parameters were analyzed to predict the failure of thrombolysis. Presence of anginal pain in the previous seven days will lead to a small infarct size resulting in successful thrombolysis as study says [15] . One interesting fact is that cigarette smoking favours successful thrombolysis . Patients undergoing early lytic therapy have more chance of

successful thrombolysis [16] .Circadian rhythm can also affect thrombolyis – thrombolysis in early morning time is less successful because of the viscosity of the blood, higher reactivity of platelet and coagulation and inhibition of natural fibrinolyis in the early morning time [17]. The levels of thrombin, anti-thrombin 3 complexes in plasma are found to have inverse relationship to the success of thrombolysis [18].

4.2. ST segment resolution (STR)

The resolution of ST segment in ecg after thrombolysis was studied as a prognosticator for patients with Acute Myocardial Infarction. It was elucidated in previous studies that ST segment resolution more than 70% in three hours after thrombolysis favours a good outcome in terms of reperfusion of the coronaries, short term and long term mortality. ST segment resolution less than 30 % is found to have an adverse outcome in patients thrombolysed for acute myocardial infarction [19] . Schroder et al tried to analyse the prognostic power of ST segment resolution for the outcome of acute myocardial infarction by taking data from the Intravenous Streptokinase in Acute Myocardial Infarction (ISAM) study which has a well characterized and large population group in which multivariate analytic study was performed. They had three groups with ST resolution less than 30 %, 30 to 70% and more than 70% at three hours of thrombolysis. Several outcomes like size of infarct by creatinine kinase MB curve area, left ventricular ejection fraction and short term mortality were analysed. There are also studies done by Saran et al. [20] who studied a cut off point of 30 % in three hours of thrombolysis and Barbash et al. [21] who studied a cut off of 50% in one hour of thrombolysis. All these studies showed an adverse outcome in patients with inadequate ST segment resolution. ST segment resoulution has been studied for years together not only to represent coronary reperfusion but has also been studied in comparison with the gold standard coronary angiography for coronary reflow. It has been stated that coronary angiography gives an illusion on coronary reflow [22] . There was a search for more physiological indicators of coronary reperfusion , that is ST segment resolution and contrast echocardiography [23] . There has also been studies to say that ST segment resolution is better than coronary angiography for coronary reperfusion [24] . When several studies give various cut off for ST segment resolution to stratifty patients and their risk, Per Johansen et al. studied what level of ST segment resolution and in what time to be identified to risk stratify patients. They studied different ST segment resolution cut offs at different times and found that a resolution of more than 50% in 60 minutes was found to have a favourable outcome.

4.3. Platelet indices

Platelets are anucleate cells, smaller in size and they play an essential role in the process of primary hemostasis and thrombosis . Newly formed or young platelets are functionally active [25] .

Following are the specialised functions of platelets and they are change in shape, adherence, aggregation, secretion , action of procoagulation and retraction of clot.There are several indices derived from the platelets by using automated analysers. They include the Mean platelet Volume (MPV), the Platelet Distribution Width (PDW), Plateletocrit, and the Platelet Lymphocyte Ratio (P-LCR). The clinical implications of these indices are under elaborate study [26] .

4.3.1. Mean platelet volume (MPV)

The assessment of volumes, size and shapes of platelets provide useful clinical and pathophysiological characteristics of platelets. The platelet function is directly proportional to the Mean Platelet Volume. It is studied that large platelets are more functional and are more granular . these concepts are proved in in-vivo studies. Platelets with a high mean platelet volume respond more aggressively to platelet agonists like collagen, ADP, arachidonic acid. They express more adhesion molecules like GPIIb/IIIa and are more prothrombotic [27,28] .

4.3.2. Megakaryocyte platelet axis

Platelets do not contain nucleus and they cannot synthesize any proteins. They are heterogenous in nature in respect to their shape, size and density . The protein content and the reactivity of platelets are pre determined before they are released. Megakaryoctyes have a unique property of redoubling their chromosomes without a mitotic division and this is called as the process of endomitosis. Using this process megakaryoctes can produce 14N to 128N ploidy cells. The modal ploidy being 16 N (the normal ploidy being 2N). Each cell produce around 1000-2000 cells which are the fragmentary processes of megakaryocytes. The specialized axis termed the MPHA (megakaryocyte-platelet hemostatic axis). The platelet mass and the platelet count are inversely proportional to the mean platelet volume. The platelet count and mean platelet volume product is always a constant. Bleeding time is inversely related to the MK ploidy. Whenever there is platelet destruction, there is increase in MPV and MK ploidy will remain the same . but when there is platelet synthesis, MK ploidy increases. So both these parameters can change either independently or together depending upon the needs and hemostatic situation [27] .

