Timing, setting and incidence of cardiovascular complications in patients with acute myocardial infarction submitted to primary percutaneous coronary intervention

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BACKGROUND: At the Istituto di Clinica Medica Generale e Cardiologia (Florence, Italy), the widespread use of percutaneous coronary intervention (PCI) has markedly changed the hospital course of patients with acute myocardial infarction (AMI). These patients are typically transferred to the coronary care unit (CCU) only after primary PCI, whereas during the thrombolytic era, patients were first admitted to CCU before reperfusion.

OBJECTIVES AND METHODS: The incidence, timing and setting of complications from symptom onset to hospital discharge in 689 consecutive AMI patients undergoing PCI were evaluated.

RESULTS: Ventricular fibrillation occurred in 11% of patients, and most episodes (94.7%) occurred before or during PCI. Of all patients, 6.3% developed complete atrioventricular block (CAVB), and in 86.3% of these cases, the CAVB occurred before or during PCI; in 94.5%, a CAVB resolution occurred in the catheterization laboratory (CL). Thirty-one patients (4.5%) had impending shock on admission to the CL. Cardiogenic shock developed in 29 patients (4.2%), mostly in the prehospital phase or in the CL. Only four patients (less than 1%) developed cardiogenic shock later during their hospital course. Similarly, circulatory and ventilatory support, as well as temporary pacing and cardiac defibrillation, were used mostly in the prehospital phase or in the CL. During the CCU stay, 45 patients (6.5%) had hemorrhagic or vascular complications, and the incidence of post-PCI ischemia and early reocclusion of the culprit vessel were low (2.1% and 0.6%, respectively). Thus, cardiac complications usually associated with AMI were observed mainly before hospital admission or in the CL during the reopening of the target vessel. These complications were rarely observed after a successful PCI.

CONCLUSIONS: For AMI patients, the CL is not only the site of PCI, it is also where most life-threatening cardiac complications are observed and treated.

Key Words: Angioplasty; Complications; Myocardial infarction

L'incidence, le moment et le lieu de survenue des complications cardiovasculaires chez les patients ayant subi une intervention coronarienne percutanée d'emblée pour cause d'infarctus aigu du myocarde

CONTEXTE : Le recours fréquent à l'intervention coronarienne percutanée (ICP) à l'Istituto di Clinica Medica Generale e Cardiologia, à Florence, en Italie, a considérablement changé le traitement des patients hospitalisés ayant subi un infarctus aigu du myocarde (IAM). Ceux-ci sont généralement mutés au service de soins coronariens (SSC) seulement après une ICP d'emblée, tandis que, à l'époque de la thrombolyse, les patients étaient d'abord admis au SSC avant d'être soumis au traitement de reperfusion.

BUT ET MÉTHODE : L'étude avait pour but d'évaluer l'incidence, le moment et le lieu de survenue des complications depuis l'apparition des symptômes jusqu'au congé de l'hôpital chez 689 patients consécutifs ayant subi une ICP pour cause d'IAM.

RÉSULTATS : Il y a eu fibrillation ventriculaire chez 11 % des patients, et la plupart des épisodes (94,7 %) se sont produits avant ou pendant l'ICP. Un bloc auriculo-ventriculaire (BAV) complet est apparu chez 6,3 % des patients; dans 86,3 % des cas, le trouble de conduction est survenu avant ou pendant l'ICP et, dans 94,5 % des cas, le BAV complet est disparu au laboratoire de cathétérisme. Trente et un patients (4,5 %) présentaient des signes de choc imminent au moment de l'admission au laboratoire. Un état de choc cardiogène s'est installé chez 29 patients (4,2 %), surtout au cours de la période préhospitalière ou au laboratoire. En revanche, quatre (moins de 1 %) cas de choc cardiogène sont apparus plus tard, en cours d'hospitalisation. Il en va de même pour l'assistance circulatoire ou ventilatoire, ainsi que pour la stimulation cardiaque temporaire et la défibrillation; on y a eu recours, la plupart du temps, avant l'admission à l'hôpital ou au laboratoire de cathétérisme. Pendant le séjour au SSC, 45 patients (6,5 %) ont connu des complications hémorragiques ou vasculaires, et l'incidence de l'ischémie post-ICP et de la réoblitération précoce du vaisseau lésé a été faible (2,1 % et 0,6 %, respectivement). Aussi peut-on déduire que les complications cardiaques généralement associées à l'IAM se produisent le plus souvent avant l'admission à l'hôpital ou au laboratoire de cathétérisme durant la reperméabilisation du vaisseau obstrué. Ces complications s'observent rarement après une ICP réussie.

