

AIM OF THE WORK

The aim of this work was to evaluate the role of CRP and procalcitonin as prognostic factors in cases of community acquired pneumonia.

PATIENTS

The study was carried out during the period from May 2014 to November 2014 on 20 adult patients, who presented to the emergency casualty in Alexandria Main University hospital; diagnosed as community acquired pneumonia.

Approval of the medical ethics committee of Alexandria faculty of Medicine, and an informed consent from the patients or the first degree relatives of the patients was taken before conducting the study.

Inclusion criteria:

1. Adult patients of both sexes above 18 years old.
2. Patients presented with community acquired pneumonia.

Exclusion criteria:

1. Pregnant females.
2. Patients diagnosed as nosocomial pneumonia.
3. Septic shock.
4. Conditions causing elevated procalcitonin levels other than pneumonia as trauma, burns, surgery, neuroendocrine tumours.

METHODS

All patients included in the study were subjected on admission to the followings:

1. Full history taking (name, age, sex, occupation, marital status, past history).
2. Complete physical examination.
3. Peripheral venous blood specimens were collected on admission, for measuring of routine laboratory investigations including: CBC, Na, K, fasting blood sugar, PT, PTT, Serum Urea and creatinine were done on admission and every other day.
4. Procalcitonin level (ng/ml)^(149, 150) was estimated with Elecsys BRAHMS PCT REF **05056888** 200 100, in the serum of the studied patients in the first hour of presentation and follow up after two weeks of antibiotic therapy. The Electrochemiluminescence immunoassay (ECLIA) was used for quantitative determinant of PCT on Elecsys and **cobas e** immunoassay analyzers.

Test Principle: Sandwich principle. Total duration of assay: 18 minute.

- 1st incubation: Antigen in the sample (30µL), a biotinylated monoclonal PCT-specific antibody, and a monoclonal PCT-specific antibody labeled with a ruthenium complex react to form a sandwich complex.
- 2nd incubation: After addition of streptavidin coated microparticles, the complex becomes bound to the solid phase via interaction of biotin and streptavidin.
- The reaction mixture is aspirated into the measuring cell where the micro particles are magnetically captured onto the surface of the electrode. Unbound substances are removed with ProCell/ProCell M. Application of a voltage to the electrode then induces chemiluminescent emission which is measured by a photomultiplier.
- Results are determined via a calibration curve which is instrument-specifically generated by 2-point calibration and a master curve provided via the reagent barcode.

Specimen collection and preparation

- Two ml whole blood were collected using standard red-topped vacutainer tubes, centrifuged, serum was separated and then measured for PCT.

Calculation of results

The analyzer automatically calculates the analyte concentration of each sample in ng/ml.

Expected values: Clinical cut-off:

- < 0.5 ng/ml represent a low-risk of severe sepsis and/or septic shock.
- ≥0.5 ng/ml represent a high-risk of severe sepsis and/or septic shock.

5. CRP level was estimated in the serum of the studied patients in the first hour of presentation and follow up after two weeks of antibiotic therapy.
6. Sputum cultures were taken from all patients.
7. Daily Plain chest x-ray postero-anterior view was done.
8. All patients were triaged according to the severity of the community acquired pneumonia based upon CURB-65 scoring system, and were managed according to the standard protocols of management of the community acquired pneumonia.⁽¹⁻³⁾

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data (age, gender, and preexisting conditions) were described using number and percent. Quantitative data (PCT, CRP, and lactate) were described using median, minimum and maximum as well as mean and standard deviation. For qualitative variables, Chi-square test was used. When more than 20% of the cells had expected count less than 5, correction for Chi-square was conducted using Fisher's Exact test or Monte Carlo correction.

The distribution of quantitative variables was tested for normality using Kolmogorov-Smirnov test and Shapiro-Wilk test. D'Agostino test was used if there was a conflict between the two previous tests. Mann-Whitney test (for data distribution that were significantly deviated from normal) was used to analyze two independent populations, while for multi-group comparisons, Kruskal-Wallis one-way analysis of variance was applied. All statistical tests were two-tailed.

RESULTS

The present study was carried out on 20 adult patients of both sex, diagnosed as Community acquired pneumonia (CAP). Patients were divided according to outcome into two groups; Survivors=Group I (n= 14) and Non-survivors=Group II (n=6).

Demographic Characteristics

Table (3) shows the distribution of the studied patients according to the age and gender.

Gender

Males constituted 7 patients (50%) of Group I and 4 patients (66.7%) of Group II, while females constituted 7 patients (50%) of Group I and 2 patients (33.3%) of Group II with no statistically significant difference between the two groups regarding gender ($p=0.642$) (Table 4) (Figure 2&3).

Age

The age in Group I ranged from 48.0 – 75.0 years with a mean age of 62.21 ± 8.84 years, and the age in Group II ranged from 63.0 – 78.0 years with a mean age of 69.83 ± 5.34 years. There was no statistically significant difference between both groups regarding age ($p=0.067$) (Table 4) (Figure 4 &5).

Table (3): Distribution of the studied cases according to demographic data

| | No. | % |
|----------------|------------------|------|
| Sex | | |
| Male | 11 | 55.0 |
| Female | 9 | 45.0 |
| Age | | |
| >65 | 11 | 55.0 |
| <65 | 9 | 45.0 |
| Min. – Max. | 48.0 - 78.0 | |
| Mean \pm SD. | 64.50 ± 8.59 | |
| Median | 65.50 | |

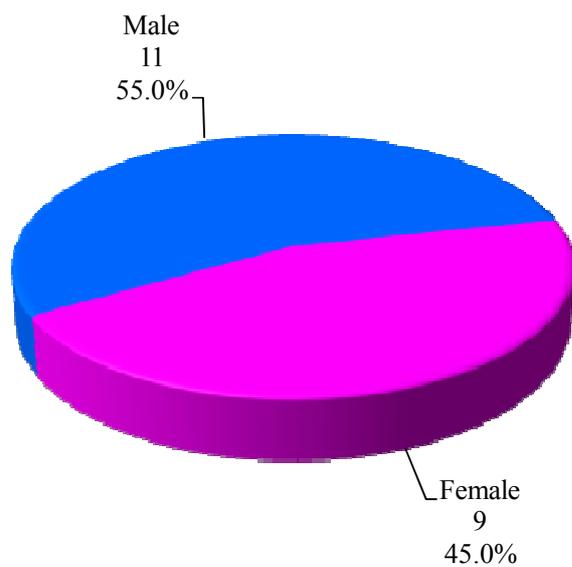


Figure (2): Distribution of the studied cases according to sex

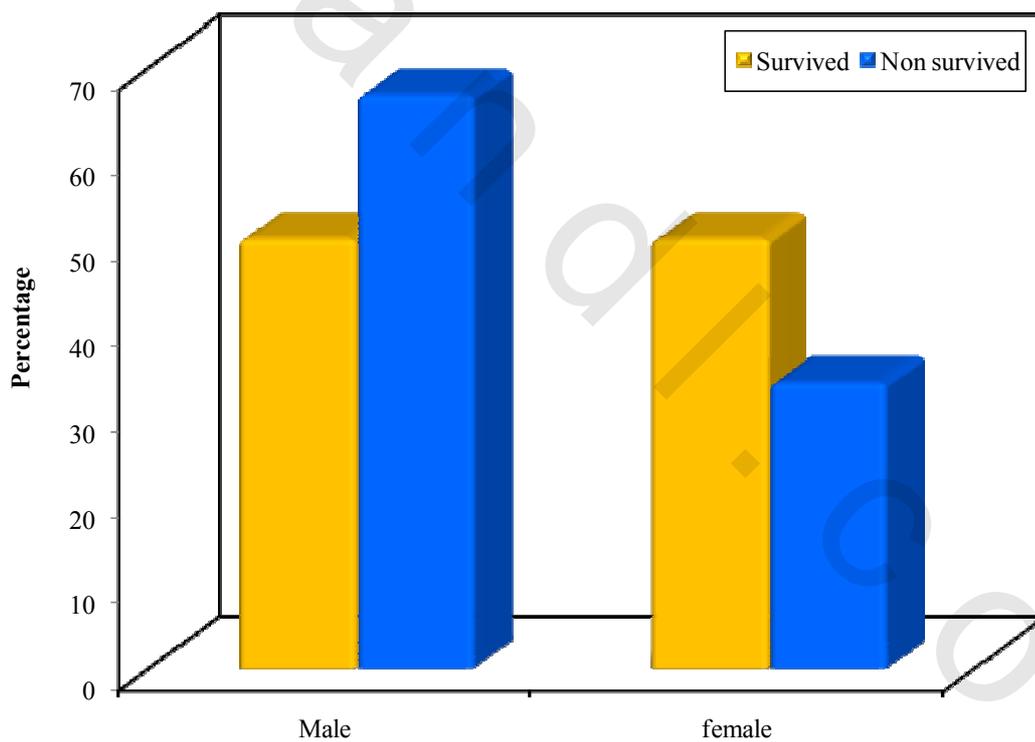


Figure (3): Relation between outcome with sex

Table (4): Relation between outcome with demographic data

| | Outcome | | | | Test of sig. | P |
|---------------|---------------------|------|---------------------|------|------------------|-------------|
| | Group I (n = 14) | | Group II (n = 6) | | | |
| | No. | % | No. | % | | |
| Gender | | | | | | |
| Male | 7 | 50.0 | 4 | 66.7 | $\chi^2 = 0.471$ | FE p= 0.642 |
| female | 7 | 50.0 | 2 | 33.3 | | |
| Age | | | | | | |
| >65 | 6 | 42.9 | 5 | 83.3 | $\chi^2 = 2.780$ | FE p= 0.157 |
| <65 | 8 | 57.1 | 1 | 16.7 | | |
| Min – Max. | 48.0 – 75.0 | | 63.0 – 78.0 | | t= 1.946 | 0.067 |
| Mean ± SD. | 62.21 ± 8.84 | | 69.83 ± 5.34 | | | |
| Median | 63.50 | | 69.50 | | | |

χ^2 : Value for chi square

FE: Fisher Exact test

t: Student t-test

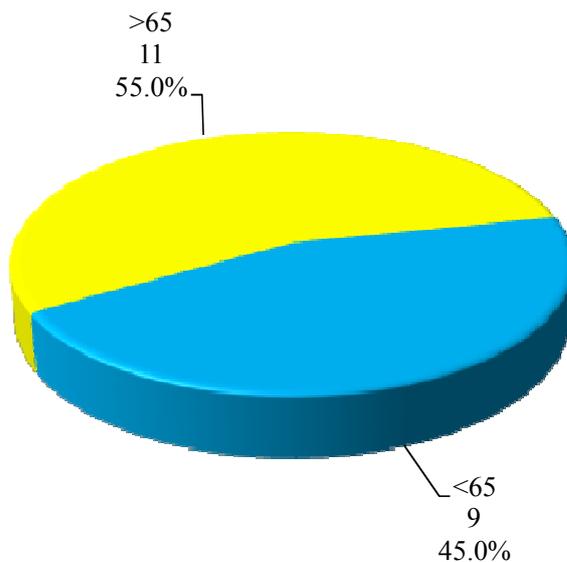


Figure (4): Distribution of the studied cases according to age

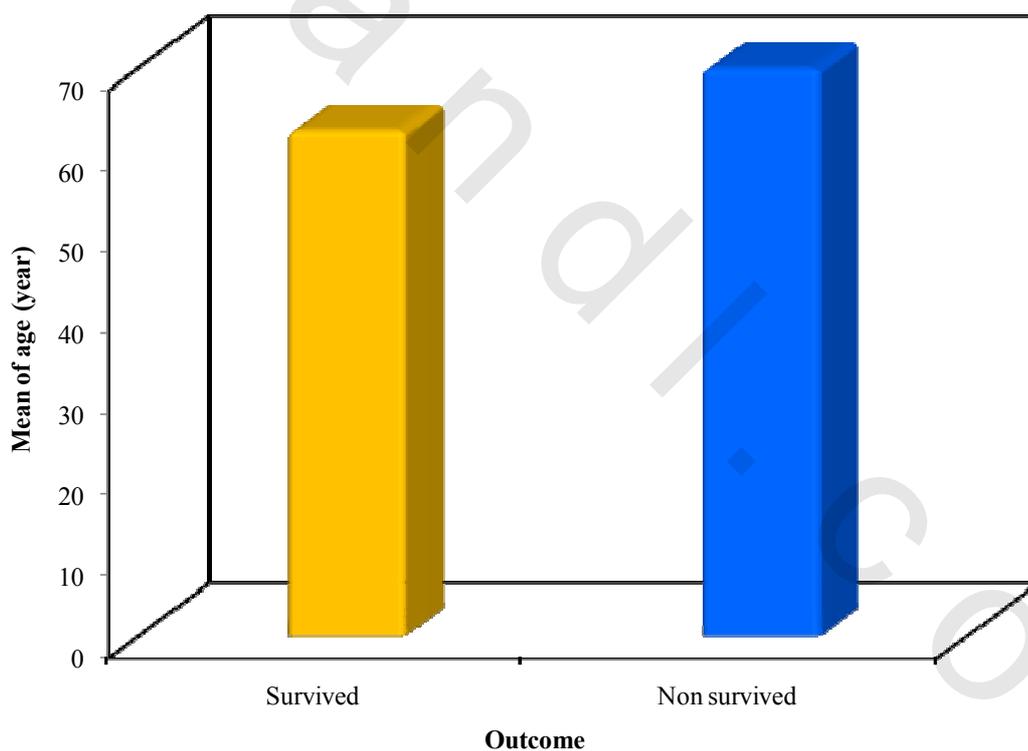


Figure (5): Relation between outcome with age

Co-morbidities

Regarding existence of associated diseases, 12 patients presented with diabetes mellitus, 11 patients with hypertension, 7 patients with ischemic heart disease, 4 patients with COPD, 4 patients with heart failure, 3 patients with chronic kidney disease, and 2 patients with liver impairment (Table 5) (figure 6).

