| **Table (1): Clinical and echocardiographic characteristics** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Overall, N = 441** | **GLS higher than -10 & less than -16, N = 17** | **GLS higher than -16, N = 15** | **GLS less than -10, N = 12** | **p-value2** |
| **Patient age** |  |  |  |  | **0.020** |
| Mean ± SD | 50.32 ± 10.73 | 50.41 ± 10.53 | 45.53 ± 11.17 | 56.17 ± 7.85 |  |
| Median (IQR) | 50.50 (15.00) | 49.00 (7.00) | 43.00 (17.50) | 56.50 (11.00) |  |
| **Gender** |  |  |  |  | **0.004** |
| female | 12 (27%) | 6 (35%) | 0 (0%) | 6 (50%) |  |
| male | 32 (73%) | 11 (65%) | 15 (100%) | 6 (50%) |  |
| **Hypertension** |  |  |  |  | 0.14 |
| No | 30 (68%) | 11 (65%) | 13 (87%) | 6 (50%) |  |
| Yes | 14 (32%) | 6 (35%) | 2 (13%) | 6 (50%) |  |
| **Diabetes Mellitus** |  |  |  |  | **<0.001** |
| No | 28 (64%) | 9 (53%) | 15 (100%) | 4 (33%) |  |
| Yes | 16 (36%) | 8 (47%) | 0 (0%) | 8 (67%) |  |
| **HbA1c** |  |  |  |  | 0.10 |
| Mean ± SD | 8.19 ± 1.14 | 8.60 ± 1.07 | NA ± NA | 7.68 ± 1.05 |  |
| Median (IQR) | 8.20 (2.00) | 9.00 (1.00) | NA (NA) | 7.60 (1.52) |  |
| **History of smoking** |  |  |  |  | **<0.001** |
| Ex-smoker | 8 (18%) | 0 (0%) | 6 (40%) | 2 (17%) |  |
| No | 24 (55%) | 12 (71%) | 2 (13%) | 10 (83%) |  |
| Smoker | 12 (27%) | 5 (29%) | 7 (47%) | 0 (0%) |  |
| **Hemoglobin level** |  |  |  |  | **0.044** |
| Mean ± SD | 13.43 ± 1.29 | 13.11 ± 1.28 | 14.13 ± 1.13 | 13.00 ± 1.21 |  |
| Median (IQR) | 13.00 (2.00) | 13.00 (2.00) | 14.00 (2.00) | 12.50 (2.00) |  |
| **Lipid Profile** |  |  |  |  | 0.25 |
| high | 25 (57%) | 7 (41%) | 10 (67%) | 8 (67%) |  |
| normal | 19 (43%) | 10 (59%) | 5 (33%) | 4 (33%) |  |
| **Systolic blood pressure** |  |  |  |  | 0.17 |
| Mean ± SD | 122.05 ± 18.37 | 127.65 ± 20.16 | 121.33 ± 8.34 | 115.00 ± 23.16 |  |
| Median (IQR) | 120.00 (30.00) | 120.00 (30.00) | 120.00 (0.00) | 105.00 (40.00) |  |
| **Diastolic blood pressure** |  |  |  |  | 0.35 |
| Mean ± SD | 73.41 ± 12.00 | 73.53 ± 13.20 | 76.00 ± 10.56 | 70.00 ± 12.06 |  |
| Median (IQR) | 70.00 (20.00) | 70.00 (20.00) | 70.00 (10.00) | 65.00 (20.00) |  |
| **Heart rate** |  |  |  |  | **0.039** |
| Mean ± SD | 68.84 ± 7.13 | 70.06 ± 8.33 | 65.07 ± 3.71 | 71.83 ± 6.99 |  |
| Median (IQR) | 68.50 (10.00) | 70.00 (11.00) | 65.00 (5.00) | 71.50 (14.00) |  |
| **S.Troponin** |  |  |  |  | 0.14 |
| Mean ± SD | 1,524.95 ± 1,226.81 | 1,394.12 ± 877.12 | 1,571.87 ± 856.42 | 1,651.67 ± 1,945.24 |  |
| Median (IQR) | 1,054.00 (1,244.00) | 1,000.00 (1,600.00) | 1,450.00 (896.00) | 878.00 (243.00) |  |
| **Electrocardiogram** |  |  |  |  |  |
| NSTEMI | 44 (100%) | 17 (100%) | 15 (100%) | 12 (100%) |  |
| **LVESV** |  |  |  |  | 0.63 |
| Mean ± SD | 64.10 ± 35.45 | 68.17 ± 44.33 | 55.31 ± 16.86 | 69.32 ± 39.14 |  |
| Median (IQR) | 56.00 (29.40) | 44.00 (26.70) | 47.00 (29.50) | 63.50 (15.90) |  |
| **LVEDV** |  |  |  |  | 0.62 |
| Mean ± SD | 122.94 ± 45.96 | 126.91 ± 63.90 | 125.26 ± 27.76 | 114.39 ± 35.04 |  |
| Median (IQR) | 103.00 (36.60) | 100.00 (50.03) | 112.00 (37.40) | 103.00 (18.00) |  |
| **LVEF** |  |  |  |  | **<0.001** |
| Mean ± SD | 48.78 ± 11.30 | 48.83 ± 7.42 | 57.94 ± 6.42 | 37.26 ± 10.35 |  |
| Median (IQR) | 50.60 (16.25) | 50.30 (7.06) | 57.00 (12.20) | 35.23 (17.63) |  |
| **Follow up during in-hospital stay** |  |  |  |  | **<0.001** |
| developed symptoms of heart failure | 16 (36%) | 4 (24%) | 0 (0%) | 12 (100%) |  |
| discharged with good general condition | 28 (64%) | 13 (76%) | 15 (100%) | 0 (0%) |  |
| 1Mean ± SD, Median (IQR); n (%) | | | | | |
| 2Kruskal-Wallis rank sum test; Fisher's exact test; Pearson's Chi-squared test | | | | | |

