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Percutaneous Coronary Intervention in Ibn Al-Bitar Hospital; Acute in-Hospital Outcome

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Abstract: Background: The term "angina pectoris" was introduced by Heberden in 1772 to describe a syndrome the commonest etiology is atheromatous coronary artery disease. The terms “chronic" and "stable" refer to anginal symptoms that have been present for at least several weeks without major deterioration. **Objective:** The study was designed to evaluate the acute in-hospital outcomes of PCI in Ibn-Al- Bitar hospital for cardiac surgery. **Patients and method:** It was a prospective and observational study. All patients who underwent PCIs in Ibn- AL-Bitar hospital for cardiac surgery from the seventeenth of July 2008 to the eighteenth of November 2021 were included in this study. Baseline characteristics were collected from each patient by direct questionnaire and case records various investigations were recorded. The incidence of procedural complications, which included angiographic complications and adverse clinical outcomes (Death, MI, and need for emergency CABG) during hospitalization, was recorded. **Results and Discussion:** There were 213 patients, 184 (86.4%) of them were men, and 29 (13.6%) were women. The lesions were 411 critical and 13 were intermediate lesions, 415 (97.6%) were de novo lesions, and 9 (2.4%) were due to in-stent restenosis (ISR). The majority of procedures were elective PCI [203 patients out of 213 (95.3 %)], while Adhoc PCI was done in 10 patients out of a total of 213 (4.7 %). The angiographic success rate in non-totally occluded lesions was 99.5%, while in totally occluded lesions was 68.2%. The majority of patients had a smoothin–hospital course, with One patient had acute stent thrombosis leading to nonfatal Q-wave infarction, and one patient died twenty hours after the procedure, but there were no urgent surgical revascularization procedures during a hospital stay. The procedural success rate in non-totally occluded lesions is 98.5%, while in totally occluded lesions is 68.2%. **Conclusion:** PCI is a safe and effective modality in treating CAD, with excellent acute results and negligible major cardiac events during in hospital post-procedural period prior to discharge.

Keywords: CAD; CABG; ISR; elective PCI; and MI.

INTRODUCTION

The term "angina pectoris" was introduced by Heberden in 1772 to describe a syndrome characterized by a sensation of "strangling and anxiety" in the chest. Today, it is used for chest discomfort attributed to myocardial ischemia arising from increased myocardial oxygen consumption. This is often induced by physical exertion, and the commonest etiology is atheromatous coronary artery disease [Keeley, E.C. *et al*., 2003]. The terms “chronic" and "stable" refer to anginal symptoms that have been present for at least several weeks without major deterioration. However, symptom variation occurs for several reasons, such as mental stress, ambient temperature, consumption of alcohol or large meals, and factors that may increase coronary tones, such as drugs and hormonal change. [Levine, G.N. *et al*., 2016; McNamara, R.L. *et al*., 2006]

History of myocardial revascularization. In the management of chronic sable angina, there are two invasive techniques available for myocardial revascularization: coronary artery bypass surgery and catheter-attached devices [Capodanno, D. *et al*., 2018]. Although coronary artery bypass surgery was introduced in 1968, the first percutaneous transluminal coronary angioplasty was not performed until September 1977 by Andreas Graenzig, a Swiss radiologist, in Zurich. The patient, 38-year-old Adolph Bachman, underwent successful angioplasty of a left coronary artery lesion. After the success of the operation, six patients were successfully treated with percutaneous transluminal coronary angioplasty in that year.

