RESULTS

The current study included 30 patients who were referred for M.D.C.T coronary angiography in the national heart institute for suspected coronary artery disease and were enrolled for invasive coronary angiography. The study was conducted in the national heart institute during the period between August 2009 till May 2010.

Demographic Data

The studied population included 10 females and 20 males (Fig. 23). The mean age was 57 ± 11 years.

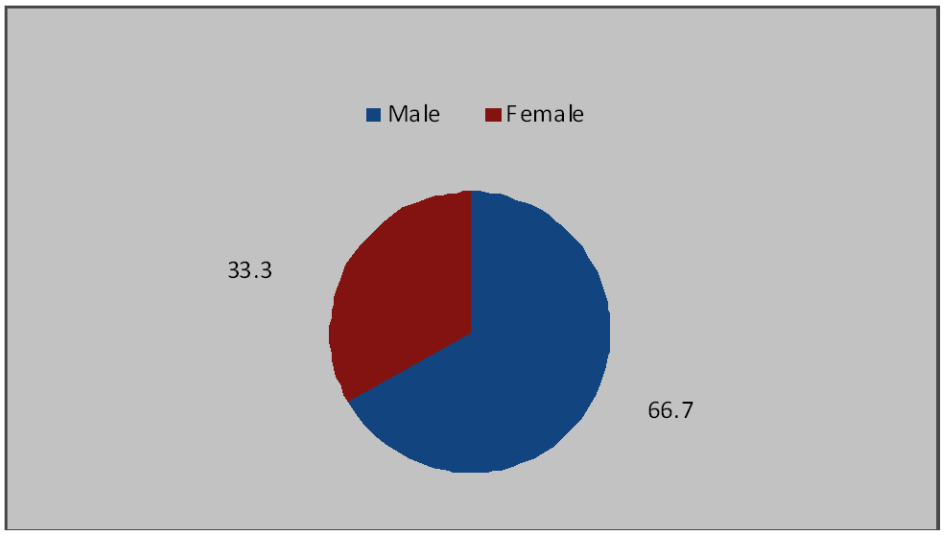

Fig. (23) showing gender distribution in the study

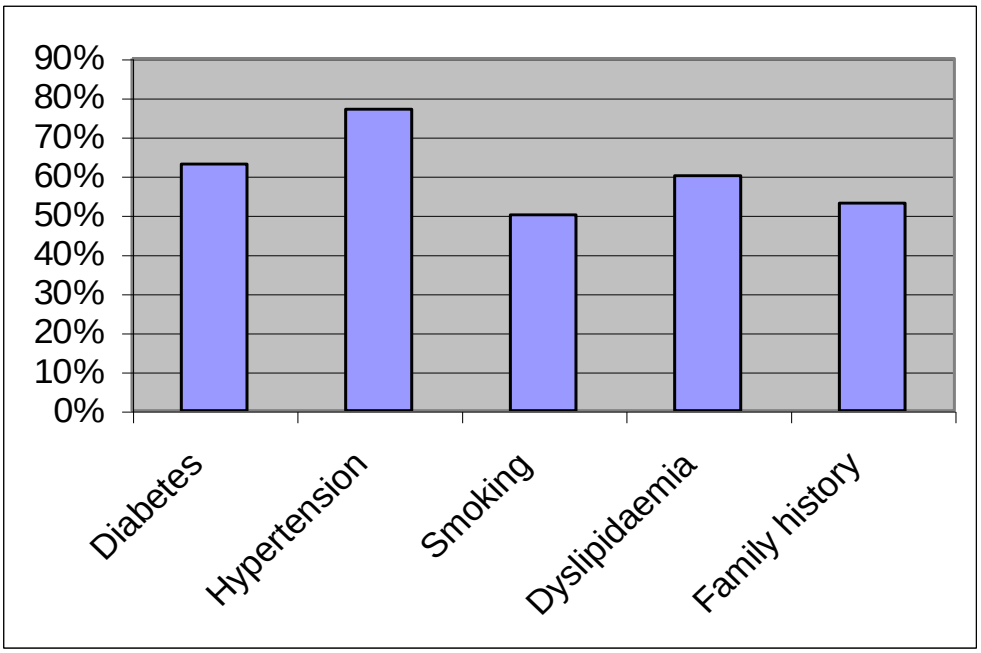

Fig. (24) showing percentage of different risk factors among the study population