CONCLUSION : Le laboratoire de cathétérisme est non seulement le lieu où l'on pratique les ICP chez les patients ayant subi un AIM, mais aussi le lieu où l'on observe et l'on traite la plupart des complications cardiaques potentiellement mortelles.

Primary percutaneous coronary intervention (PCI) is the reperfusion therapy of choice for patients with acute myocardial infarction (AMI) with ST elevation (STEMI), because it is associated with a higher incidence of Thrombolysis in Myocardial Infarction (TIMI) grade 3 flow, a reduced mortality, and a lower

incidence of recurrent ischemia and stroke compared with thrombolysis (1,2).

At the Istituto di Clinica Medica Generale e Cardiologia ('the institute'), in Florence, Italy, the widespread use of PCI has markedly changed the hospital course of patients with

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AMI (3). In fact, STEMI patients are currently first evaluated by the Emergency Medical Services staff in the prehospital setting. They are then either admitted and rapidly transferred to the catheterization laboratory (CL), or they may be admitted directly to the CL. Thus, STEMI patients are transferred to the CCU only after primary PCI, which is different from the thrombolytic era, during which STEMI patients were admitted to CCU before reperfusion.

In the present investigation, we evaluated the incidence, timing and setting of complications from symptom onset to hospital discharge in 689 consecutive patients with STEMI, all of whom had undergone primary PCI.

PATIENTS AND METHODS

Study population

From January 2002 to December 2003, 689 consecutive patients with STEMI were treated with PCI in the CL of the institute; 317 of these patients (46.0%) were directly admitted to the institute and 372 (53.9%) were transferred from other hospitals. The institute is a tertiary care centre where PCI is performed 24 h a day both on patients admitted directly and on those transferred from primary and secondary centres where PCI is not available (4). All patients were referred to the CL for PCI within 12 h of the onset of symptoms, or within 24 h if signs of persistent ischemia or shock were present. AMI was defined as typical chest pain lasting longer than 20 min associated with ST segment elevation of at least 1 mm in two contiguous leads or with new complete left bundle branch block.

In the study population of the present investigation, the incidence, timing and setting of the main complications were evaluated. Complications included ventricular fibrillation (VF), complete atrioventricular block (CAVB), pulmonary edema, cardiogenic shock, recurrent chest pain, cardiac tamponade, acute renal failure, and hemorrhagic and mechanical complications.

Moreover, the incidence, timing and setting of orotracheal intubation, intra-aortic balloon pump (IABP) counterpulsation, temporary pacing and defibrillation were assessed as indirect indicators of severe hemodynamic and arrhythmic instability.

All data were collected in a dedicated database. The study protocol was approved by the local ethics committee and written consent was obtained from all patients.

Definitions

'Impending shock' was defined as a clinical state preceding that of cardiogenic shock, characterized by a slightly faster heart rate, dyspnea, a mild reduction in urinary output, basilar pulmonary rales and gradual changes of the sensorium in the presence of a systolic blood pressure of approximately 90 mmHg responsive to inotropic drug administration or IABP (5).

'Cardiogenic shock' was defined as a state of systolic blood pressure of less than 90 mmHg (with or without inotropic drugs or IABP) associated with signs of end-organ hypoperfusion such as cold or diaphoretic extremities, altered mental status or anuria (6-8).

Hemorrhagic complications were considered major if they were associated with a decrease in hemoglobin level of more than 0.5 g/L, and minor if associated with a decrease in hemoglobin level of 0.3 g/L to 0.5 g/L (9).