By today’s standards, the early procedures used cumbersome equipment: guide cathet-ers were large and could easily traumatize he vessel, there were no guide wires, and balloon catheters were large with low burst pressures. As a result, the procedure was limited to patients with refractory angina, good left ventricular function, and a discrete, proximal, concentric, and non-calcified lesion in a single major coronary artery with no involvement of major side branches or angulations. Consequently, it was considered feasible in only 10% of all patients needing revascularization. [Levine, G.N. *et al*., 2012; Abdel-Wahab, M. *et al*., 2013; Kishi, K. *et al*., 2001]

Developments in Percutaneous Intervention. During 1977-86 guide catheters, guide wires, and balloon catheter technology were improved, with slimmer profiles and increased tolerance to high inflation pressures. As equipment improved and experience increased, so more complex lesions were treated and in more acute

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situations. Consequently, percutaneous transluminal coronary angioplasty can now be undertaken in about half of patients needing revascularization (more in some countries), and it is also offered to high-risk patients for whom coronary artery bypass surgery may be considered - too dangerous. [Waksman, R. *et al*., 2019; Witzenbichler, B. *et al*., 2014]

Although percutaneous transluminal coronary angioplasty causes plaque compression, the major change in lumen geometry is caused by fracturing and fissuring of the atheroma, extending into the vessel wall at variable depths and lengths. This injury accounts for the two major limitations of percutaneous transluminal coronary angioplasty

-acute vessel closure and restenosis. [Redfors, B. *et al*., 2017]

Acute vessel closure-This usually occurs within the first 24 hours of the procedure in about 3-5% of cases and follows vessel dissection, acute thrombus formation, or both. Important clinical consequences include myocardial infarction, emergency coronary art-ery bypass surgery, and death. [Tajti, P. *et al*., 2018]

Restenosis occurring in the first six months after angioplasty is caused largely by smooth muscle cell proliferation and fibro intimal hyperplasia (often called neointimal proliferation), as well as elastic recoil. I am usually defined as a greater than 50% reduction in luminal diameter and has an incidence of 25-50% (higher after vein graft angioplasty). Further intervention may be indicated if angina and ischemia recur. [Numasawa, Y. *et al*., 2015; Head, S.J. *et al*., 2014; Farmer, J.A. *et al*., 2014]

MATERIAL AND METHOD

The study was prospective and observational. All patients who underwent PCIs in Ibn-AL-Bitar hospital for cardiac surgery from the seventeenth of July 2008 to the eighteenth of November of the same year were included in this study. There were 213 patients.

PCI treatment was defined as any attempted procedure that was or was not successful. The insertion of a guide wire into a coronary artery was defined as an attempted procedure and separated from diagnostic catheterization. Initial and repeated interventional procedures for the same patient performed during any time of the study periods were evaluated. Baseline characteristics were collected from each patient by direct questionnaire and case records. These characteristics included age, sex, previous history of AMI, systemic hypertension, diabetes mellitus, and previous revascularization procedures (i.e., [CABG] or PCI) as well as the clinical diagnosis of stable or unstable angina pectoris, various investigations including ECG, Echocardiography, exercise test and the results of biochemical investigations were recorded.

Furthermore, from the angiographic records describing the results of coronary angiography preceding the index PCI, data on the location of the coronary artery disease, as well as the distribution with regard to 1-, 2-, and 3-vessel disease, were collected. For the group previously treated with PCI, information was collected from the angiography and PCI records to establish whether the index PCI was performed because of restenosis (target lesion revascularization), other lesions in previously treated vessels (target vessel revascularization), or in another vessel than previously treated. If necessary, coronary angiographic results were retrieved and analyzed to make these determinations. Data concerning details of the procedures, including primary operator and assistant, procedure time (calculated from the time of use of the guide catheter), amount of contrast, and total radiation exposure time, were recorded for each individual case as well as the various balloons and stents that were used.

Acute complications, as well as the success of the procedure as judged by the interventionist, were also obtained. The incidence of procedural complications, which included angiographic complications and adverse clinical outcomes (Death, MI, and need for emergency CABG) during hospitalization, was recorded.
PCI. All procedural decisions, including device selection and adjunctive pharmacotherapy, were made at the discretion of the individual physician performing the

PCI. Angiographic assessments were made for each individual patient and generally were achieved by visual assessment. Cardiac enzymes troponin was obtained the morning after PCI.