Chart, bar chart, box and whisker chart

Description automatically generated

**Figure (1): Distribution of patients according to gender**

73% of the patients in the study were male, 27% were female. There was a statistically significant difference in gender across GLS groups (P= 0.004).

Chart, box and whisker chart

Description automatically generated

**Figure (2): Distribution of patients’ age across GLS groups**

Mean patient age was 50.32±10.73 years old. There was a statistically significant difference in age across GLS groups (P= 0.02).

Chart, box and whisker chart

Description automatically generated

**Figure (3): Distribution of patients according to presence of hypertension in relation to GLS score**

32% of patients had hypertension. No statistically significant association was found between presence of hypertension and GLS score (P= 0.14).

Chart, box and whisker chart

Description automatically generated

**Figure (4): Distribution of patients according to presence of diabetes mellitus in relation to GLS score**

36% of patients had diabetes mellitus, and a statistically significant association was found between presence of diabetes and GLS score (P< 0.001). Mean HbA1c in diabetic patients was 8.19±1.14 %.

Chart, box and whisker chart

Description automatically generated

**Figure (5): Distribution of patients according to smoking status in relation to GLS score**

27% of patients were smoker, 18% were ex-smokers, and 55% were non-smokers. A statistically significant association was found between smoking and GLS score (P< 0.001).

Chart, box and whisker chart

Description automatically generated

**Figure (6): Distribution of hemoglobin level across GLS groups**

Mean hemoglobin level was 13.43±1.29 g/dl. A statistically significant difference was found between hemoglobin level across GLS groups (P= 0.044).

Chart, box and whisker chart

Description automatically generated

**Figure (7): Distribution of patients’ lipid profile in relation to GLS groups**

57% of patients had a high lipid profile, but no statistically significant association was found between lipid profile and GLS score (P= 0.25).

Chart, box and whisker chart

Description automatically generated

**Figure (8): Distribution of systolic blood pressure across GLS groups**

Mean systolic blood pressure was 122.05±18.37 mmHg. No statistically significant difference in systolic blood pressure was found across GLS groups (P= 0.17).

Chart, box and whisker chart

Description automatically generated

**Figure (9): Distribution of diastolic blood pressure across GLS groups**

Mean diastolic blood pressure was 73.41±12.00 mmHg. No statistically significant difference in diastolic blood pressure was found across GLS groups (P= 0.35).

Chart, box and whisker chart

Description automatically generated

**Figure (10): Distribution of heart rate across GLS groups**

Mean heart rate was 68.84±7.13 bpm, and a statistically significant difference was found in heart rate across GLS groups (P= 0.039).

