Result

- The current study included 20 patients all were presented with acute coronary syndrome; all had performed MSCT coronary angiography and invasive coronary angiography.
- The study population include 3 females (15%) and 17 male (85%) **(Figure 35)**

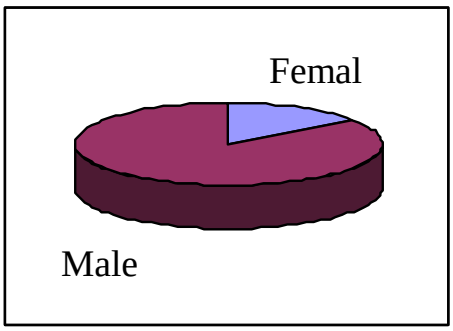

Figure 35: Sex distribution of patients.

- Age was between 43 and 74 years with mean age 60±5. **(fig. 36 & table 1)**

Table 1: age of patients at presentation

Ages	No.	%
43 - 49	3	15
50 – 59	8	40
60 - 69	7	35
70 - 74	2	10

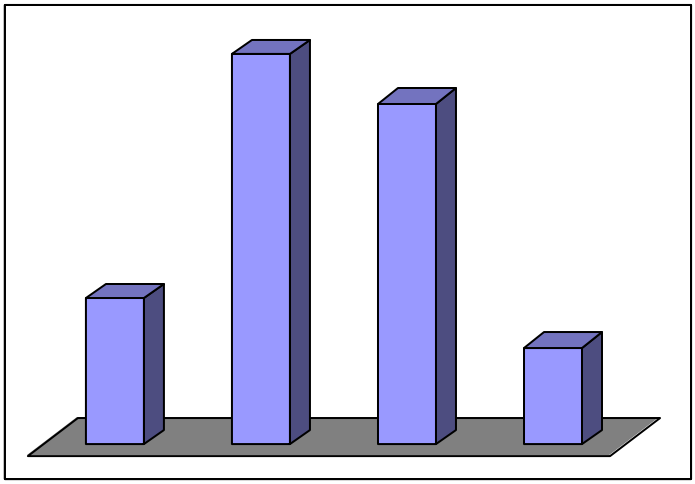

Figure 36: Age of patients at presentation

Risk factors

- The prevalence of risk factors among study population is demonstrated in the following table:

Table 2: distribution of risk factors among patients

Risk factor	No.	%
smoking	13	65
hypertension	12	60
dyslipedemia	8	40
Diabetes mellitus	9	45
Obesity "BMI > 30 kg/m²"	8	40
Family history of IHD	3	15

ECG changes

- ECG changes among patients were the following:
    1. Anterior ischemia in the form of inverted T wave and depressed ST segment in leads V1 - V3 in 4 patients.
    2. Lateral ischemia in the form of inverted T wave in leads L1, aVL, V5 & V6 in 3 patients.
    3. Anteriolateral ischemia in the form of inverted T wave and depressed ST segment in leads V1 - V6 in 5 patients.
    4. Inferior ischemia in the form of inverted T wave and depressed ST segment in leads L2, L3 & aVF in 3 patients.
    5. Inferior & lateral ischemia in the form of inverted T wave in leads L2, L3, aVF, V5 & V6 in one patient.
    6. Anterior & inferior ischemia in the form of inverted T wave in leads inverted T wave and depressed ST segment in leads V1 - V3, L2, L3 & aVF in one patient.
    7. Non specific changes in 3 patients. **(table 3)**

Table 3: ECG changes among patients.