4.3.3. Platelet volume measurement

There are several methods to measure platelet volume. The basically used method is using the coulter principle in which cells are allowed to pass through a small aperture in an electrical field which produces a change in voltage depending upon the size of the cells passing through. This is interpreted as a histogram and is analysed to conclude the platelet count and size. The curve is used to calculate the mean platelet volume by the formula MPV(fl)=pct(%)x1000/plt(x10^3 per microlitre) [28] .The other method with Technicon instruments uses laser optic technology which interprets the granularity and the size of platelets in suspension. Here light beams are passed through the cells and the scatters are studied. The forward scatter represents the size of the cells and the side scatter denotes the granularity of the cells. MPV is calculated as a mode from the histogram obtained. There is approximately 40 % difference with the Technicon and the Coulter techniques [29] .The normal values for MPV ranges from 4.5 to 8.5 fL (mean – 6.5 fL) [28] .

4.3.4. Platelet distribution width (PDW)

Platelet distribution width shows the heterogenosity in the size of platelets and is derived from the platelet indices from an automated analyzer. The reference range in a study done by Mariela Graniro Farias was derived as 13.3 % as median with a reference range of 10% to 17.9% . Platelet distribution width is a marker of platelet reactivity [30] .When laser technology is used in an analyzer it primarily detects the cross diameter of the cell to derive its volume. Machines using impedance principle focus on the vertical diameter of the cell to asses the cell's size. Whatever may be the technique used, activated platelets will be larger and is not dependent on the technique of analysis [31] .

4.3.5. Role of platelets in coronary artery heart disease

Whenever there is a stressful situation, the platelets that are produced are larger in size and they posses a very high potential for thrombus formation since they produce more thromboxane B2 . During situations of platelet activation both MPV and PDW increase. This change is hypothesized due to the change in platelet shape from that of discoid to spherical shape to attain larger surface area. These changes can be analyzed by the hematology analyzers that works on the impedance principle discussed already. Platelet activation is a very essential step in the production and propagation of the process of atherothrombosis [32] .

The platelet parameters like MPV and PDW are independent risk parameters in Myocardial Infarction (MI) and stroke indicating worse clinical course and mortality [33]. ST-segment Elevation Myocardial Infarction (STEMI) and failure of thrombolysis is influenced by high PDW values. Also it has been studied that PDW is higher in patients with STEMI rather than stable Coronary Artery Disease (CAD). Rather than just association they also influence the success of thrombolysis in STEMI patients [34]

There are several studies which analysed the risk of Platelet Distribution Width (PDW) in acute coronary syndrome like ST Elevtion Myocardial Infarction. Varasteh-ravan et al. [30] studied the relationship of platelet distribution width in patients with acute STEMI thrombolysed with streptokinase and found that patients with higher platelet distribution width had more risk of thromblysis failure measured by ST segment resolution. PDW can be used as an independent marker of risk of thrombolysis failure and short term mortality in patients with STEMI.

4.4. White blood cells

Human white blood cell count is normally 4000 to 11000 cells per microlitre. The most predominant of these cells are the polymorphonuclear leukocytes. Leukocytosis indicates an increase in the blood leukocytes number. As a response to many of the inflammatory states and neoplastic states leukocyte count increases. The increase in leukocyte count depends upon several factors like the storage pool of the precursors, size of the precursors, presence of growth factors, rate of release of the cells from the storage pool, the amount of cells marginating (adhered to) the vessel wall at any time, the extravasation of cells from blood into the tissues [35] .

4.4.1. WBC and ischemic heart disease

The relationship between leukocytes and ischemic heart disease has been studied by several authors. It is also found that WBC count in high normal range is a risk factor for myocardial infarction. Those patients with raised WBC count has a high risk for re-infarction and high in-hospital mortality [36] .

Friedman et al. in 1974 studied the association between WBC count and myocardial infarction. It was found that a raise in the WBC count not only significantly increased the risk of acute myocardial infarction but also the rate of re-infarction. Patients with WBC count more than 10,000 cells per microlitre has double the risk than those patients with a count less than 6000 cells per microlitre. A study in the survivors of Hiroshima and Nagasaki also showed similar results. The risk increases if the patient is a smoker and in later studies it was proved that leukocytosis increases the risk of myocardial infarction independent of smoking. Leukocytosis as a

risk factor is also considered as equal to serum cholesterol level and blood pressure measurement. Surveillance and follow up studies also show that a fall in the WBC count also decreases the risk of myocardial infarction. This hypothesis was also extended to patients with stroke. On differential count examination strong association was found to be with neutrophils. When the risk of myocardial infarction for men with WBC count of 5000 cells per microlitre is set to 1, men with a WBC count of 9000 cells per microlitre is estimated to have a 3.5 times risk of getting a re-infarction [37] . Cole et al. [38] studied that myocardial infarction patients with WBC counts more than 15,000 cells per microlitre had a risk of death in two months than patients with WBC counts less than 10,000 cells per microlitre. It was reported by Maisel et al. [39] that WBC count studied on admission in patients with acute myocardial infarction was found to be an independent risk factor for ventricular fibrillation. Furman and his co-workers [40] studied the association between WBC count on admission and the short term mortality in patients admitted with acute myocardial infarction. Patients with WBC count in the uppermost quintiles had more complicated hospital course and also extensive necrosis of the cardiac muscle. These studies showed the individual risk prediction of admission WBC count on short term mortality following an acute myocardial infarction.