Medical Therapy. All Patients were pretreated with aspirin 100 mg/day and clopidogrel 150 mg/day at least three days before PCI, and heparin was given intravenously as a bolus dose of 10.000 IU at the beginning of the procedure and later 2000 units every 30 minutes. Patients were discharged on clopidogrel 75 mg/day for one month regarding

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bare metal stent and one year for a drug-eluting stent (supplied free by the center) and aspirin 100 mg/day and one of the statin groups of drugs indefinitely.

Definitions. Intravenous glycoprotein IIb/IIIa inhibitors were considered to be administered when abciximab, eptifibatide, or tirofiban were given during or within three h after PCI. Heparin therapy indicates treatment with intravenous heparin within 48 h before the PCI. Nitroglycerin treatment indicates therapy with intravenous nitroglycerin within 24 h of the procedure for ongoing ischemia or left ventricular failure. Diabetes mellitus is defined by treatment with oral hypoglycemic agents or insulin. The definition of renal insufficiency was standardized as a serum creatinine ≥2.5 mg/dl. A buccal temperature of ≥ 38°C indicated fever. Extracardiac vascular disease was defined as a history of stroke or peripheral vascular disease. Periprocedural myocardial infarction (MI) was considered to have occurred when an elevation in CK-MB was three times higher than normal after the procedure.

RESULTS

Table 1: Characteristics of type A, B, and C coronary lesions according to ACC/AHA classification

Type A lesion	**Type B lesion**	**Type C lesions**
Discrete (< 10 mm)	Tubular (10 – 20 mm length)	Diffuse (≥20 mm length)
Concentric	Eccentric	Total occlusion >3 mo old
Readily accessible	Irregular contour	Extremely angulated segment ≥ 90
Non-angulated segment, < 45□	Moderately angulated segment ≥ 45□ < 90□	tortuosity of the proximal segment
Smooth contour	Moderate tortuosity of proximal segment	Inability to protect major side branch
Little or no calcium	Moderate to heavy calcification	Degenerated vein grafts with friable lesion
Less than totally occluded	Total occlusion < 3 mo old	
Not ostial	Ostial	
No major side branches involvement	Bifurcation	
Absence of thrombus	Some thrombus present	

Table 2: Distribution according to age and gender

	(20-39)YEAR	**(40-59)YEAR**	**≥60 YEARS**	
MALE	6 (2.8%)	118 (55.4%)	60 (28.2%)	184 (86.4%)
FEMALE	-	19 (8.9%)	10 (4.7%)	29 (13.6%)
	6 (2.8%)	137 (64.3%)	70 (32.9%)	213

Table 3: Clinical presentation, functional class, and non-invasive evaluation results

		MALE	**FEMALE**	**TOTAL NO.**
CHEST PAIN		152	29	181 (84.98%)
DYSPNEA		34	0	34 (15.96%)
ARRYTHMIA		1	0	1 (0.5%)
ANGINAL CLASS (CCS classification)	II	83	22	105 (49.3%)
	III	101	7	108 (50.7%)
	IV	0	0	0
EXERCISE TEST	NOT DONE	5	0	5 (2.4%)
	NEGATIVE	6	1	7 (3.3%)
	POSITIVE	29	6	35 (16.4%)
	HIGHLY POSITIVE	17	4	21 (9.9%)
Ejection fraction	NOT MEASURED	14	5	19 (8.9%)
	EF >40%	160	22	186 (85.4%)
	EF ≤ 40%	12	0	8 (5.6%)

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CHRONIC STABLE ANGINA	142	26	168 (78.9%)
UNSTABLE ANGINA	42	3	45 (21.1%)
CABG	0	0	0
MI	63	1	64 (30.1%)
PCI	33	5	38 (17.8%)

Table 4: Risk factors of ischemic heart disease

	MALE	**FEMALE**	**TOTAL NO.**
HYPERTENSION	96	24	120 (56.4%)
DIABETES MELLITUS	59	16	75 (35.2%)
SMOKING	75	3	78 (36.6%)
FAMILY HISTORY	11	1	12 (5.6%)
HYPERLIPIDEMIA	11	2	13 (6.1%)
ONE RISK FACTOR	65	11	76 (35.7%)
TWO RISK FACTORS	69	11	80 (37.6%)
THREE RISK FOCTORS	15	3	13 (6.1%)