ECG changes	No.	%
Anterior ischemia	4	20
Leteral ischemia	3	15
Antrolateral ischemia	5	25
Inferior ischemia	3	15
Inferolateral ischemia	1	5
Antroinferior ischemia	1	5
Nonspecific changes	3	15

Cardiac enzymes:

- Treponin test was +ve in 6 patients (30%) and was –ve in 14 patients (70%).**(table 4 & fig. 37)**

Treponin	No.	%
+ve	6	30
–ve	14	70

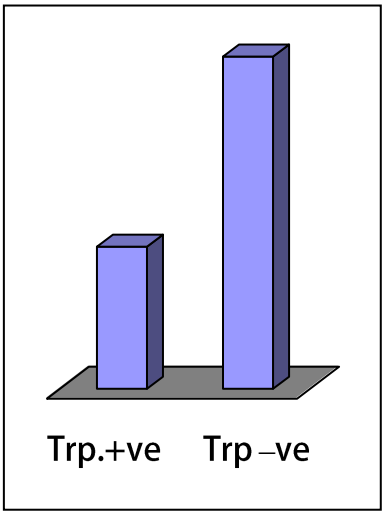

Table 4 and Figure 37: clinical diagnosis and treponin results

Coronary calcium scoring:

The total calcium score according to Agatston scoring system ranged from (0) to (1492) and was distributed as following: **(table 5)**

Table 5: calcium scoring of the patients

Calcium scoring	No.	%
0 – 10	2	10
11 – 100	3	15
101 – 400	9	45
> 400	6	30

Coronary stenosis evaluation:

- The AHA 15 segments coronary model was used to evaluate the coronary tree by both methods.
- A total number of 300 segments were subjected to evaluation in the study
- Among the 300 segments 48 segments (16%) were considered to have significant stenosis while the remaining 252 segments (84%) were free of significant stenosis by MSCT coronary angiography.

- Also by the use of invasive coronary angiography 48 segments (16%) were considered to have significant stenosis while the remaining 252 segments (84%) were free of significant stenosis. **(table 6)**

Table 6: analysis of coronary stenosis by both methods

	MSCT CA		ICA	
	No.	%	No.	%
Segments with significant stenosis	48	16%	48	16%
Segments with non significant stenosis	252	84%	252	84%

- And these segments were distributed as following:**(table 7)**

Table 7: Nature of coronary segment by both methods

	MSCT CA		ICA	
Nature of segment	No.	%	No.	%
Normal	235	78%	233	77.6%
Non significant stenosis	17	5.6%	19	6.3%
Significant stenosis and occluded	48	16%	48	16%

- These segments with significant stenosis were found in 19 patients by MSCT CA and in 17 patients by ICA.

- 17 patients had segments with significant stenosis with both methods & 2 patients considered to have segments with significant stenosis by MSCT CA only (false positive results).

- One patient presented with ACS was free of diseased segments by MSCT CA & 3 patients had no diseased coronary segments by invasive coronary angiography.

- There was no difference in the anatomy of coronary arteries by both methods (origin, course & side branches).

- From the 17 patients diagnosed to have CAD 9 patients had single vessel disease, 4 patients had two vessel disease & 4 patients had multi-vessel disease by invasive coronary angiography. **(table 8)**

Table 8: Distribution of significant lesions among study population

	LM MSCT	LM ICA	LAD MSCT	LAD ICA	LCX MSCT	LCX ICA	RCA MSCT	RCA ICA
PT. 1	0	0	1	2	1	1	0	0
PT. 2	0	0	0	0	0	0	2	2
PT. 3	0	0	0	0	0	2	1	1
PT. 4	0	0	2	3	4	4	1	1
PT. 5	0	0	2	3	1	1	1	1
PT. 6	0	0	1	1	0	0	0	0
PT. 7	0	0	1	1	1	1	1	1
PT. 8	0	0	3	3	2	2	1	1
PT. 9	0	0	0	0	0	0	0	0
PT. 10	0	0	2	2	0	0	0	0
PT. 11	0	0	1	0	0	0	0	0
PT. 12	0	0	3	3	0	0	0	0
PT. 13	0	0	1	1	1	1	0	0
PT. 14	0	0	1	0	0	0	1	1
PT. 15	0	0	1	1	0	0	0	0
PT. 16	0	0	0	0	0	0	1	0
PT. 17	0	0	4	4	1	1	0	0
PT. 18	0	0	1	1	0	0	1	0
PT. 19	0	0	1	0	1	1	0	0
PT. 20	0	0	1	1	0	0	0	0

- But by comparing the results of the two methods 42 out of 48 lesions with significant stenosis by MSCT are present in invasive coronary angiography and MSCT over estimate 6 lesiones (false +ve lesions).