Even in normal circumstances there is slowing of blood flow due to the rheological properties of the white blood cells. They traverse the nutrient capillaries by alteration in their rheology. In certain pathological conditions, this leads to tissue ischemia by a vicious circle [41,42] .WBCs are found to be responsible for the formation of larger thrombus in plaques indicating a marker for hypercoagulable state. It can be due to the following mechanisms.

1. Acyte myocardial infarction creates a state of systemic inflammation as evidenced by the ability of plasma from these patients to induce expression of interleukin 8 and interleukin 1 beta.
2. The activation of procoagulant activity of monocytes by interleukin 6 and interleukin 8 has been proposed as a link between thrombosis and inflammation. These cytokines increase the expression of tissue factor on the surface of monocytes which increases the procoagulant activity.
3. Mac 1 (CD 11b/CD 18) which is a beta 2 integrin causes leukocyte adhesion and also converts factor X to Xa and binds fibrinogen. Platelet adhesion to polymorpho nuclear cells through Mac 1 can also lead to formation of thrombus [43,44] .

4.4.2. WBC count in acute coronary syndrome

There are strong evidences to say that systemic inflammatory response play an important role in acute coronary syndromes [45] . More studies have been done to find the association between white cell count and acute coronary syndrome. It has also been found that high counts are associated with increased mortality and reinfarction and it can also be used as an inexpensive and simple tool to risk stratify patients with acute coronary syndrome [46,47] .

4.5. Previous studies

Varasteh-ravan et al did a study to analyse the relationship of mean platelet volume, platelet distribution width and white blood cells on admission in patients with ST elevation myocardial infarction with ST segment resolution when they are thrombolysed with streptokinase. And they derived cut off values for mean platelet volume, platelet distribution width and white blood cell count for ST segment resolution with best sensitivity and specificity.

In a recent study done by Cetin et al. it was found that platelet distribution width and white blood cells were increased in patients with STEMI and they served as independent predictors for acute STEMI. They also found that mean platelet volume and platelet distribution width were independent predictors of failure of thrombolysis. Also patients with acute STEMI had these indices on the higher side when compared with paitents who had a stable coronary artery disease.

Celik T et al. studied that mean platelet volume is found to be an independent marker of impaired reperfusion angiographically and six month mortality in patients with ST segment elevation myocardial infarction who are treated with primary percutaneous coronary intervention but there was less data which analysed the platelet distribution width and in-hospital adverse cardiovascular events. He also proved that admission mean platelet volume and platelet distribution width correlates independently with no reflow phenomenon and in-hospital major cardiovascular event.

Georg Slavka et al. studied that mortality due to a vascular cause increases when the mean platelet volume is more than 11.01 fL.

Conne E Byrne et al. studied that white blood cell count is found to be elevated in acute coronary syndromes and is related to recurrent events.

4.6. Current Study AND Results :

In our study there was no association between age, sex, smoking, systemic hypertension, dyslipidemia, area of myocardial infarction, 30 day mortality and platelet distribution width.

There was significant association between duration of myocardial infarction, door to needle time, ST segment resolution, hospital stay and platelet distribution width.

There was no significant association between age, sex, smoking, systemic hypertension, dyslipidemia, area of myocardial infarction, 30 day mortality with ST segment resolution.

There was significant association between duration of myocardial infarction, door to needle time hospital stay with ST segment resolution.

There was also significant association between white blood cell count and ST segment resolution.

4.7. Limitations

Further angiographic correlation could give better picture of the association between platelet distribution width and white blood cell count with coronary flow and prognosis of the patients post myocardial infarction.

V. Conclusion

Platelet indices like Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) are well studied markers to prognosticate patients. It was hypothesized that in acute coronary heart diseae, there is increased platelet swelling and pseudopodia formation which causes an increase in the Mean Platelet Volume and Platelet Distribution Width. Among the two indices Platelet Distribution Width is found to be a more specific marker for the activation of platelets. White blood cells are a marker of inflammation and it is also well studied in patients with acute coronary syndrome which causes a rise in the inflammatory markers. White blood cell count, a marker of inflammatory response and platelet distribution width, a marker of reactivity of platelets have been studied to have unfavourable outcomes in patients with ST elevation myocardial infarction. The results of our study has shown significant association between platelet distribution width and white blood cell count with ST segment resolution in patients with STEMI thrombolysed with streptokinase. These factors can be used as simple markers for failure of thrombolysis to suggest an alternative and aggressive management protocol for these patients which require further studies in this context.

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