Out of 30 patients included in the study diabetic patients were 19 (63%). Hypertensive patients were 23 (77%). Fifteen patients were smokers (50%). Eighteen patients were dyslipidemic (60%). sixteen patients had a family history of CAD (53%).

Table (1): Risk factors among patients included in the study.

Risk Factor	Numbers	Percentage
Diabetes	19	63 %
Hypertension	23	77 %
Smoking	15	50 %
Dyslipidaemia	18	60 %
Family history	16	53 %

Clinical Presentations

Out of 30 patients 18 patients presented with chest pain (60%). Eight patients presented with exertional dyspnea (26.7%). Four patients presented for equivocal stress test (13.3%) (table 2).

Table(2) Different clinical presentations of the patients in the study:

Clinical Presentations	Number	Percentage
Chest pain	18	60%
Exertional dyspnea	8	26.7%
Equivocal stress test	4	13.3%

Scan Statistics:

Heart Rate

The heart rate of the subjects during the scan ranged between 47 and 102 bpm with a mean of 70.3 ± 9.7 bpm. 25 patients (83.33%) had a heart rate of less than 70bpm, whereas only 5 patients (16.7%) had a heart rate of more than 70bpm (table 3).

The mean calcium score for the group of patients with heart rate > 70 bpm was 390.6 ± 170.9 and for the group of patients with heart rate ≤ 70 bpm was 403.44 ± 228.2

Table (3): Heart rate among the study population.

Heart rate (beat per minute)	Number	Percentage	Calcium score
> 70	5	16.7%	390.6 ± 170.9
≤ 70	25	83.3 %	403.44 ± 228.2

This difference in the calcium score between the two groups is not statistically significant (p value > 0.05).

Calcium Score

The total coronary calcium score, according to Agastson scoring system, ranged from zero to 870, with a mean of 401 ± 217.2 units.

Twenty patients (66.6%) from the studied population had a total coronary calcium score of less than 400 according to Agaston Score. The remaining 10 patients (33.3%) had a total coronary calcium score of 400 or more according to Agatston score.

The mean heart rate of the group of patients with calcium score > 400 HU units was 69.8 ± 8 and for the group of patients with calcium score < 400 HU units was 70.6 ± 10.7

Table (4): showing calcium score among the study population.

Calcium score	Number	Percentage	Heart rate
< 400	20	66.6 %	70.6 ± 10.7
> 400	10	33.4 %	69.8 ± 8

This difference in the heart rate between the two groups is not statistically significant (p value > 0.05).

Coronary Stenosis Evaluation

The AHA 15-segment coronary model ***(Austen et al., 1975)*** was used to evaluate the coronary tree by both methods.

Analysis was done according to the degree of stenosis, per-segment, per-vessel and on individual basis.

A total of 450 coronary segments were subjected to evaluation by both techniques.

Among the 450 segments 19 segments were non evaluable (4.2%). The causes for non evaluablity were motion artificats which constituted 12 segments (2.6%) and excessive calcification which impeded the evaluation of 7 segments (1.5%) (table 4).

Table (5): The number and percentage of different degrees of stenosis.

Segment	Frequency	Percent
Non significant stenosis	359	79.7 %
Significant stenosis	91	20.2 %
Motion artifact	12	2.6 %
Calcification	7	1.5 %
Total	450	100 %

Per-segment analysis

A total of 91 coronary artery stenoses with a luminal narrowing of more than 50% in diameter were identified using invasive coronary angiography.

85 coronary artery stenoses with luminal narrowing more than 50% were correctly diagnosed with CT coronary angiography.

Four coronary segments were underestimated to have non significant stenosis and two coronary segments were non evaluable with CT angiography.