- Also 246 out of 252 lesions free of significant stenosis by MSCT are also free of significant stenosis by invasive coronary angiography and MSCT misses 6 lesions (false -ve lesions). **(table 9)**

Table 9: analysis of results of MSCT CA

TRUE +ve	TRUE –ve	FALSE +ve	FALSE –ve
42	246	6	6

- This will yield an overall sensitivity 87.5%, specificity 97.6%, positive predictive value (PPV) 87.5%, negative predictive value 97.6% and overall accuracy 96%. **(table 10 & fig. 38)**

Table 10: Data analysis of results of MSCT CA of overall coronary system

Sensitivity	87.5%
Specificity	97.6%
PPV	87.5%
NPV	97.6%
Accuracy	96%

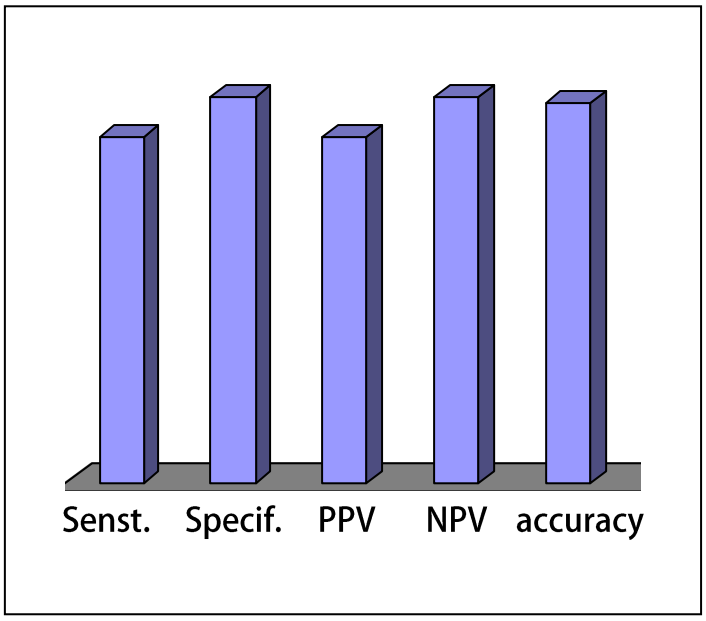

Figure 38: Data analysis of results of MSCT CA of overall coronary system.

Per vessel assessment:

- when analyzing the results of MSCT on per vessel level the results were as following **(table 11)**

Table 11: analysis of results of MSCT CA per vessel

	TRUE +ve	TRUE —ve	FALSE +ve	FALSE —ve
LM	0	20	0	0
LAD	23	71	3	3
LCX	11	87	0	2
RCA	8	68	3	1

- And when assessing the accuracy of MSCT for every vessel of the coronary vessels LAD, LCX and RCA the sensitivity, specificity, PPV, NPV and clinical accuracy were respectively as the following:
- 88%, 96%, 88%, 96% and 97% for LAD
- 84.6%, 100%, 100%, 97.7% and 98% for LCX
- 89%, 95.7%, 73%, 98.5% and 95% for RCA **(table12 & Figure 39 - 41)**

Table 12: Data analysis of results of MSCT CA per vessel

	LAD	LCX	RCA
Sensitivity	88%	84.6%	89%
Specificity	96%	100%	95.7%
PPV	88%	100%	73%
NPV	96%	97.7%	98.5%
Accuracy	97%	98%	95%

- The assessment of the left main coronary (LMCA) artery in this study was considered perfect; MSCT didn't detect any significant lesion in the LMCA which was the same result of invasive coronary angiography.