'Acute renal failure' was defined as a sudden loss of the ability of the kidneys to excrete wastes, concentrate urine, conserve electrolytes and maintain fluid balance (10,11).

Procedural technique

Coronary angiography and angioplasty were performed using standard techniques, usually by the percutaneous femoral approach. Before PCI, an 80 U/kg intravenous bolus of unfractionated heparin was administered, followed by additional weight-adjusted doses, to maintain an activated clotting time of at least 250 s throughout the procedure. All patients were given 500 mg of acetylsalicylic acid. Platelet glycoprotein IIb/IIIa receptor (GP IIb/IIIa) inhibitors were administered according to the operator's judgement.

PCI was attempted only at the site of the culprit lesion, except in patients with cardiogenic shock, who received the most complete revascularization possible.

An optimal angiographic result was defined as a residual stenosis of less than 30% associated with TIMI grade 3 flow. A TIMI grade 2 flow or a residual stenosis of more than 50% was considered to be a suboptimal result. An unsuccessful PCI was defined as the procedure resulting in TIMI grade 0 or I flow, irrespective of the residual stenosis.

Statistical analysis

Statistical analysis was performed using SPSS statistical software (version 11.01, SPSS Inc, USA). Results are expressed as mean $\pm$ SD. Group comparisons were performed by χ^2 (with Yate's corrections when needed). $P < 0.05$ was considered statistically significant.

RESULTS

Table 1 shows the clinical characteristics of patients included in the study.

Fifty-six per cent of all patients underwent PCI within 4 h from symptom onset, and 80% were treated within 6 h. Table 2 shows the angiographic and procedural data of these patients.

Table 3 shows the incidence, timing and setting of the major cardiac complications and deaths observed in the prehospital phase, in the CL and during the hospital course (CCU and ward, mean 7.41 ± 4.11 days). Of 76 patients who experienced complications, VF occurred before or during PCI in 72 (94.7%). VF episodes were observed in only four patients (5.3%) during the remainder of the hospital course, and all episodes were secondary to shock or severe heart failure. VF was statistically more frequent in patients with inferior AMI than in those with anterior AMI (47 versus 29 patients, $P < 0.001$).

Of 44 patients with CAVB, 38 (86.3%) developed CAVB before or during PCI. Among these patients, one died in the CL of cardiogenic shock. Of the remaining 37 patients, 35 (94.5%) exhibited a CAVB resolution, and two exhibited a partial resolution (persistent grade II atrioventricular block) while in the CL. Among the 44 patients with CAVB, only six (13.6%) developed CAVB late during the hospital course. All six were older than 80 years of age with pre-existing right or left bundle branch block.

Among the 44 patients with CAVB, 39 (88.6%) had inferior MI, while the remaining five (11.3%) had anterior MI ($P < 0.001$).

Impending shock was observed in 31 patients (4.5%) before or during the PCI, with a significant improvement in hemodynamic parameters at the end of the procedure in all patients (Table 3).

Cardiogenic shock was observed in 29 patients (4.2%) (Table 3). Twenty-five patients (86.2%) exhibited the shock in the prehospital phase or in the CL. Only four developed cardiogenic shock later during the hospital course; in two patients

TABLE 1
Characteristics of patients with acute myocardial infarction treated with primary percutaneous coronary intervention (n=689)

Age, years (mean $\pm$ SD)	66 $\pm$ 12
Men, n (%)	501 (73)
Smokers, n (%)	259 (37)
Arterial hypertension, n (%)	308 (45)
Hypercholesterolemia, n (%)	173 (25)
Diabetes mellitus, n (%)	188 (27)
Previous unstable angina, n (%)	169 (24)
Previous stable angina, n (%)	86 (12)
Previous acute myocardial infarction, n (%)	101 (15)
Acute myocardial infarction location, n (%)	
Anterior	343 (50)
Lateral	38 (5)
Inferior	308 (45)
Time to revascularization procedure, n (%)	
0 h – 2 h	149 (22)
2 h – 4 h	238 (34)
4 h – 6 h	166 (24)
6 h – 12 h	118 (17)
>12 h	18 (3)
Killip class before intervention, n (%)	
I	591 (86)
II	50 (7)
III	23 (3)
IV	25 (4)
Medication on admission to catheterization laboratory, n (%)	
Angiotensin-converting enzyme inhibitors	131 (19)
Beta-blockers	38 (6)
Calcium antagonists	95 (14)
Acetylsalicylic acid	65 (9)
Statins	61 (8)
Anticoagulants	11 (2)
Ticlopidine	19 (3)