Table (5): Distribution of the studied cases according to past history (n = 20)

| | No. | % |
|-------------------------|-----|------|
| DM | 12 | 60.0 |
| HTN | 11 | 55.0 |
| IHD | 7 | 35.0 |
| COPD | 4 | 20.0 |
| HF | 4 | 20.0 |
| CKD | 3 | 15.0 |
| Liver Impairment | 2 | 10.0 |

DM: Diabetes mellitus

HTN: Hypertension

HF: Heart failure

COPD: Chronic obstructive pulmonary disease

CKD: Chronic kidney disease

IHD: Ischemic heart disease

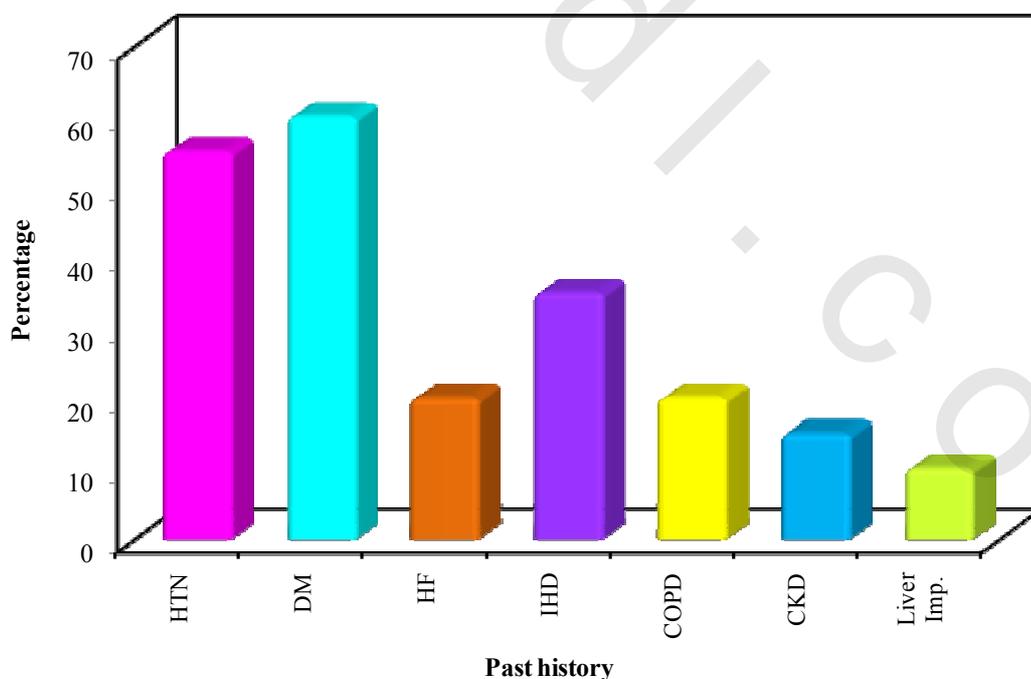


Figure (6): Distribution of the studied cases according to co-morbidities

Clinical Data

Cough was the commonest complaint among the studied patients (100%) followed by fever, dyspnea, and chest pain (90%, 85%, 50%, respectively) (Table 6) (figure 7).

Table (7) demonstrates the vital signs of all studied patients. The respiratory rate ranged between 16.0 – 44.0 breaths per minute with a mean of 29.40 ± 8.43 breath per minute. The heart rate ranged between 70.0 – 140.0 beats per minute with a mean of 103.75 ± 17.46 beats per minute. The systolic blood pressure ranged from 70.0 - 180.0 mmHg with a mean of 114.0 ± 25.83 mmHg.

Table (6): Distribution of the studied cases according to symptoms (n = 20)

| | No. | % |
|-------------------|-----|-------|
| Cough | 20 | 100.0 |
| Fever | 18 | 90.0 |
| Dyspnea | 17 | 85.0 |
| Chest pain | 10 | 50.0 |

Table (7): Descriptive analysis of the studied cases according to vital signs (n=20)

| | Min. – Max. | Mean \pm SD | Median |
|------------|--------------|--------------------|--------|
| RR | 16.0 – 44.0 | 29.40 ± 8.43 | 29.50 |
| HR | 70.0 – 140.0 | 103.75 ± 17.46 | 105.0 |
| SBP | 70.0 - 180.0 | 114.0 ± 25.83 | 110.0 |

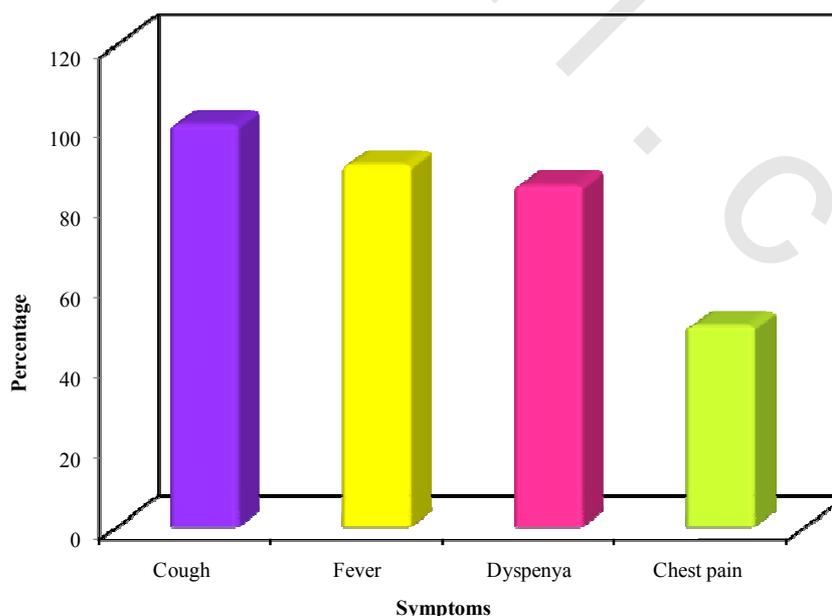


Figure (7): Distribution of the studied cases according to symptoms

Routine Laboratory Investigations (Table 8)

Concerning the complete blood count, hemoglobin level (Hb) ranged between 6.70 g/dl - 16.10 g/dl with a mean of 11.59 ± 2.67 g/dl, white blood count (WBCs) ranged between $3.70 - 32.80 \times 10^3$ /ul with a mean of $16.06 \pm 8.05 \times 10^3$ /ul, platelets counts ranged between $80.0 - 420.0 \times 10^3$ /ul with a mean of $243.45 \pm 104.69 \times 10^3$ /ul.

Regarding liver enzymes, alanine amino tranferase (ALT) ranged between 20.0 – 300.0 U/L with a mean of 69.50 ± 73.57 U/L, aspartate amino tarnsferase (AST) ranged between 20.0 – 392.0 U/L with a mean of 75.20 ± 88.80 U/L.

Regarding renal function tests, blood urea ranged between 16.0 – 44.0 mg/dl with a mean of 78.90 ± 45.21 mg/dl, serum creatinine ranged between 0.60 – 3.10 mg/dl with a mean of 1.37 ± 0.68 mg/dl.

Table (8): Descriptive analysis of the studied cases according to routine laboratory results (n=20)

| | Min. – Max. | Mean \pm SD | Median |
|---|--------------------|---------------------------------|---------------|
| Hb (g/dl) | 6.70 – 16.10 | 11.59 ± 2.67 | 11.85 |
| WBCs ($\times 10^3$) /ul | 3.70 – 32.80 | 16.06 ± 8.05 | 14.90 |
| Neutrophils % | 67.0 – 95.60 | 81.68 ± 8.58 | 79.85 |
| Lymphocytes % | 2.70 – 30.0 | 12.59 ± 7.37 | 13.15 |
| Platelets ($\times 10^3$) /ul | 80.0 – 420.0 | 243.45 ± 104.69 | 255.0 |
| Serum Creatinine (mg/dl) | 0.60 – 3.10 | 1.37 ± 0.68 | 1.15 |
| Serum Urea (mg/dl) | 18.0 - 193.0 | 78.90 ± 45.21 | 29.50 |
| Serum ALT (U/L) | 20.0 – 300.0 | 69.50 ± 73.57 | 39.50 |
| Serum AST (U/L) | 20.0 – 392.0 | 75.20 ± 88.80 | 40.0 |

Sputum Cultures (Table 9)

Sputum cultures were positive in 16 patients (80%), and in 4 patients (20%), sputum cultures were no growth. *Streptococcus pneumoniae* was the commonest isolated gram-positive organism representing 12 patients (60%). *Pseudomonas aeruginosa* was detected in 2 patients (20%). Staphylococcus aureus was detected in 1 patient (5%). Enterobacteriaceae was detected in 1 patient (5%).

Table (9): Showing individual results of sputum cultures (causative organism):

| Sputum Cultures | No. | % |
|---------------------------------|------------------|-------------------|
| No Growth | <u>4</u> | <u>20%</u> |
| Survived | 4 | 100 % |
| Not survived | 0 | 0 % |
| Gram +ve | <u>13</u> | <u>65%</u> |
| Streptococcus pneumoniae | 12 | 92.3% |
| Survived | 7 | 58.3% |
| Not survived | 5 | 41.7% |
| Staphylococcus aureus | 1 | 5% |
| Survived | 1 | 100% |
| Not survived | 0 | 0.0% |
| Gram –ve | <u>3</u> | <u>15%</u> |
| Pseudomonas aeruginosa | 2 | 10% |
| Survived | 1 | 50% |
| Not survived | 1 | 50% |
| Enterobacteriaceae | 1 | 5% |
| Survived | 1 | 100% |
| Not survived | 0 | 0% |

Distribution of the studied cases according to CURB-65 (confusion, urea, respiratory rate, and systolic blood pressure, and age >65) (Table 10) (Figure 8)

According to CURB 65, among the whole studied patients, 9 patients (45%) were confused, 17 patients (85%) were in renal impairment with a mean serum urea of the whole studied patients was 78.90 ± 45.21 mg/dl, 10 patients (50%) were tachypnic with a mean respiratory rate of the whole studied patients was 29.40 ± 8.43 breath/minute, 3 patients (15%) were hypotensive with a mean systolic blood pressure of the whole studied patients was 114.0 ± 25.83 mm/Hg. Also, The CURB-65 score ranged from 0.0 – 5.0 with a mean of 2.65 ± 1.23 .