Table 5: characteristics of the lesions

Total no. of patients 213	One vessel	83 (39%)
	Two vessels	91 (42.7%)
	Three vessels	38 (17.8%)
	Four vessels	1 (0.5%)
Total no. of lesions 424	LAD	201 (47.3%)
	LCX	82 (19.3%)
	RCA	138 (32.6%)
	RAMUS	3 (0.8%)
Type of the lesion	ISR	9 (2.4%)
	INT	13 (3.1%)
	TYPE A	43 (10.1%)
	TYPE B	245 (57.7%)
	TYPE C	114 (26.7%)
Thrombus containing	3	(0.8%)
Ostial	13	(3.1%)
Bifurcation	70	(16.5%)
Long lesion	40	(9.4%)
Calcified	8	(1.9%)

Table 6: Outcome of interventional procedures

No. of intervention per patient		single	179 (84.1%)
		multiple	34 (15.9%)
Results of the procedure		Complete revascularization	95 (44.6%)
		One vessel intervention	86 (40.4%)
		≥ 2 vessels intervention	17 (7.9%)
		failure	15 (7.1%)
angiograp hic success rate	ɔnoccluded lesions	202 out of 203	99.5%
	totally occluded lesions	30 out of 44	68.2%
procedura l success rate	ɔnoccluded lesions	200 out of 203	98.5 %
	totally occluded lesions	30 out of 44	68.2%
		successful	30 (68.2%)
		failure	14 (31.8%)

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hic total occlusion results (64)	No intervention	20 (31.3%)
Mean duration of the procedure		45.5 min
Mean amount of contrast		274.5 ml
Mean radiation exposure time		14.5 min

Table 7: Procedural complications

Complication	No. of Patients		%
	Male	Female	
HEMATOMA	2	3	2.4%
DISSECTION	11	9	9.4%
PERFORATION	1	0	0.5%
NO FLOW	1	0	0.5%
STROKE	0	1	0.5%
DEATH	1	0	0.5%
STENT THROMBOSIS	1	0	0.5%
FEVER	1	1	0.9%
CHILLS	0	1	0.5%

Table no. (9): Results of interventions in patients with left ventricular dysfunction

		EF>40%	EF≤40%
No. of intervention per patient	single	175 (82.2%)	10 (83.3%)
	multiple	26	2 (16.7%)
		(12.2%)	
	Complete	92	3 (25%)
	revascularization	(45.8%)	
	One vessel intervention	80	6 (50%)
Results of the procedure		(39.8%)	
	≥ 2 vessels	15 (7.5%)	2 (16.7%)
	intervention		
	failure	14 (7%)	1 (8.3%)
giograp hic	Non-totally occluded lesions	188 (99.5%)	13 (92.9%)
success rate			
	totally occluded lesions	30 (76.9%)	0
procedura l success	Non-totally occluded lesions	187 (98.9%)	13 (92.9%)
rate	totally occluded lesions	30	0
		(76.9%)	

Table 10: Dose-area-product (DAP) for percutaneous coronary intervention

DAP mean Gycm²	Year of publication	Reference
163	1997	Bakalyar (20)
91.8	1997	Zorzetto (21)
87.5	1995	Vano (22)
75	2003	Efstathopoulos (23)
82.1	2004	Efstathopoulos (24)
68	2003	Tsapaki (25)
10.4	2002	Kuon (26)
6.7	2004	Kuon (27)

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DISCUSSION

The study demonstrated that PCI was associated with a high procedural success rate of about 98.5 % and negligible in – hospital adverse clinical outcomes. The high procedural success may be in part due to improved techniques, equipment, and operator experience, and the use of current adjunctive pharmacotherapies with proper selection of the candidate for PCI. [Mohr, F.W. *et al*., 2013]

We found that gender did not affect the procedural success rate and in-hospital complications; men and women had the same results, while in many established studies, women had a higher relative risk for vascular complications, in–hospital repeat revascularization, strokes, and non –Q-wave MI. this difference can probably be explained by small size sample in this study. [Verma, S. *et al*., 2013]