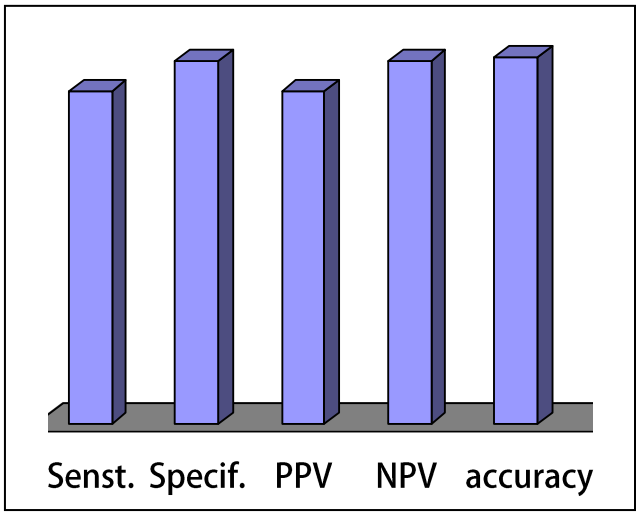

Figure 39: Statistical analysis of MSCT CA of LAD artery.

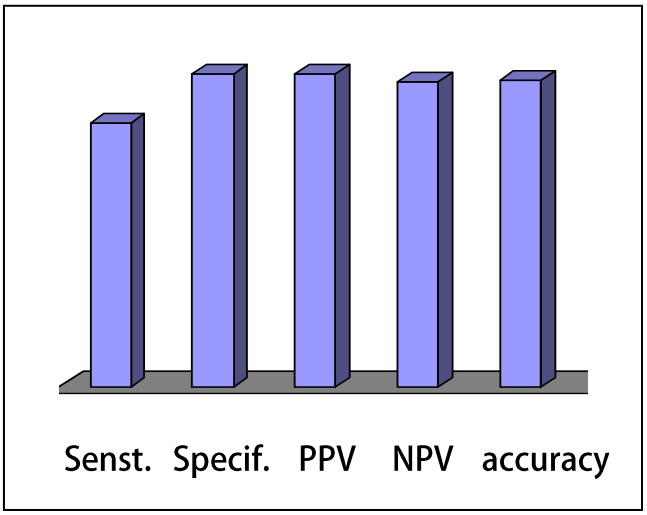

Figure 40: Statistical analysis of MSCT CA of LCX artery.

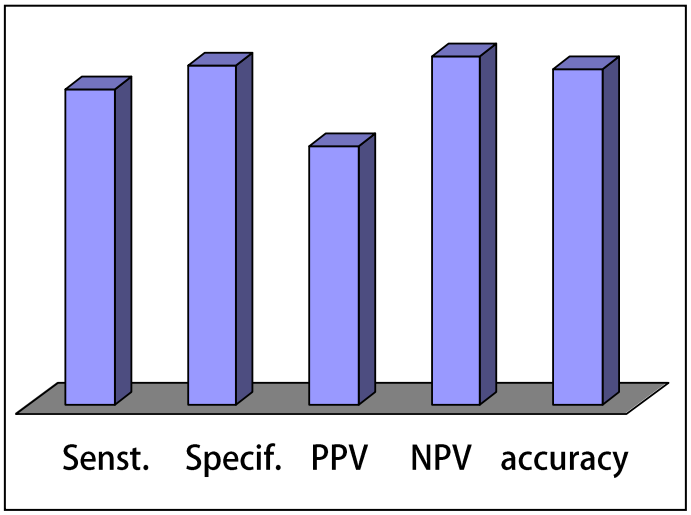

Figure 41: Statistical analysis of MSCT CA of RCA artery.