Table (10): Distribution of the studied cases according to CURB-65 (confusion, urea, respiratory rate, and systolic blood pressure, and age >65)

| | No. | % |
|--|-------------------|------|
| Confusion | | |
| Yes | 9 | 45.0 |
| No | 11 | 55.0 |
| Serum Urea | | |
| >20 mg/dL | 17 | 85.0 |
| <20 mg/dL | 3 | 15.0 |
| Respiratory rate(≥ 30 breaths per minute) | | |
| Yes | 10 | 50.0 |
| No | 10 | 50.0 |
| Hypotension(Systolic pressure <90 mmHg) | | |
| Yes | 3 | 15.0 |
| No | 17 | 85.0 |
| Serum Urea | | |
| Min - max | 18.0 - 193.0 | |
| Mean \pm SD | 78.90 \pm 45.21 | |
| Median | 76.0 | |
| Respiratory rate | | |
| Min - max | 16.0 - 44.0 | |
| Mean \pm SD | 29.40 \pm 8.43 | |
| Median | 29.50 | |
| Systolic blood pressure | | |
| Min - max | 70.0 - 180 | |
| Mean \pm SD | 114.0 \pm 25.83 | |
| Median | 110.0 | |
| CURB65 | | |
| Min - max | 0.0 - 5.0 | |
| Mean \pm SD | 2.65 \pm 1.23 | |
| Median | 2.0 | |
| Age | | |
| >65 | 11 | 55.0 |
| >65 | 9 | 45.0 |
| Min. - Max | 48.0 - 78.0 | |
| Mean \pm SD. | 64.50 \pm 8.59 | |
| Median | 65.50 | |

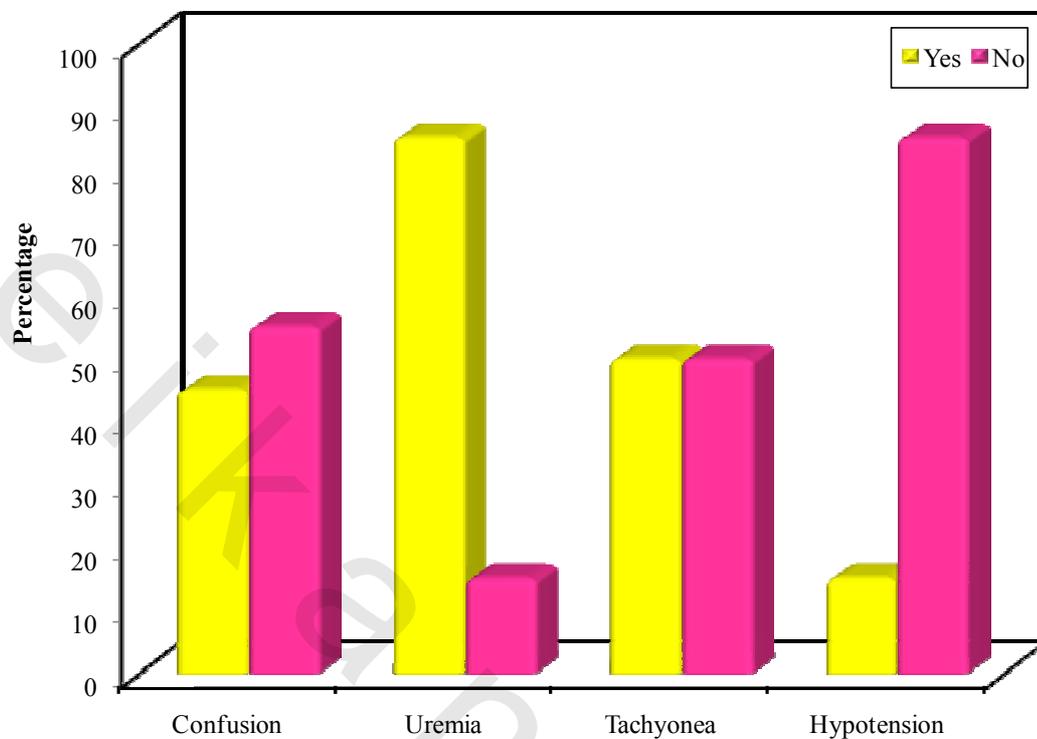


Figure (8): Distribution of the studied cases according to confusion, urea, tachypnea, and hypotension.

Comparison between Group I and Group II Regarding Preexisting Conditions

The preexisting medical conditions were similar in both groups, with diabetes mellitus as the commonest preexisting condition representing 7 patients (50%) in Group I and 5 patients (83.3%) in Group II with no statistically significant difference between the two groups ($p=0.325$). Hypertension was the second common preexisting condition representing 7 patients (50%) and 4 patients (66.7%) in Group I and Group II, respectively with no statistically significant difference between the two groups ($p=0.642$).

Ischemic heart disease represented 4 patients (28.6%) in Group I and 3 patients (50%) in Group II, and COPD represented 2 patients (14.3%) in Group I and 2 patients (33.3%) in Group II with no statistically significant difference between the two groups ($p=0.613$, $p=0.549$, respectively) (Table 11) (Figure 9).

Table (11): Relation between outcome & past history

| Past history | Outcome | | | | χ^2 | FE p | |
|-------------------------|----------------|------|-----------------|------|----------|--------|----|
| | Group (n = 14) | | I Group (n = 6) | | | | II |
| | No. | % | No. | % | | | |
| DM | 7 | 50.0 | 5 | 83.3 | 1.944 | 0.325 | |
| HTN | 7 | 50.0 | 4 | 66.7 | 0.471 | 0.642 | |
| IHD | 4 | 28.6 | 3 | 50.0 | 0.848 | 0.613 | |
| COPD | 2 | 14.3 | 2 | 33.3 | 0.952 | 0.549 | |
| HF | 3 | 21.4 | 1 | 16.7 | 0.060 | 1.000 | |
| CKD | 2 | 14.3 | 1 | 16.7 | 0.019 | 1.000 | |
| Liver impairment | 1 | 7.1 | 1 | 16.7 | 0.423 | 0.1521 | |

χ^2 : Chi square test

FE: Fisher Exact test

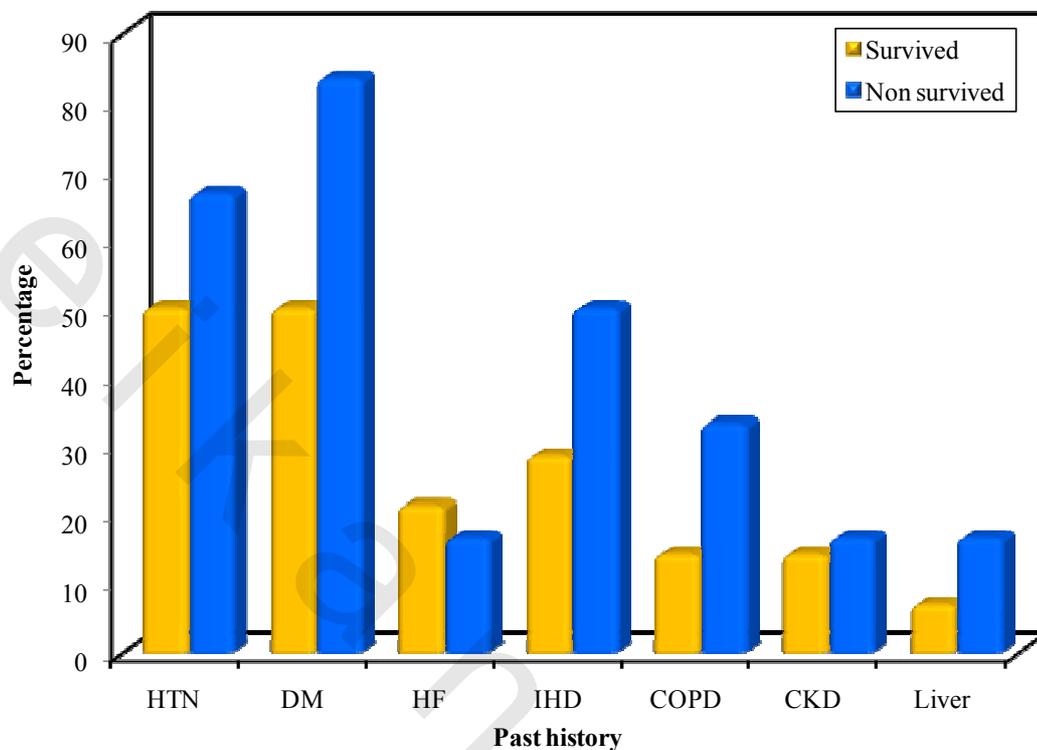


Figure (9): Relation between outcome & co-morbidities

Comparison between Group I and Group II Regarding Clinical Data

There was no statistically significant difference between Group I and Group II regarding cough, fever, dyspnea, and chest pain ($p=1$, $p=0.521$, $p=0.521$, and $p=0.628$, respectively) (Table 12) (figure 10).

Also there was no statistically significant difference between Group I and Group II regarding respiratory rate, heart rate, and systolic blood pressure ($p=0.755$, $p=0.192$, and $p=0.14$, respectively) (Table 13)

Table (12): Relation between outcome & symptoms

| Symptoms | Outcome | | | | χ^2 | FE p |
|-------------------|------------------|-------|------------------|-------|----------|-------|
| | Group I (n = 14) | | Group II (n = 6) | | | |
| | No. | % | No. | % | | |
| Cough | 14 | 100.0 | 6 | 100.0 | - | - |
| Fever | 13 | 92.9 | 5 | 83.3 | 0.423 | 0.521 |
| Dyspnea | 11 | 78.6 | 6 | 100.0 | 1.513 | 0.521 |
| Chest pain | 6 | 42.9 | 4 | 66.7 | 0.952 | 0.628 |

χ^2 : Chi square test

FE: Fisher Exact test

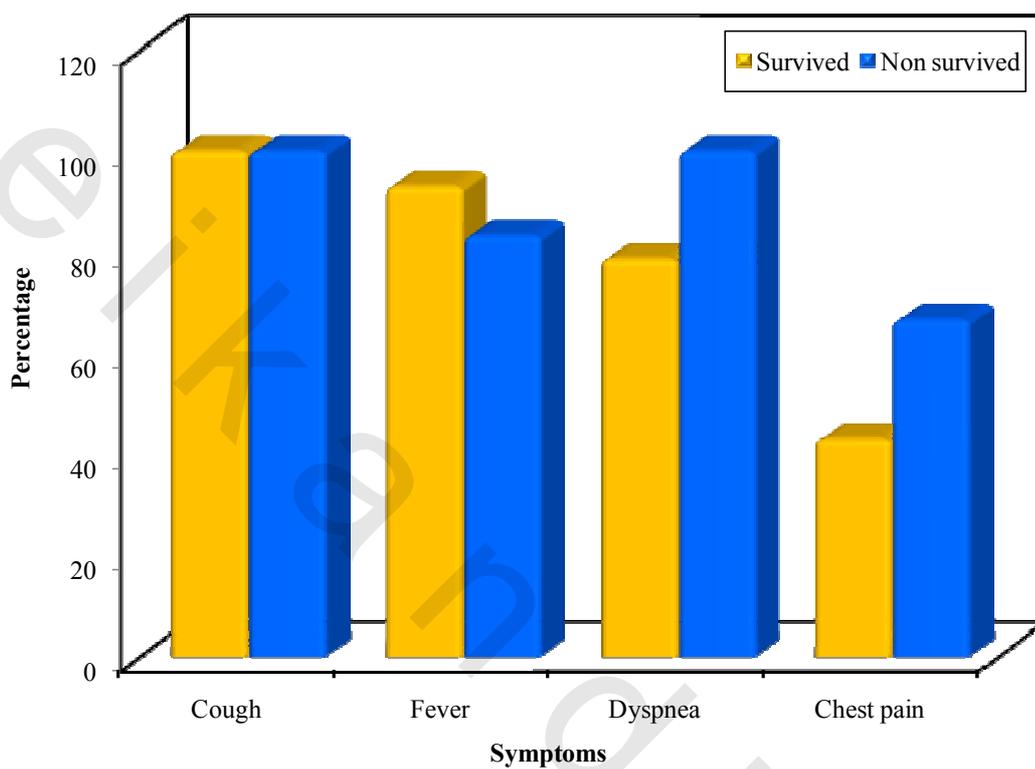


Figure (10): Relation between outcome & symptoms

Table (13): Comparison between Group I and Group II Regarding vital signs

| Vital signs | Outcome | | t | p |
|-------------|----------------|----------------|-------|-------|
| | Group (n = 14) | Group (n = 6) | | |
| RR | | | | |
| Min. – Max. | 16.0 – 44.0 | 16.0 – 41.0 | | |
| Mean ± SD | 29.0 ± 8.10 | 30.33 ± 9.91 | 0.316 | 0.755 |
| Median | 29.50 | 30.0 | | |
| HR | | | | |
| Min. – Max. | 70.0 – 130.0 | 85.0 – 140.0 | | |
| Mean ± SD | 100.36 ± 16.46 | 111.67 ± 18.62 | 1.356 | 0.192 |
| Median | 102.50 | 112.50 | | |
| SBP | | | | |
| Min. – Max. | 90.0 – 180.0 | 70.0 – 140.0 | | |
| Mean ± SD | 119.64 ± 24.61 | 100.83 ± 25.77 | 1.546 | 0.140 |
| Median | 112.50 | 97.50 | | |

t: Student t-test

Comparison between Group I and Group II Regarding Routine Laboratory Investigations

There was no statistically significant difference between Group I and Group II regarding, Hb, neutrophils, and platelets ($p=0.396$, $p=0.0126$, and $p=0.973$, respectively) (Table 14) (figure 11-13).