Seven coronary segments were overestimated to have more than 50% stenosis.

Signficant stenosis was correctly excluded in 335 coronary segments (luminal narrowing less than 50%) with both CCA and CTA (table 6,7).

Table (6): Results of CTA in comparison with CCA when non evaluable segments are excluded.

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	**85**	**7**	**92**
	- ve	**4**	**335**	**339**
	Total	**89**	**342**	**431**

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

So, when non evaluable segments were excluded the over all sensitivity, specificity ,positive predictive value, negative predictive value was 95.5%, 97.9%, 92.4%, 98.8 % respectively and accuracy was 97.4%.

When evaluating the coronary segments, the non evaluable segments would affect the accuracy of the test. To include these segments, this would increase the number of false positive finding and affect the whole accuracy of the test.

Table (7): Results of CTA in comparison with CCA when non evaluable segments are included as false positive:

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	**85**	**26**	**111**
	- ve	**4**	**335**	**339**
	Total	**89**	**361**	**450**

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

Considering these non evaluable segments in the evaluation would yield overall sensitivity, specificity, positive predictive value and negative predictive value of 95.5%, 92.7%, 76.7% and 98.8% respectively, with a diagnostic accuracy of 93.3% .

Effect of Patients' Characteristics and Scanning Conditions on Diagnostic Accuracy

Scanning Heart Rate

Patients with heart rate > 70 bpm

Out of 75 coronary segments, 9 segments were detected to have > 50% stenosis with both CTA and CCA.

One coronary segment was underestimated to have less than 50% stenosis with CTA.

Ten coronary segments were overestimated to have more than 50% stenosis with CTA.

Significant stenosis was excluded in 55 coronary segments with both CTA and CCA (table 8).

Table (8): Results of CTA in comparison with CCA in patients with HR > 70 bpm (5 pt):

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	9	10	19
	- ve	1	55	56
	Total	10	65	75

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

BPM → beat per minute

This would yield a sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 90%, 84.6%, 47.4%, 98.2%. 85.3% respectively.

Patients with heart rate ≤ 70 bpm

Out of 375 coronary segments, 76 segments were detected to have > 50% stenosis with both CTA and CCA.

Three coronary segments were underestimated to have less than 50% stenosis with CT angiography.

Sixteen coronary segments were overestimated to have more than 50% stenosis with CT angiography.

Significant stenosis was excluded in 280 coronary segments with both CTA and CCA (table 9).

Table (9): Results of CTA in comparison with CCA in patients with HR ≤ 70 bpm (25 pt):

		CCA		**Total**
CTA		**+ ve**	**- ve**	
	+ ve	76	16	92
	- ve	3	280	283
	Total	79	296	375

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

BPM → beat per minute

This would yield a sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 96.2%, 94.6%, 82.6%, 98.9%. 94.9% respectively.

Again there was no significant change in the calcium score between the two groups of patients.

P value > 0.05.

Total Coronary Calcification

Patients with calcium score > 400 HU

Out of 150 coronary segments, 37 segments were detected to have > 50% stenosis with both CTA and CCA.

Three coronary segments were underestimated to have less than 50% stenosis with CT angiography.

Fourteen coronary segments were overestimated to have more than 50% stenosis with CT angiography.

Significant stenosis was excluded in 96 coronary segments with both CT and CCA (table 10).

Table (10): Results of CTA in comparison with CCA in patients with calcium score > 400 HU (10 pt):

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	37	14	51
	- ve	3	96	99
	Total	40	110	150

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

HU → hounsefield unit

This would yield a sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 92.5%, 87.3%, 72.5%, 97%. 88.6% respectively.

Patients with calcium score < 400 HU

Out of 300 coronary segments, 48 segments were detected to have > 50% stenosis with both CTA and CCA.

One segment was underestimated to have less than 50% stenosis with CTA.

Twelve segments were overestimated to have more than 50% stenosis with CTA.

Significant stenosis was excluded in 239 segments with both CTA and CCA (table 11).