Chart, box and whisker chart

Description automatically generated

**Figure (11): Distribution of troponin across GLS groups**

Mean troponin level was 1524.95±1226.81 pg/ml. No statistically significant difference was found in troponin level across GLS groups (P= 0.14).

Chart, box and whisker chart

Description automatically generated

**Figure (12): Results of patients’ follow up in relation to GLS score**

36% of patients developed symptoms of heart failure, including 100% of those were classified as having important reduced GLS score (less than -10%) and 24% of those classified as having reduced GLS score (less than -16% and higher than -10%). A statistically significant difference was found in follow up results across GLS groups (P< 0.001).

Chart, box and whisker chart

Description automatically generated

**Figure (13): Distribution of left ventricular ejection fraction across GLS groups**

Mean left ventricular ejection fraction was 48.78±11.30 %. A statistically significant difference was found in left ventricular ejection fraction across GLS groups (P< 0.001).

Chart, scatter chart

Description automatically generated

**Figure (14): GLS score in relation to left ventricular ejection fraction**

A statistically significant correlation was found between the results of left ventricular ejection fraction and GLS score (r= 0.82, P< 0.001)

| **Table (2): Differentiation of patients according to Simpson's LVEF in relation to follow up** | | | | |
| --- | --- | --- | --- | --- |
|  | **Simpson's LVEF** | |  | |
| **Characteristic** | **Diseased** | **Normal** | **Total** | **p-value1** |
| **Follow up** |  |  |  | **<0.001** |
| Diseased | 10 | 4 | 14 |  |
| Normal | 0 | 26 | 26 |  |
| **Total** | 10 | 30 | 40 |  |
| 1Fisher's exact test | | | | |
| **Table (3): Differentiation of patients according to GLS score in relation to follow up** | | | | |
|  | **GLS** | |  | |
| **Characteristic** | **Diseased** | **Normal** | **Total** | **p-value1** |
| **Follow up** |  |  |  | **<0.001** |
| Diseased | 12 | 4 | 16 |  |
| Normal | 0 | 28 | 28 |  |
| **Total** | 12 | 32 | 44 |  |
| 1Fisher's exact test | | | | |
| **Table (4): Differentiation of patients according to GLS score in relation to Simpson's LVEF** | | | | |
|  | **GLS** | |  | |
| **Characteristic** | **Diseased** | **Normal** | **Total** | **p-value1** |
| **Simpson's LVEF** |  |  |  | **0.007** |
| Diseased | 6 | 4 | 10 |  |
| Normal | 4 | 26 | 30 |  |
| **Total** | 10 | 30 | 40 |  |
| **1Fisher's exact test** | | | | |
| **Kappa = 0.47, P value = 0.004** | | | | |

Statistically significant associations were found between patients’ classification according to left ventricular ejection fraction and their follow up results (P< 0.001), between patients’ classification according to GLS score and their follow up results (P< 0.001), and between patients’ classification according to left ventricular ejection fraction and GLS score (P= 0.007).

Inter-rater reliability between Simpson’s left ventricular ejection fraction and GLS score was 0.46 and was statistically significant (P= 0.004).

| **Table (5): Validity: Simpson's LVEF** | |
| --- | --- |
| **Item** | **Value** |
| **Sensitivity** | 100 % |
| **Specificity** | 87 % |
| **PPV** | 71 % |
| **NPV** | 100 % |
| **Accuracy** | 90 % |
| **Table (6): Validity: GLS** | |
| **Item** | **Value** |
| **Sensitivity** | 100 % |
| **Specificity** | 88 % |
| **PPV** | 75 % |
| **NPV** | 100 % |
| **Accuracy** | 91 % |

The table shows high sensitivity and specificity of both Simpson’s left ventricular ejection fraction and GLS score in identifying patients with heart failure, with GLS score reaching 90% accuracy and Simpson’s left ventricular ejection fraction reaching 91% accuracy.

Chart

Description automatically generated

**Figure (15): ROC (receiver operating characteristic) curve of Simpson’s LVEF**

Chart

Description automatically generated

**Figure (16): ROC (receiver operating characteristic) curve of GLS score**

Both Simpson’s left ventricular ejection fraction and GLS score reached the optimum area under the curve (AUC) of 100%.