Also there was no statistically significant difference between Group I and Group II regarding ALT, AST ($p=0.107$, $p=0.127$, respectively), neither creatinine ($p=0.804$) (Table 14) (figure 14).

Table (14): Comparison between Group I and Group II Regarding Routine Laboratory Investigations

| Routine lab | Outcome | | Test of sig. | p |
|--------------------|----------------|------------------|--------------|-------|
| | Group (n = 14) | Group II (n = 6) | | |
| Hb | | | | |
| Min. – Max. | 6.70 – 16.10 | 7.0 – 15.30 | | |
| Mean ± SD | 11.24 ± 2.60 | 12.38 ± 2.89 | t= 0.870 | 0.396 |
| Median | 11.30 | 13.15 | | |
| Neutrophils | | | | |
| Min. – Max. | 67.0 – 95.0 | 77.0 – 95.60 | | |
| Mean ± SD | 79.74 ± 8.73 | 86.20 ± 6.80 | t= 1.606 | 0.126 |
| Median | 78.0 | 86.45 | | |
| Platelets | | | | |
| Min. – Max. | 95.0 – 420.0 | 80.0 – 410.0 | | |
| Mean ± SD | 244.0 ± 98.36 | 242.17 ± 128.41 | t= 0.035 | 0.973 |
| Median | 255.0 | 252.50 | | |
| ALT | | | | |
| Min. – Max. | 20.0 – 100.0 | 22.0 – 300.0 | | |
| Mean ± SD | 41.71 ± 21.35 | 134.33 ± 110.34 | Z= 1.610 | 0.107 |
| Median | 38.50 | 110.0 | | |
| AST | | | | |
| Min. – Max. | 20.0 – 88.0 | 21.0 – 392.0 | | |
| Mean ± SD | 42.57 ± 18.45 | 151.33 ± 138.36 | Z= 1.528 | 0.127 |
| Median | 39.0 | 124.50 | | |
| Creatinine | | | | |
| Min. – Max. | 0.60 – 3.10 | 0.90 – 2.27 | | |
| Mean ± SD | 1.38 ± 0.75 | 1.35 ± 0.54 | Z= 0.248 | 0.804 |
| Median | 1.15 | 1.15 | | |

Z: Z for Mann Whitney test
t: Student t-test

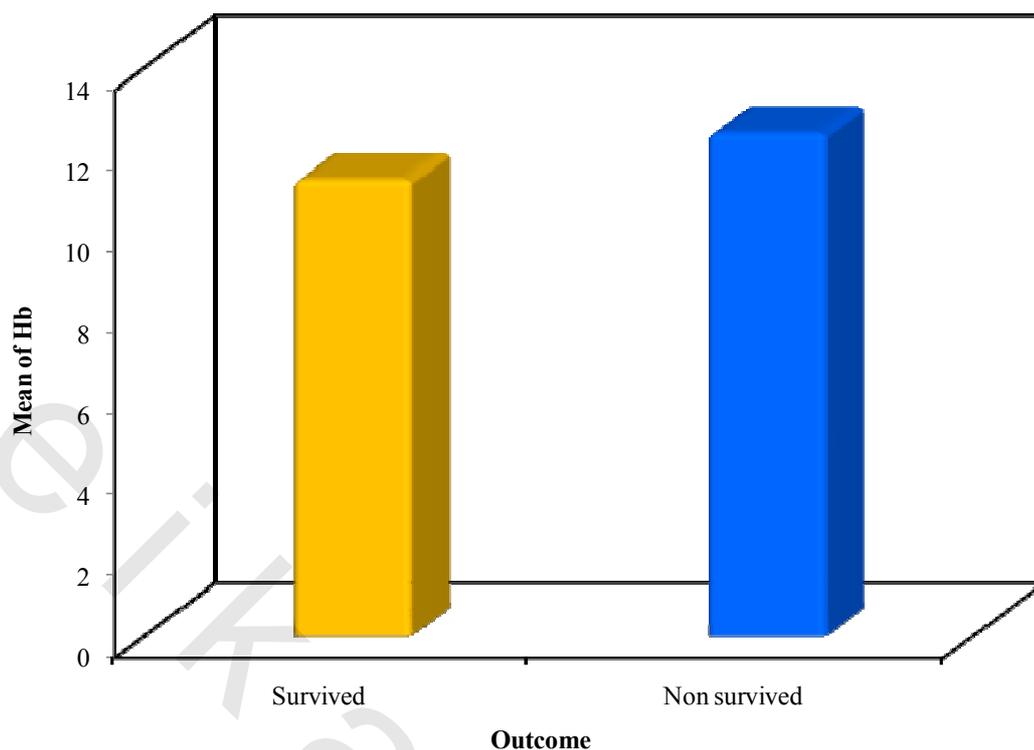


Figure (11): Relation between outcome with Hb

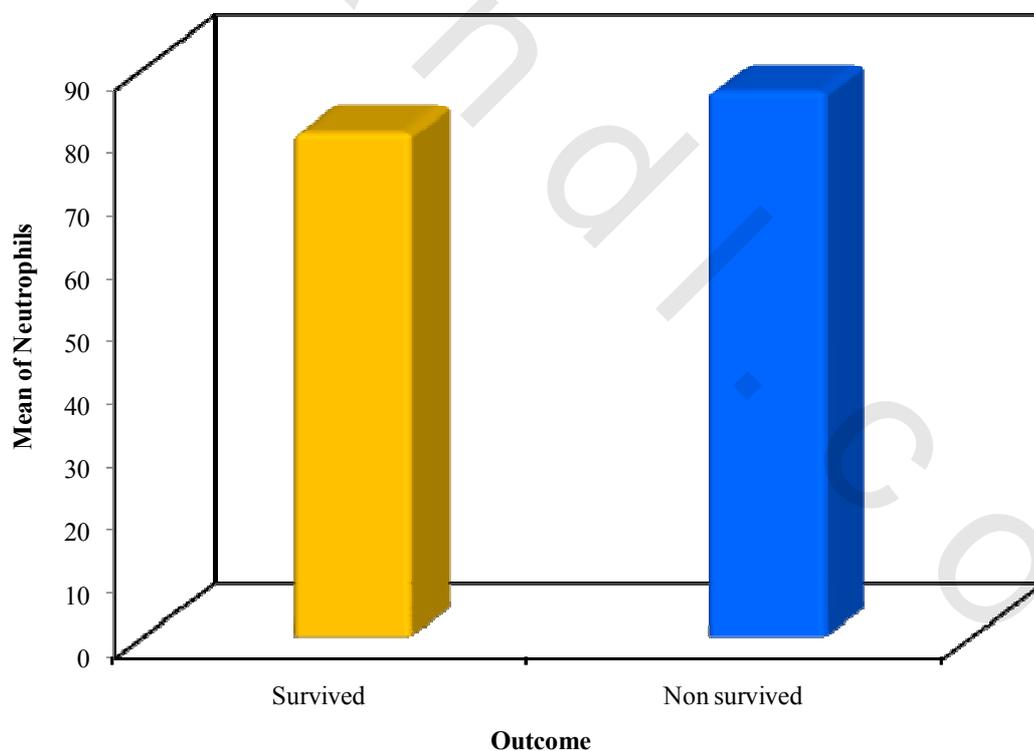


Figure (12): Relation between outcome with Neutrophils

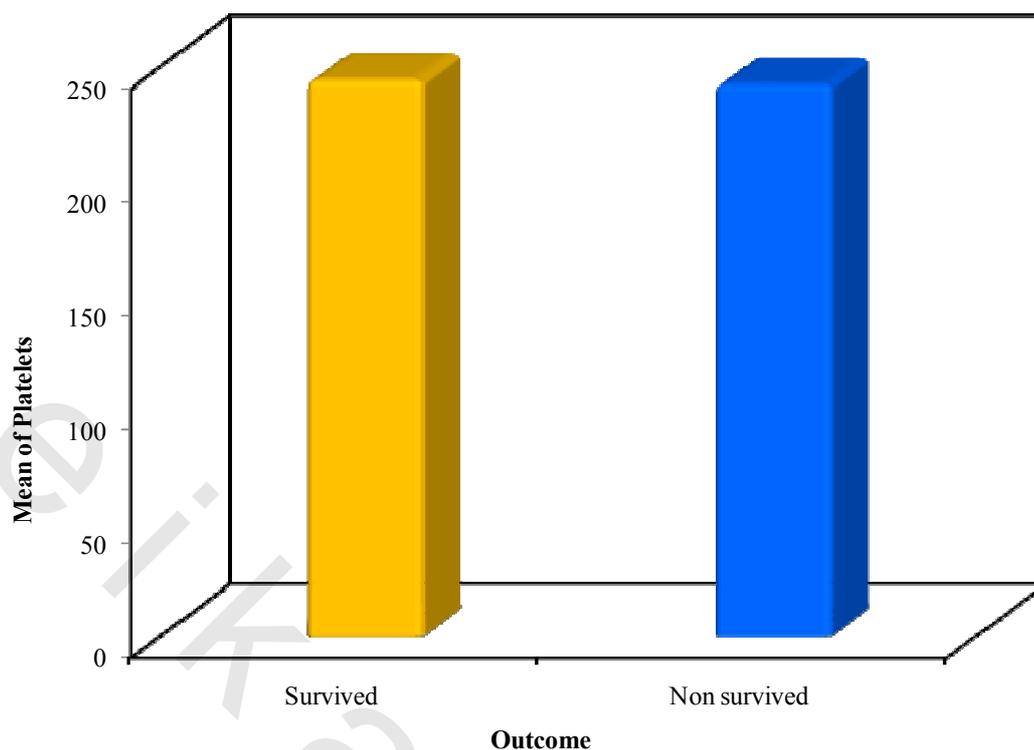


Figure (13): Relation between outcome with Platelets

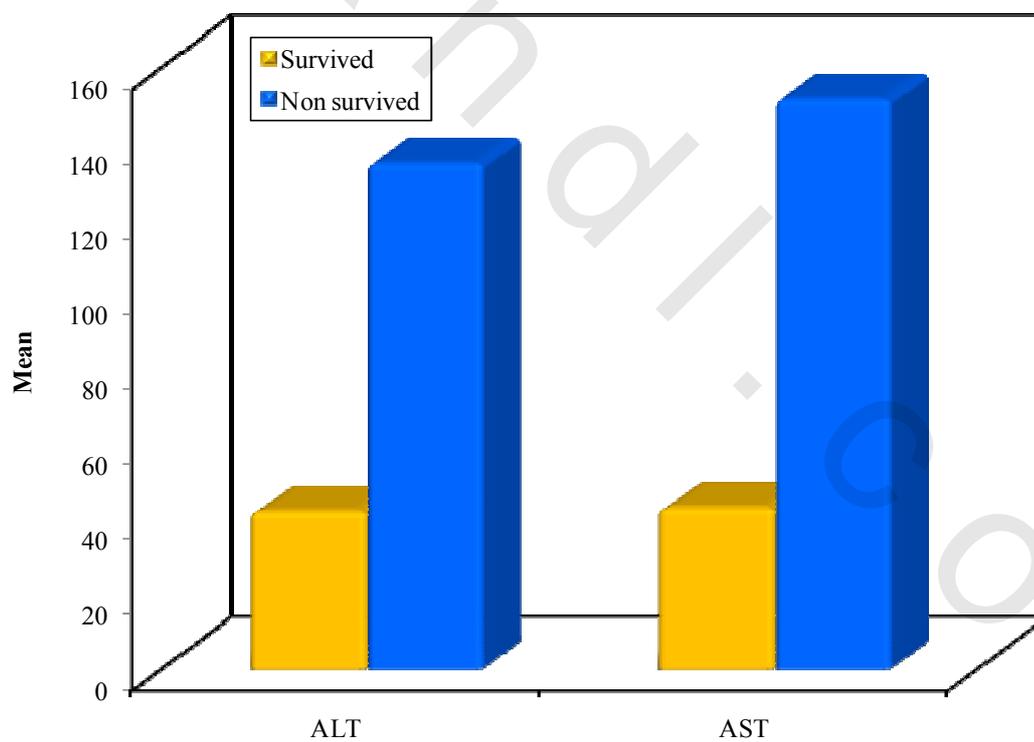


Figure (14): Relation between outcome with ALT and AST

Role of the studied markers in Prognosis of CAP

Regarding Outcome

The mean levels of PCT concentrations were 3.59 ± 3.96 ng/ml in Group I on admission and 9.33 ± 5.16 ng/ml in Group II. Median levels of PCT concentrations were 2.50 ng/ml in Group I on admission and 9.50 ng/ml in Group II. PCT concentrations were significantly higher in Group II ($P=0.020$) in comparison to Group I (Table 15) (Figure 15).