Proximal versus non proximal segments:

- The coronary tree was divided into two groups of segments; those representing the proximal coronary tree i.e. LMCA, proximal LAD, proximal LCX and proximal RCA, other segments were labeled as non proximal segments.
- When comparing the diagnostic accuracy of MSCT coronary angiography in evaluating proximal versus non proximal segments; the results was as following: **(table13)**

Table 13: analysis of results of MSCT CA according to proximity of the lesion

	TRUE +ve	TRUE —ve	FALSE +ve	FALSE —ve
Proximal segments	14	44	1	1
Non proximal segments	28	202	5	5

- And it was found that the sensitivity, specificity, PPV, NPV and clinical accuracy for;
  - Proximal segments were: 93.3%, 97.7%, 93.3%, 97.7% and 96.6% respectively.
  - Non proximal segments were: 85%, 97.5%, 85%, 97.5% and 95.8% respectively. **(table14 & Figure 42, 43)**

Table 14: statistical analysis of MSCT CA results according to proximity of the lesion.

	PROXIMAL SEGMENTS	Non PROXIMAL SEGMENTS
Sensitivity	93.3%	85%
Specificity	97.7%	97.5%
PPV	93.3%	85%
NPV	97.7%	97.5%
Accuracy	96.6%	95.8%

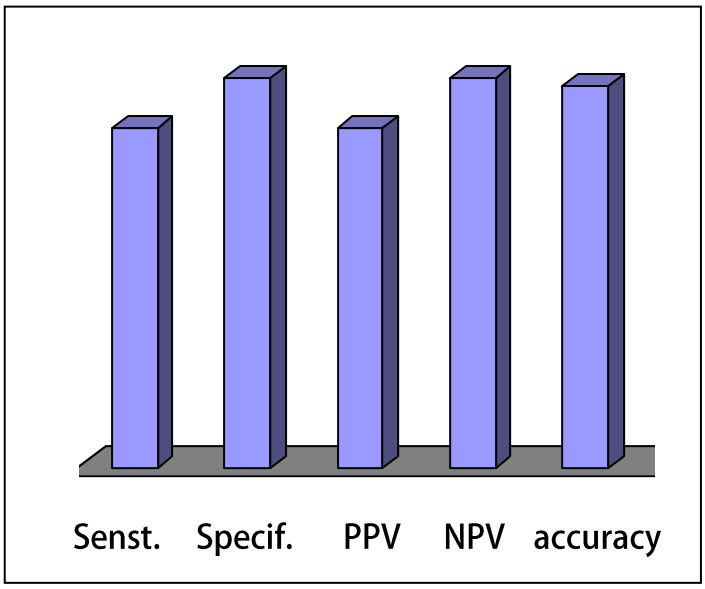

Figure 42: Statistical analysis of MSCT CA of proximal lesions.

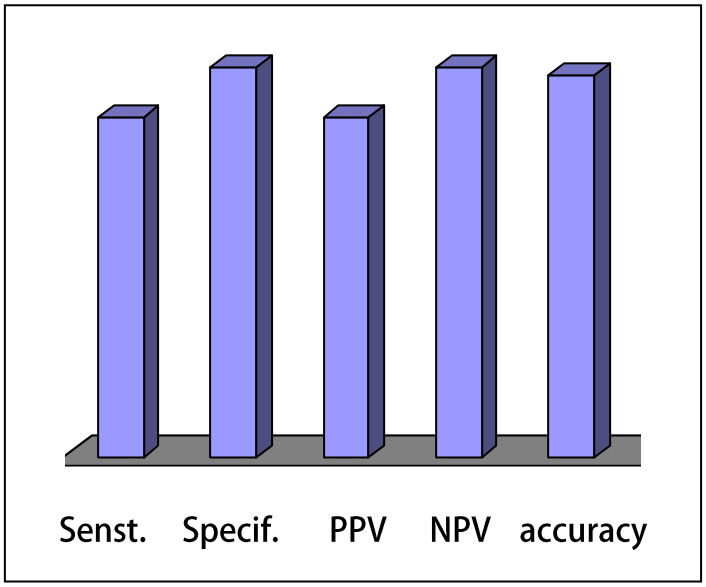

Figure 43: Statistical analysis of MSCT CA of non proximal lesions.