Table (11): Results of CTA in comparison with CCA in patients with calcium score < 400 HU (20 pt):

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	48	12	60
	- ve	1	239	240
	Total	49	251	300

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

HU → hounsefield unit

This would yield a sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 98%, 95.2%, 80%, 99.6%. 95.7% respectively.

Accuracy according to severity of the stenosis severity

Different grades of severity of stenosis were found in the study population upon invasive coronary angiography.

The sensitivity of the CTA to detect the presence of significant stenosis in a segment varied according to the degree of stenosis severity, with a sensitivity of 93.9% to detect stenosis 50-75% in severity and 100% sensitivity with > 75% stenosis (table 12).

Table (12): Sensitivity of CTA according to severity of stenosis

Stenosis Severity	**Number of Segments**	**Sensitivity**
50-75%	**66**	**93.9%**
> 75 %	**25**	**100%**

Per Vessel Assessment

Left main artery

The assessment of the left main coronary artery in this study was considered perfect, the CT could detect successfully the two significant left main diseases found in the study population and could exclude the presence of left main significant stenosis among the rest of the patients (table 13).

Table (13): Results of CTA in comparison with CCA in detection of Left Main stenosis:

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	2	0	2
	- ve	0	28	28
	Total	2	28	30

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CT →computed tomography angiography

This would yield sensitivity, specificity, positive predictive value,negative predictive value and accuracy of 100%.

LAD artery

Out of 30 arteries the CTA successfully detected the presence of significant stenosis in 17 arteries.

One artery was underestimated to have less than 50% stenosis.

One artery was overestimated to have more than 50% stenosis.

The CTA successfully excluded the presence of significant stenosis in 11 arteries (table 14).

Table (14): Results of CTA in comparison with CCA in detection of LAD stenosis:

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	17	1	18
	- ve	1	11	12
	Total	18	12	30

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

LAD → left anterior descending artery

This would yield sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 94.4%, 91.7%, 94.4%, 91.7% and 93.3% respectively.

The LCX artery

Out of 30 arteries the CTA successfully detected the presence of significant stenosis in 16 arteries.

One artery was underestimated to have less than 50% stenosis.

Two arteries were overestimated to have more than 50% stenosis.

The CT successfully excluded the presence of significant stenosis in 11 arteries (table 15).

Table (15): Results of CTA in comparison with CCA in detection of LCX stenosis.

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	16	2	18
	- ve	1	11	12
	Total	17	13	30

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

LCX→ left circumflex artery

This would yield sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 94.1%, 84.6%, 88.9%, 91.7% and 90% respectively.

RCA artery

Out of 30 arteries the CTA successfully detected the presence of significant stenosis in 15 arteries.

One artery was underestimated to have less than 50% stenosis.

Two arteries were overestimated to have more than 50% stenosis.

The CTA successfully excluded the presence of significant stenosis in 12 arteries (table 16).

Table (16): Results of CTA in comparison with CCA in detection of RCA stenosis:

		CCA		Total
CTA		**+ ve**	**- ve**	
	+ ve	15	2	17
	- ve	1	12	13
	Total	16	14	30

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

RCA → right coronary artery

This would yield sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 93.8%, 85.7%, 88.2%, 92.3%, 90% respectively.

Assessment on individual basis

Out of 30 patients examined 13 patients had significant coronary artery stenosis (> 50% of the luminal diameter) with both CTA and CCA.

Sixteen patients were successfully excluded to have significant coronary artery stenosis by both CTA and CCA.

One patient was over estimated to have more than 50% stenosis (table 17).

Table (17): Results of CTA in comparison with CCA on individual basis;

		CCA		**Total**
CTA		**+ ve**	**- ve**	
	+ ve	13	1	14
	- ve	0	16	16
	Total	13	17	30

+ ve → positive

- ve → negative

CCA → conventional coronary angiography

CTA → computed tomography angiography

This would yield sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 100%, 94.1%, 92.9%, 100% and 96.7% respectively.