The mean levels of CRP concentrations in plasma were 82.29 ± 55.19 mg/dl in Group I on admission and 53.17 ± 31.28 mg/dl in Group II. Median levels of CRP concentrations in plasma were 79.50 mg/dl in Group I on admission and 52.50 mg/dl in Group II. There was no statistically significant difference between both groups regarding CRP concentration on admission ($p=0.282$) (Table 15) (Figure 16).

The mean values of CURB-65 score were 2.21 ± 1.05 in Group I on admission and 3.67 ± 1.0 in Group II. Median values of CURB-65 score were 2.0 in Group I on admission and 4.0 in Group II. CURB-65 score was significantly higher in Group II ($P=0.014$) in comparison to Group I (Table 15) (Figure 17).

The mean levels of WBCs were $15.39 \pm 7.06 \times 10^3$ /ul in Group I on admission and $17.62 \pm 10.60 \times 10^3$ /ul in Group II. Median levels of WBCs were 14.90×10^3 /ul in Group I on admission and 16.90×10^3 /ul in Group II. There was no statistically significant difference between both groups regarding WBC on admission ($p=0.584$) (Table 15) (Figure 18).

Table (15): Relation between outcome with PCT day 1, CRP day 1, CURB-65 and WBCs

| | Outcome | | Test sig. | of P |
|------------------|---------------------|---------------------|------------|--------|
| | Group I (n = 14) | Group II (n = 6) | | |
| PCT day 1 | | | | |
| Min – Max. | 0.30 – 14.0 | 1.0 – 15.0 | | |
| Mean ± SD. | 3.59 ± 3.96 | 9.33 ± 5.16 | Z = 2.323* | 0.020* |
| Median | 2.50 | 9.50 | | |
| CRP day 1 | | | | |
| Min – Max. | 25.0 – 192.0 | 16.0 – 88.0 | | |
| Mean ± SD. | 82.29 ± 55.19 | 53.17 ± 31.28 | Z = 1.075 | 0.282 |
| Median | 79.50 | 52.50 | | |
| CURB-65 | | | | |
| Min – Max. | 0.0 – 4.0 | 2.0 – 5.0 | | |
| Mean ± SD. | 2.21 ± 1.05 | 3.67 ± 1.03 | Z = 2.446* | 0.014* |
| Median | 2.0 | 4.0 | | |
| WBCs | | | | |
| Min – Max. | 5.90 – 27.30 | 3.70 – 32.80 | | |
| Mean ± SD. | 15.39 ± 7.06 | 17.62 ± 10.60 | t = 0.558 | 0.584 |
| Median | 14.90 | 16.90 | | |