Effect of patients characteristics on diagnostic accuracy:

* Heart rate:

Heart rate of all patients before doing CT scan was controlled with by beta blockers to be less than 65 beats per minute, and by controlling heart rate among patients in the study all coronary segments were adequately evaluated by MSCT as there were no artifacts in the CT images and coronary arteries were viewed clearly.

* Effect of body mass index (BMI) on diagnostic accuracy:

According to BMI we divided the patients into two groups:

- Patients with BMI below 30 kg/m^2 (12 patients)
- Patients with BMI above 30 kg/m^2 (8 patients)

We found that sensitivity and specificity of MSCT CA to detect significant coronary lesions is more in non obese patients with BMI <30kg/m^2 than in obese patients with BMI >30kg/m^2. **(table15)**

Table 15: statistical analysis of MSCT CA results according to BMI

	Sensitivity	Specificity	PPV	NPV	Accuracy
Obese patients "BMI >30kg/m^2"	85%	97%	85%	97%	95%
Non-obese patients "BMI <30kg/m^2"	88.8%	98%	88.8%	98%	96.6%

According to stenosis severity:

We grade results of significant coronary stenosis upon invasive coronary angiography into:

- Segments with stenosis severity from 50 % – 75 %.
- Segments with stenosis severity above 75 %. **(145)**

MSCT CA detected 22 lesions with stenosis severity from 50 % – 75 % and missed 4 lesions.
Also MSCT CA detected 20 lesions with stenosis severity above 75 % and missed 2 lesions when compared to invasive coronary angiography.

This shows that sensitivity of MSCT CA to found lesion with stenosis severity from 50 % – 75 % is **84%** and its sensitivity to found lesion with stenosis severity above 75 % is **90%. (table16)**

Table 16: statistical analysis of MSCT CA results according to the sevirity of the lesion.

	sensitivity
Lesions from 50 % – 75 % stenosis	84%
Lesions above 75 % stenosis	90%

Effect of calcium scoring on the diagnostic accuracy:

- As regard the effect of total coronary calcification on the diagnostic accuracy of MSCT CA we found that with increasing coronary calcification sensitivity of MSCT CA to detect significant coronary stenosis drop from **100%** in patients with Agatston score 0 – 10 units to **83%** in patients with Agatston score above 400 units.

- On the other hand specificity of MSCT CA increases slightly with elevation of total coronary calcium score in same previous groups from **96%** to **98.8%. (table17)**

Table 17: statistical analysis of MSCT CA results according to calcium score.

Calcium score	Sensitivity	Specificity	PPV	NPV	Accuracy
0 - 10	100%	96%	100%	100%	96.6%
10 - 100	100%	97.6%	75%	100%	97.7%
100 - 400	93%	97.5%	82%	99%	97.7%
> 400	83%	98.3%	96%	92%	93%

Calcium scoring and prediction of coronary artery disease:

- We notice from the study that no. of diseased coronary segments increase with elevation of calcium scoring as there were no diseased segments "by invasive CA" in patients with calcium score (0 - 10) and there were 30 segments with significant coronary stenosis in patients with calcium score more than 400 .

- Also the three patients who diagnosed to have normal coronaries by invasive coronary angiography have calcium score below 100 units.

- On the other hand all the patients who had multi - vessel disease by invasive coronary angiography had calcium score above 400 units. **(table18)**

Table 18: Distribution of diseased coronary segments among patients according to calcium score

Calcium score	No. of patients	No. of coronary segments with significant stenosis	% "to total no of coronary segments"
0 - 10	2	0	0
10 - 100	3	3	6%
100 - 400	9	15	11%
> 400	6	30	33%

Complications

Complications were few in the study group and of low severity:

- For invasive coronary angiography:
    1) 3 patients develop large inguinal hematoma.
    2) One patient suffered from allergy to the dye.

- For MSCT CA:

Only two patients suffered from allergy to the dye. **(table20)**

Table 20 complications by both techniques

No of pt. develop complications by MSCT	1
No of pt. develop complications by ICA	3