It is reported that multivessel disease is encountered in 40-75% of patients undergoing PCI, while total occlusion lesions were present in 20-40 % of patients with angiographically documented CAD. in our study, the multivessel disease was encountered in 61%, and total occlusion lesions were present in 20.5% of patients, figures which are comparable to those mentioned in the literatures. [Rutter, M.K. *et al*., 2010]

All totally occluded lesions are considered type C lesions (ACC/AHA classification) because the time elapsed from coronary angiography to the time of PCI was more than three months. So class C lesions in this study were 114 lesions divided into two groups totally- occluded C lesions (64 lesions) and non-totally occluded C lesions (50 lesions).

The angiographic success rates for lesions classified according to the ACC/AHA classification were for type A 100% and type B 100%, and it was 98.3% for type C. non- totally occluded vessels were successfully angioplastied in 100% of the case, whereas the procedure was successful in only 68.2% of the totally-occluded vessels. These results were comparable with that of the society for cardiac angiography and interventions (SCAI) and that of the National Heart, Lung, and Blood institute dynamic registry. [Bansilal, S. *et al*., 2012; Rastan, A.J. *et al*., 2009]

Success rates of the totally occluded lesions have improved from 40–50% to 70–75% with improved techniques, equipment, and operator experience and led to increased attempts at recanalization, while in our study, it was 68.2%. Despite comparable results, a higher success rate is believed to be achieved if more advanced facilities would be available in near future. [Goldman, S. *et al*., 2004; Pitt, B. *et al*., 1999]

The study documented that the procedural success rate of PCI in Patients with LV dysfunction (LVEF≤ 40 %) was high at 92.9 %, while in patients with normal LV function was 98.9% (table 9). However, patients with LV dysfunction had less complete revascularization, 25% versus 45.8%, while in literature, complete revascularization was attempted and achieved in 57% and 46%, respectively, of patients with two- and three-vessel coronary artery disease. (36) Further studies are indicated to examine the long-term effect of revascularization on LV function in those with LV dysfunction.

There was wide use of stents in PCI for de novo lesions of about 92.9%, and this is comparable to what was found in the NHLBI registry and ACC registry.

The incidence of angiographic complications was comparable with that reported worldwide; it could be explained by improved techniques, equipment, and operator experience; the reported incidence of dissection by angiography was 20-45% [Acharjee, S. *et al*., 2016] (while in this study, was 9.4% and one (0.5%) perforation were seen in this study, and its reported incidence was ≤ 1%.

The only modality which was available at the time of the study to deal with in-stent restenosis was balloon angioplasty which proved to be safe, and with a comparable procedural success rate for de novo lesions, there were three studies that showed the same results. Despite the non-availability of other modalities (Cutting balloon, Rotational atherectomy, Directional atherectomy, Laser angioplasty, and intra-coronary radiation), the immediate results of balloon angioplasty to treat ISR are still very promising. However, a specific study is required to address the long-term course of ISR lesions. [Abdelaal, E. *et al*., 2013]

Regarding the total radiation exposure time, the mean was (14.5 minutes); the literature provides considerably varying DAP values for the same procedure (Table 10), implicating that beyond the procedure per se, operator and patient-related factors have a substantial impact on DAP levels.

The majority of procedures were elective PCI [203 patients out of 213 (95.3%)] with a mean time

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interval between diagnostic coronary angiography and PCI of 4.8 months, and this long time gives a good chance for some lesions to converted to more advanced one keeping in mind the fact that the rate of the lesion progression being widely variable between different patients and generally speaking it is hardly to be detected.

CONCLUSION

This study proved that PCI is a very promising modality of treating CAD, and it is safe and effective and associated with negligible in – hospital adverse events.

Ad hoc PCI should have more attention and being done whenever it is indicated.

Long-term results after PCI are in need for a reasonable trial to clarify and also the long-term benefit of PCI in LV dysfunction.

PCI after acute MI should have especial attention.

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