Z: Z for Mann Whitney test

t: Student t-test

*: Statistically significant at $p \leq 0.05$

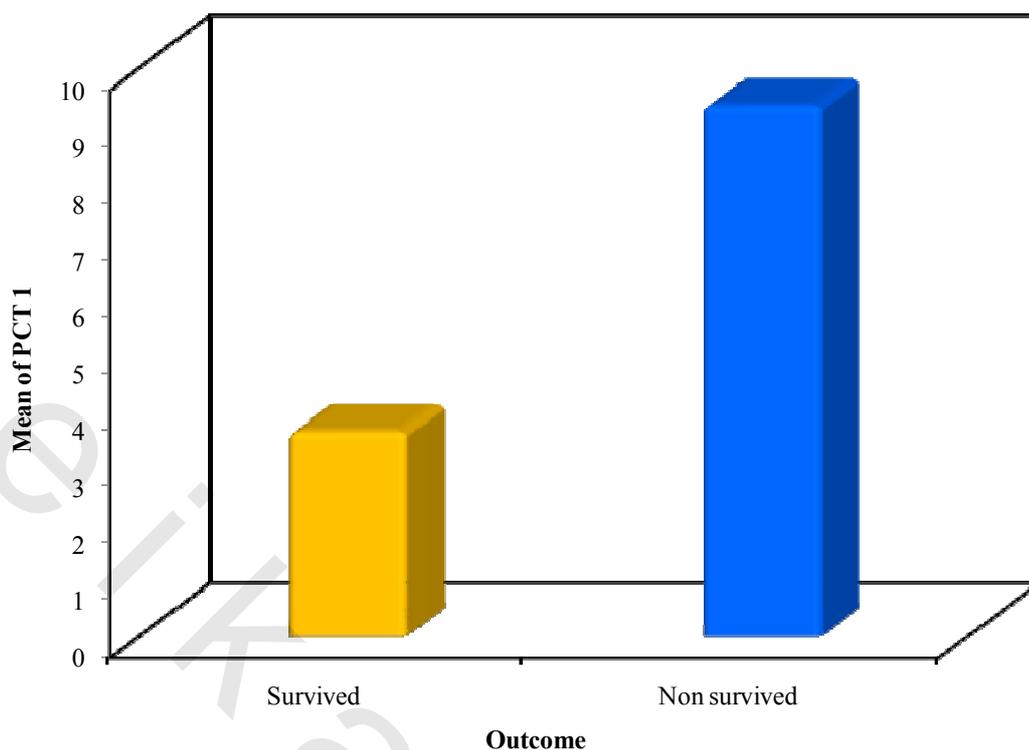


Figure (15): Relation between outcome with PCT on day 1

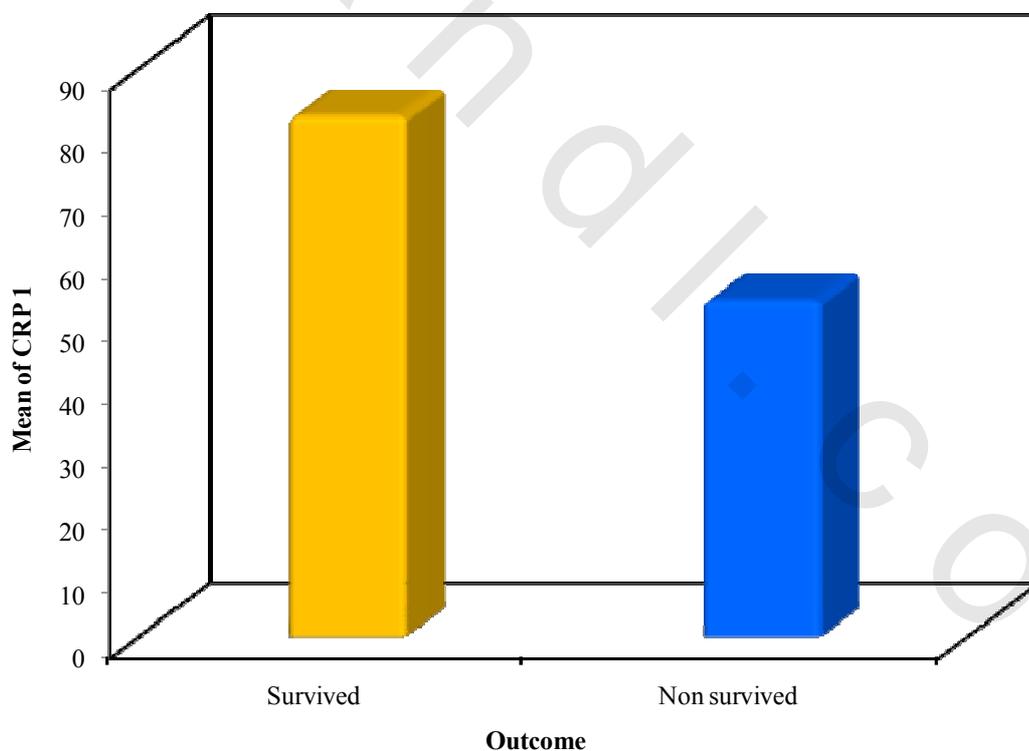


Figure (16): Relation between outcome with CRP on day 1

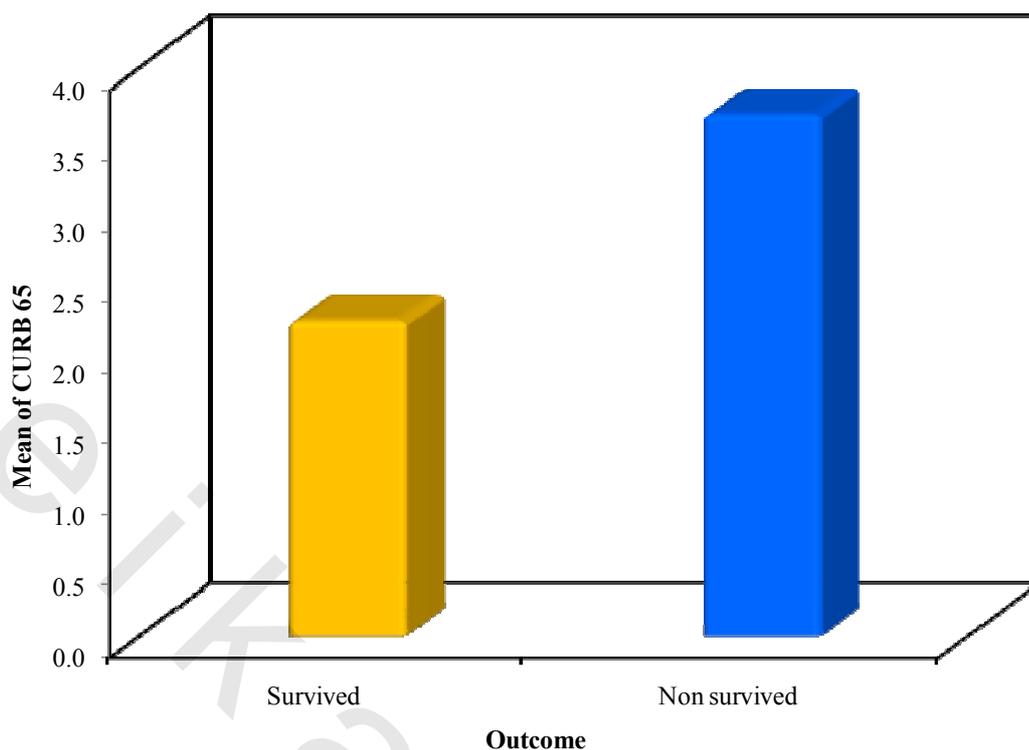


Figure (17): Relation between outcome with CURB-65

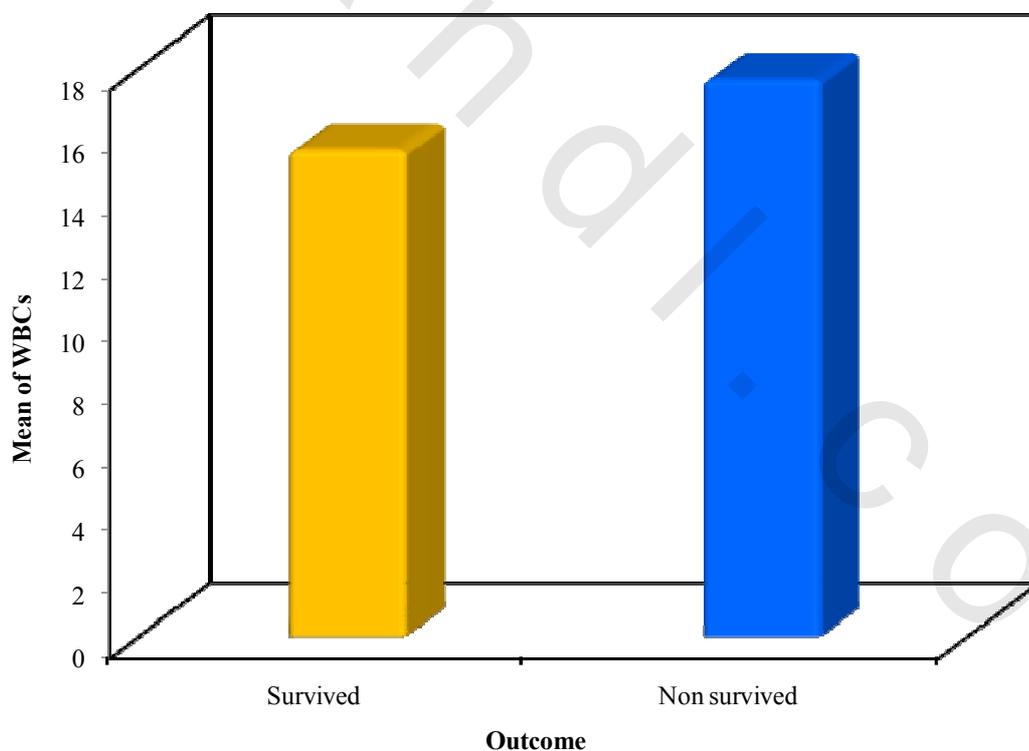


Figure (18): Relation between outcome with WBCs

Relation between admission with PCT day 1, CRP day 1, CURB-65 and WBCs

The mean levels of PCT concentrations were 5.86 ± 4.98 ng/ml in Admitted patients and 0.40 ± 0.14 ng/ml in Non-admitted patients. Median levels of PCT concentrations were 5.0 ng/ml in Admitted patients and 0.40 ng/ml in Non-admitted patients. PCT concentrations were significantly higher in Admitted patients ($P=0.037$) in comparison to Non-admitted patients (Table 16) (Figure 19).

The mean levels of CRP concentrations in plasma were 74.72 ± 51.57 mg/dl in Admitted patients and 63.0 ± 50.91 mg/dl in Non-admitted patients. Median levels of CRP concentrations in plasma were 72.0 mg/dl in Admitted patients and 63.0 mg/dl in Non-admitted patients. There was no statistically significant difference between both groups regarding CRP concentration on admission ($p=1.000$) (Table 16) (Figure 20).

The mean values of CURB-65 score were 2.89 ± 1.02 in Admitted patients and 0.50 ± 0.71 in Non-admitted patients. Median values of CURB-65 score were 2.50 in Admitted patients and 0.50 in Non-admitted patients. CURB-65 score was significantly higher in Admitted patients ($P=0.016$) in comparison to Non-admitted patients (Table 16) (Figure 21).

The mean levels of WBCs in plasma were $17.08 \pm 7.82 \times 10^3$ /ul in Admitted patients and $6.85 \pm 1.34 \times 10^3$ /ul in Non-admitted patients. Median levels of WBCs were 16.30×10^3 /ul in Admitted patients and 6.85×10^3 /ul in Non-admitted patients. There was no statistically significant difference between both groups regarding WBCs on admission ($p=0.088$) (Table 16) (Figure 22).

Table (16): Relation between admission with PCT day 1, CRP day 1, CURB65 and WBCs

| | Admission | | Test sig. | of p |
|----------------|---------------|--------------|-----------|--------|
| | Yes (n = 18) | No (n = 2) | | |
| PCT 1 | | | | |
| Min – Max. | 0.50 – 15.0 | 0.30 – 0.50 | | |
| Mean ± SD. | 5.86 ± 4.98 | 0.40 ± 0.14 | Z =2.091* | 0.037* |
| Median | 5.0 | 0.40 | | |
| CRP 1 | | | | |
| Min – Max. | 16.0 – 192.0 | 27.0 – 99.0 | | |
| Mean ± SD. | 74.72 ± 51.57 | 63.0 ± 50.91 | 0.0 | 1.000 |
| Median | 72.0 | 63.0 | | |
| CURB-65 | | | | |
| Min – Max. | 2.0 – 5.0 | 0.0 – 1.0 | | |
| Mean ± SD. | 2.89 ± 1.02 | 0.50 ± 0.71 | 2.402* | 0.016* |
| Median | 2.50 | 0.50 | | |
| WBCs | | | | |
| Min – Max. | 3.70 – 32.80 | 5.90 – 7.80 | | |
| Mean ± SD. | 17.08 ± 7.82 | 6.85 ± 1.34 | t = 1.804 | 0.088 |
| Median | 16.30 | 6.85 | | |

Z: Z for Mann Whitney test

t: Student t-test

*: Statistically significant at $p \leq 0.05$

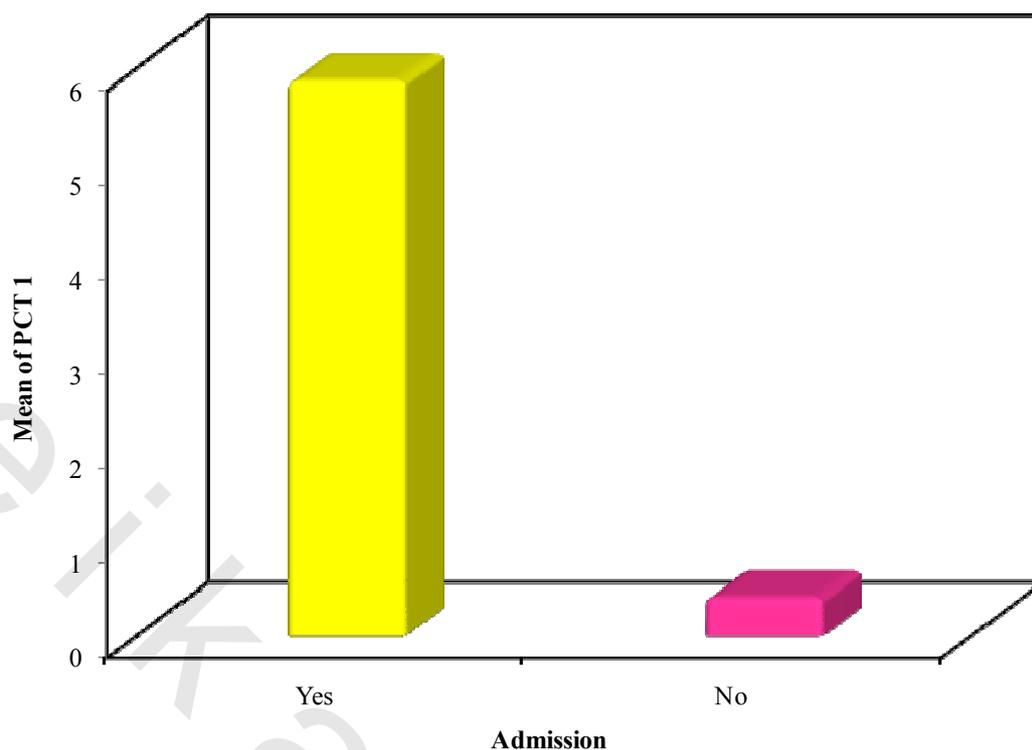


Figure (19): Relation between admission with PCT on day 1

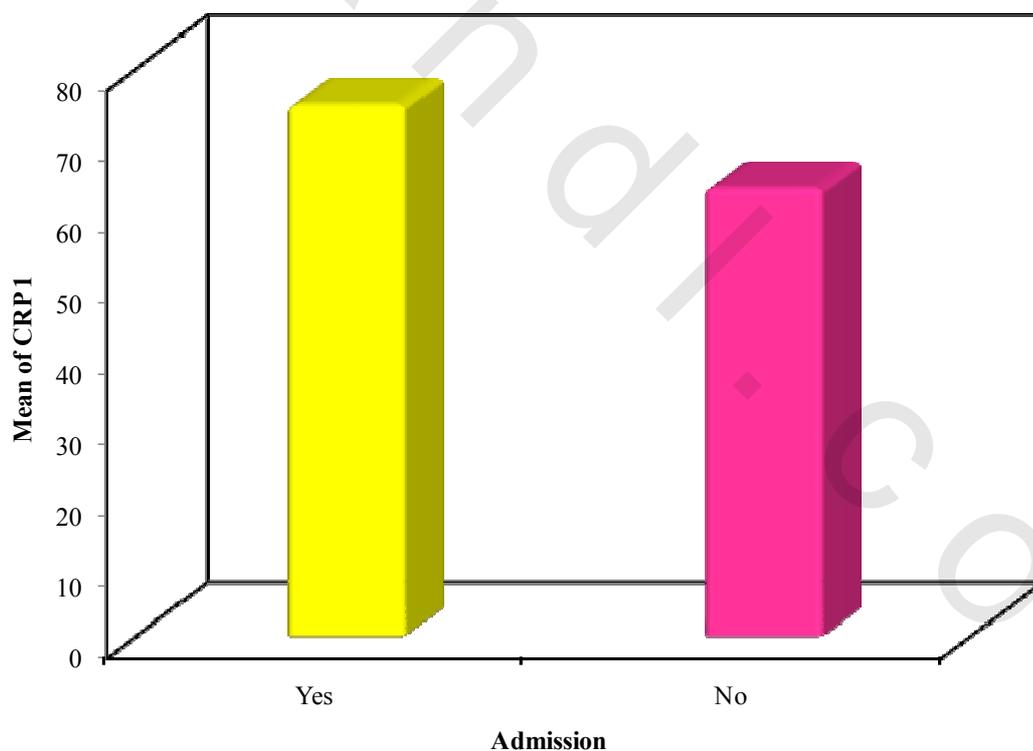


Figure (20): Relation between admission with CRP on day 1

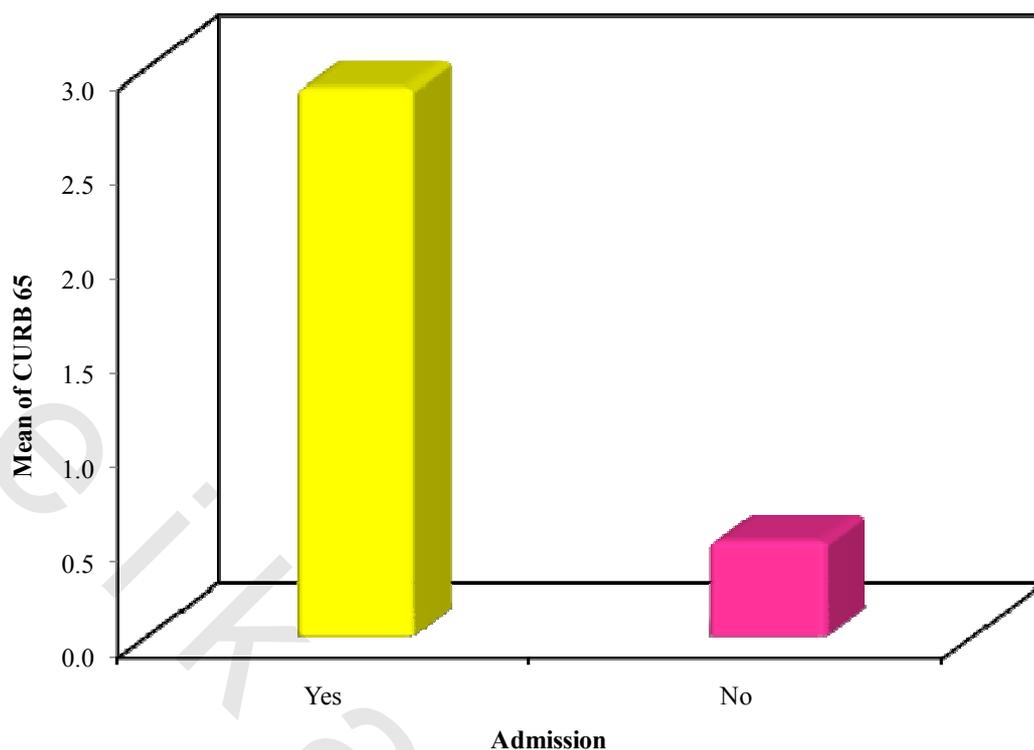


Figure (21): Relation between admission with CURB-65

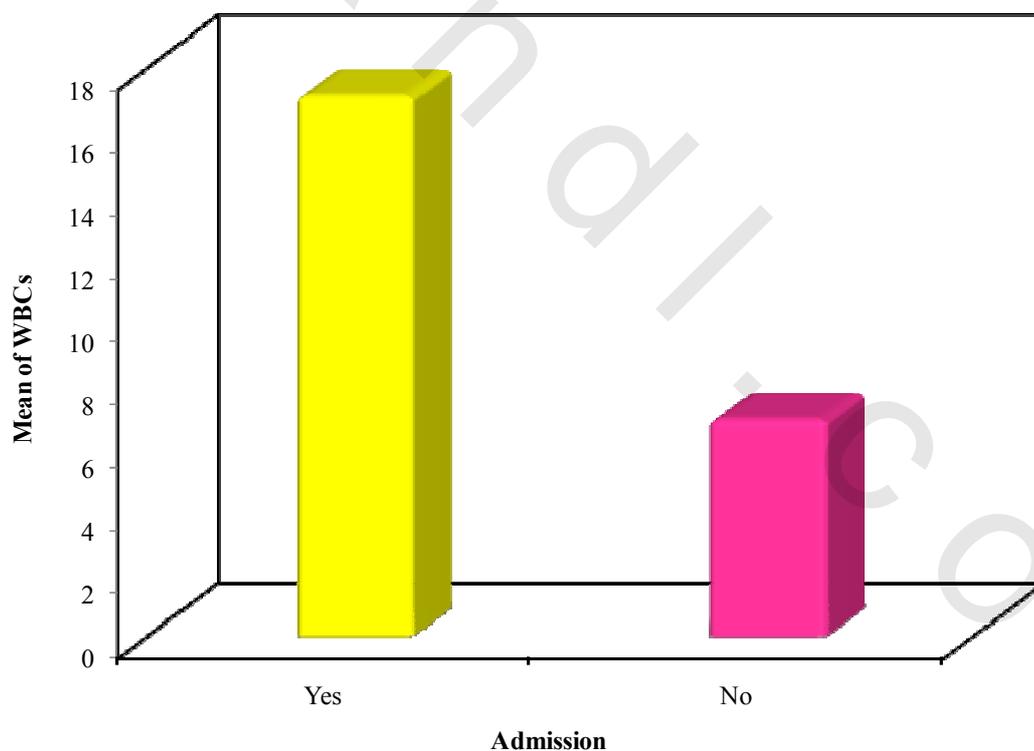


Figure (22): Relation between admission with WBCs

Relationship between procalcitonin with CRP, CURB-65, and WBCs on admission

Procalcitonin showed statistically significant positive correlation with CURB-65 and WBCs on admission. Whereas, there is statistically insignificant correlation with CRP on admission. (Table 17) (Figure 23, 24)

Table (17): Correlation between PCT on day 1 with CRP, CURB-65 and WBCs

| Day 1 | PCT | |
|---------|--------|-------|
| | r_s | p |
| CRP | 0.134 | 0.573 |
| CURB-65 | 0.549* | 0.012 |
| WBCs | 0.531* | 0.016 |

r_s : Spearman coefficient

*: Statistically significant at $p \leq 0.05$

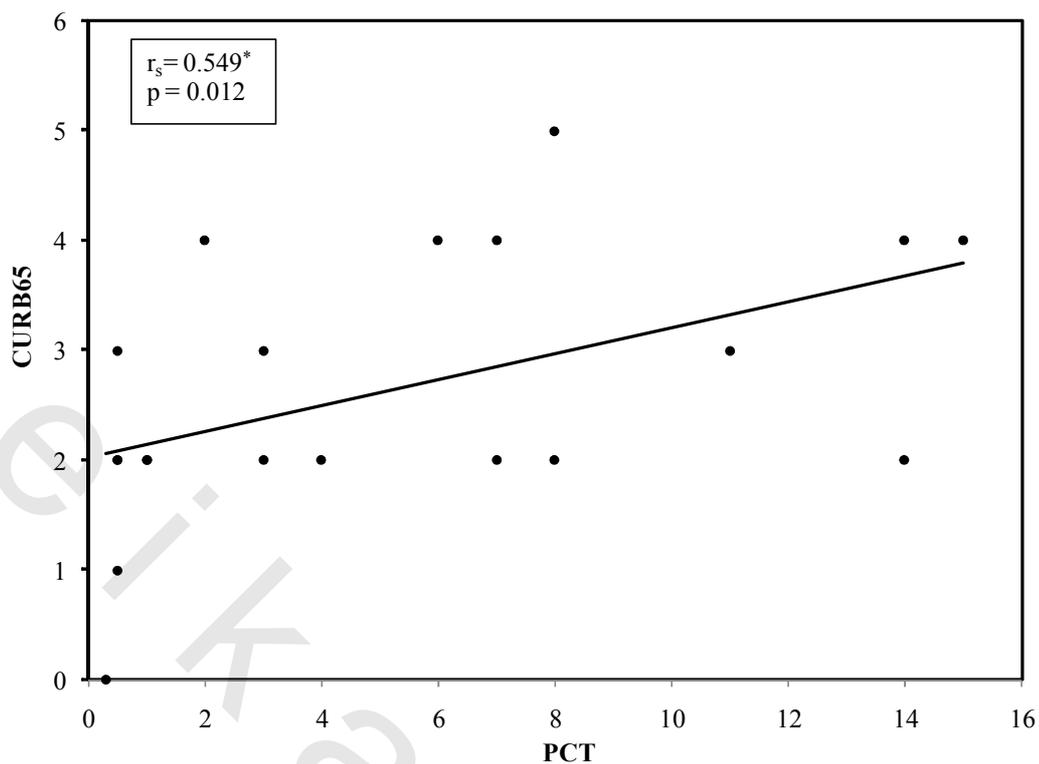


Figure (23): Correlation between PCT on day 1 with CURB65

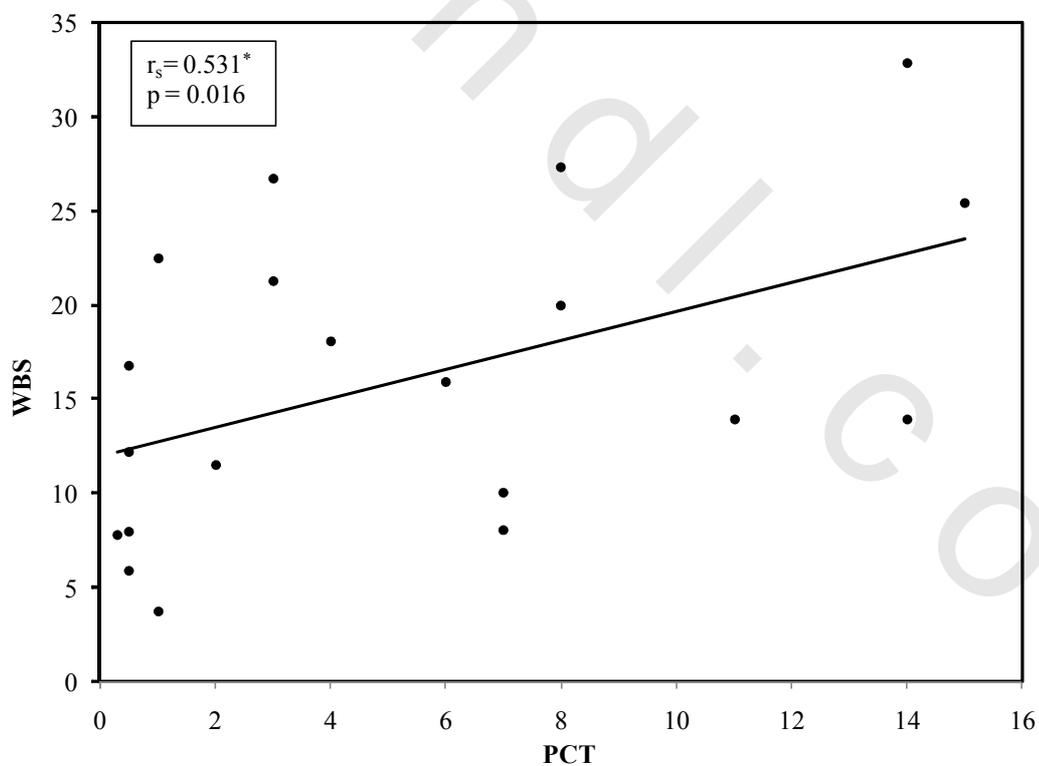


Figure (24): Correlation between PCT on day 1 with WBCs

Results

(Table 18) (Figure 25) shows that the mean levels of PCT concentrations were 0.75 ± 0.51 ng/ml in Group I on day14 and 10.33 ± 6.09 ng/ml in Group II. Median levels of PCT concentrations were 0.50 ng/ml in Group I on day14 and 11.50 ng/ml in Group II. PCT concentrations were significantly higher in Group II ($P=0.015$) in comparison to Group I).

The mean levels of CRP concentrations in plasma were 79.07 ± 57.11 mg/dl in Group I on day14 and 75.67 ± 42.34 mg/dl in Group II. Median levels of CRP concentrations in plasma were 93.0 mg/dl in Group I on day14 and 88.0 mg/dl in Group II. There was no statistically significant difference between both groups regarding CRP concentration on day 14 ($p=0.967$) (Table 18) (Figure 26).

Table (18): Relation between outcome with PCT on day 14 and CRP on day 14

| | Outcome | | Z | P |
|----------------------|---------------------|---------------------|--------|--------|
| | Group I (n = 14) | Group II (n = 6) | | |
| PCT on day 14 | | | | |
| Min – Max. | 0.0 – 2.0 | 0.0 – 16.0 | | |
| Mean \pm SD. | 0.75 ± 0.51 | 10.33 ± 6.09 | 2.434* | 0.015* |
| Median | 0.50 | 11.50 | | |
| CRP on day 14 | | | | |
| Min – Max. | 6.0 – 200.0 | 22.0 – 120.0 | | |
| Mean \pm SD. | 79.07 ± 57.11 | 75.67 ± 42.34 | 0.041 | 0.967 |
| Median | 93.0 | 88.0 | | |

Z: Z for Mann Whitney test

*: Statistically significant at $p \leq 0.05$

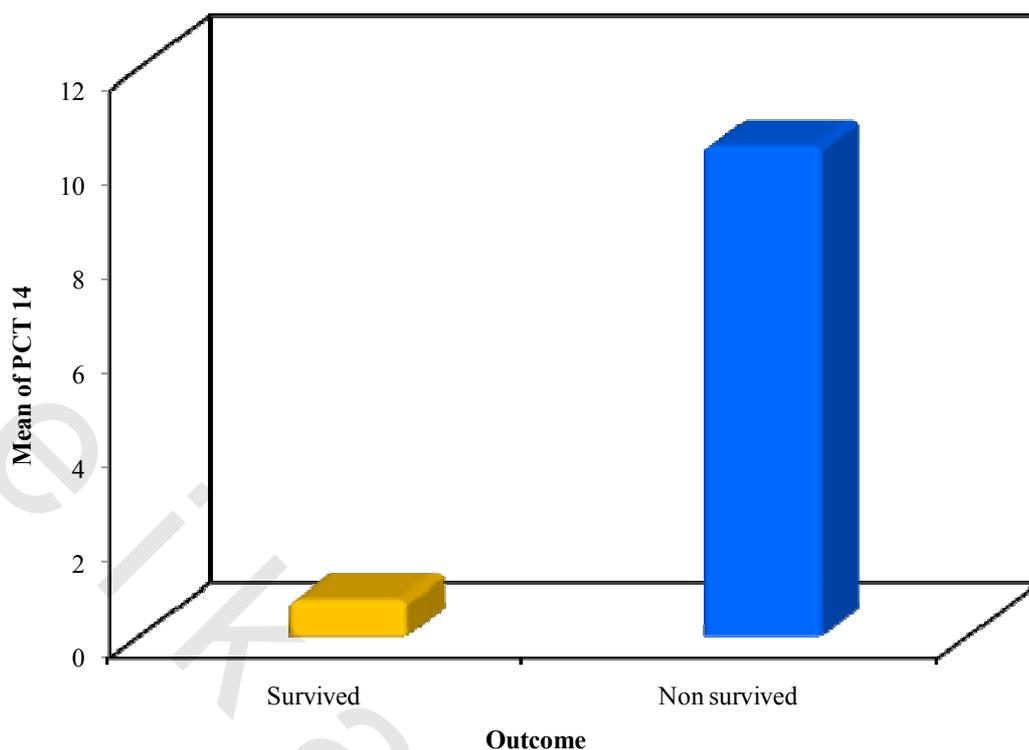


Figure (25): Relation between outcome with PCT on day 14

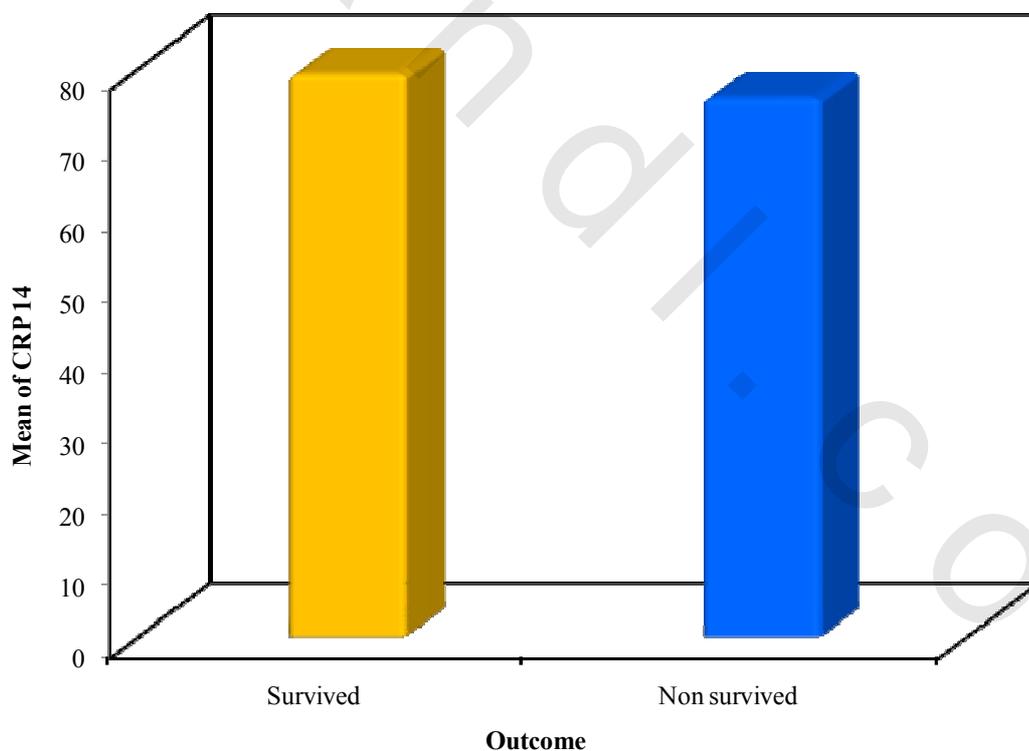


Figure (26): Relation between outcome with CRP on day 14

Distribution of the Studied Cases According to Admission and Outcome (Table 19) (Figure 27&28)

Regarding admission, 18 patients (90%) admitted, while 2 patients (10%) not admitted. Regarding Outcome, 14 patients (70%) among the studied patients survived, while 6 patients (30%) died.

Table (19): Distribution of the studied cases according to admission and outcome

| | No. | % |
|---------------------|-----|-------|
| Outcome | | |
| Survived | 14 | 70.0 |
| Admitted | 12 | 85.7 |
| Not – admitted | 2 | 14.3 |
| Non Survived | 6 | 30.0 |
| Admitted | 6 | 100.0 |
| Not – admitted | 0 | 0.0 |
| Admission | | |
| Yes | 18 | 90.0 |
| No | 2 | 10.0 |

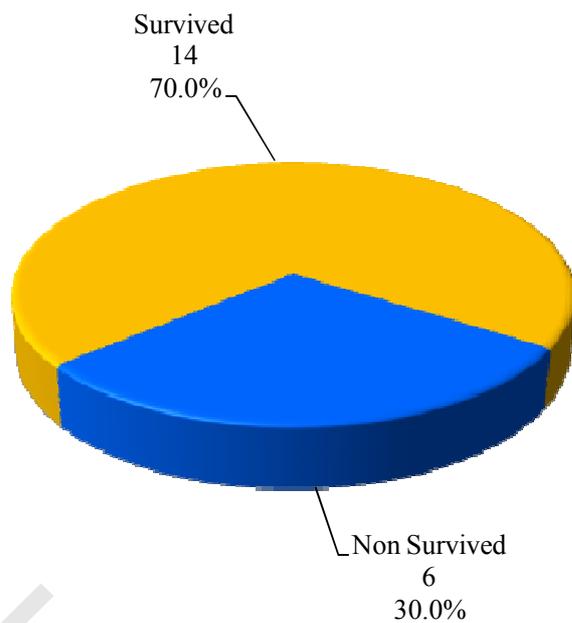


Figure (27): Distribution of the studied cases according to outcome

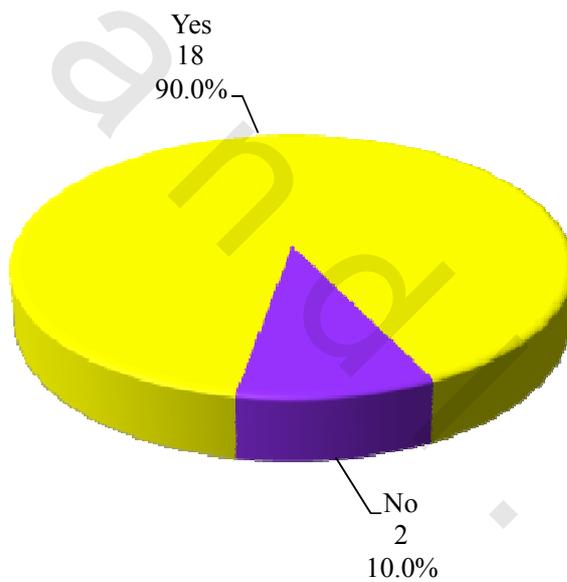


Figure (28): Distribution of the studied cases according to admission

Results

(Table 20) shows that the mean levels of PCT concentrations were 3.59 ± 3.96 ng/ml in Group I on admission and 9.33 ± 5.16 ng/ml in Group II. Median levels of PCT concentrations in plasma were 2.50 ng/ml in Group I on admission and 9.50 ng/ml in Group II. PCT concentrations were significantly higher in Group II ($P=0.020$ in comparison to Group I).

(Table 21) shows that mean levels of PCT concentrations were 5.86 ± 4.98 ng/ml in Admitted patients and 0.40 ± 0.14 ng/ml in Non admitted patients. Median levels of PCT concentrations were 5.0 ng/ml in Admitted patients and 0.40 ng/ml in Non-admitted patients. PCT concentrations were significantly higher in Admitted patients ($P=0.037$) in comparison to Non-admitted patients

Table (20): Relation between outcome & PCT on day 1

| Day 1 | Outcome | | Z | p |
|---------------|----------------------|-------------------------|--------|--------|
| | Survived (n = 14) | Non survived (n = 6) | | |
| PCT | | | | |
| Min. – Max. | 0.30 – 14.0 | 1.0 – 15.0 | | |
| Mean \pm SD | 3.59 ± 3.96 | 9.33 ± 5.16 | 2.323* | 0.020* |
| Median | 2.50 | 9.50 | | |

Z: Z for Mann Whitney test

*: Statistically significant at $p \leq 0.05$

Table (21): Relation between admissions & PCT on day 1

| Day 1 | Admission | | Z | p |
|---------------|-----------------|-----------------|--------|--------|
| | Yes (n = 18) | No (n = 2) | | |
| PCT | | | | |
| Min. – Max. | 0.50 – 15.0 | 0.30 – 0.50 | | |
| Mean \pm SD | 5.86 ± 4.98 | 0.40 ± 0.14 | 2.091* | 0.037* |
| Median | 5.0 | 0.40 | | |

Z: Z for Mann Whitney test

*: Statistically significant at $p \leq 0.05$

Accuracy of PCT on day1, CURB-65, and PCT on day1 plus CURB-65 in prognosis of CAP

The ROC curves of PCT on day 1, CURB-65, and combination of PCT on day1 with CURB-65 were designed and presented in Figure 29; results were significant. The Areas Under the Curve (AUCs) calculated from the ROC curves were 0.833 (p=0.021) for PCT on day1, 0.833 (p=0.021) for PCT, 0.833 (p=0.021) for CURB-65, 0.875 (p=0.009) for their combination, respectively (Figure 29).

The AUC for PCT on day1 was high (0.833) which was not significantly different when compared with CURB-65 (0.833). The combined use of CURB-65 and PCT on day1 even improved the accuracy to predict death (AUC=0.875).

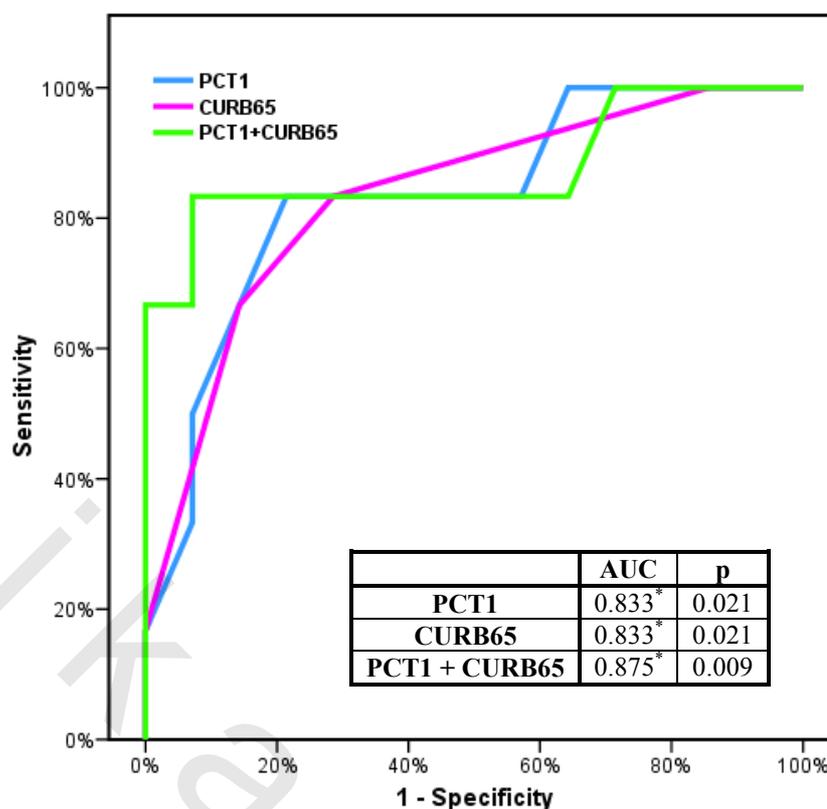


Figure (29): ROC curve for PCT day1, CURB-65 and their combination in prognosis

Table (22): Agreement (sensitivity, specificity and accuracy) for PCT1, CURB65 and PCT1 + CURB-65 with outcome

| | | Survived | Died | Sensitivity | Specificity | PPV | NPV | Accuracy |
|--------------------|--------|----------|------|-------------|-------------|-------|-------|----------|
| PCT day1 | ≤6 | 11 | 1 | 83.33 | 78.57 | 62.50 | 91.67 | 80.0 |
| | >6 | 3 | 5 | | | | | |
| CURB-65 | ≤2 | 10 | 1 | 83.33 | 71.43 | 55.56 | 90.91 | 75.0 |
| | >2 | 4 | 5 | | | | | |
| PCT day1 + CURB-65 | ≤6, ≤2 | 13 | 1 | 83.33 | 92.86 | 83.33 | 92.86 | 90.0 |
| | >6, >2 | 1 | 5 | | | | | |