(6.9%), the shock was the result of mechanical complications (interventricular septum rupture). In the present series, patients who experienced cardiogenic shock were older than those who did not (74.25 $\pm$ 11.06 years versus 66.8 $\pm$ 11.2 years, $P<0.0001$). Among the 29 patients with cardiogenic shock, 15 (51.1%) had anterior MI and 14 (48.2%) had inferior MI. Twenty-two of the 29 patients (76%) had multivessel coronary artery disease and six (20.7%) had a chronically occluded coronary artery. PCI was successful in 26 of 29 patients (89.6%). However, the mortality rate of patients with cardiogenic shock was 55.1% (16 of 29), which was significantly higher than that of patients without cardiogenic shock (55.1% versus 3.7%, respectively; $P<0.0025$) and those with impending shock (55.1% versus 10%, respectively; $P<0.001$).

During the CCU stay, 32 patients (4.6%) had post-PCI chest pain and underwent immediate coronary angiography (Table 4). In 15 (46.9%) of these patients, a repeat PCI was performed to optimize the previous angiographic result. In 17 patients (53.1%), angiography revealed the persistence of an optimal result. Among the 32 patients, four (12.5%) had early reocclusion of the culprit vessel, which resulted in a nonfatal AMI successfully treated with repeat PCI in two patients (6.3%), and a fatal AMI in the other two.

TABLE 2
Angiographic and procedural data of patients with acute myocardial infarction treated with primary percutaneous coronary intervention (n=689)

	Patients, n (%)
Infarct-related artery	
Left anterior descending	329 (47.7)
Diagonal	14 (2)
Circumflex	85 (12)
Right coronary	251 (37)
Left main	4 (0.5)
Venous graft	6 (0.8)
Percutaneous coronary intervention with stent	613 (89)
Patients treated with GP IIb/IIIa inhibitors	395 (57)
Left ventricular ejection fraction <45%	143 (20)
Successful percutaneous coronary intervention	678 (98)
TIMI flow grade preprocedure	
0	619 (90)
>0	70 (10)
TIMI flow grade postprocedure	
III	657 (95)
II	21 (3)
I	1 (1)
0	10 (1)
Single-vessel disease	340 (49)
Double-vessel disease	192 (28)
Triple-vessel disease	157 (23)

GP IIb/IIIa Platelet glycoprotein IIb/IIIa receptor; TIMI Thrombolysis in Myocardial Infarction

TABLE 3
Timing of major cardiac events in patients with acute myocardial infarction treated with primary percutaneous coronary intervention (n=689)

	Prehospital phase	Catheterization laboratory	CCU	Ward	Total, n (%)
Ventricular fibrillation	34	38	3	1	76 (11.0)
CAVB	22	16	0	6	44 (6.3)
Impending shock	NA	31	0	0	31 (4.5)
Pulmonary edema	23	14	9	0	46 (6.7)
Cardiogenic shock	18	7	4	0	29 (4.2)
Death	1	7	23	11	41 (5.9)
Cardiac tamponade	0	0	7	0	7 (1.0)
Recurrent chest pain	0	0	32	0	32 (4.6)
Vascular/hemorrhagic events	0	0	45	0	45 (6.5)
Acute renal failure	0	0	10	0	10 (1.4)

CAVB Complete atrioventricular block; CCU Coronary care unit; NA Not applicable

During the CCU stay, seven patients (1.0%) developed cardiac tamponade; all cases were treated by pericardiocentesis (Table 4). In four of these patients (57.1%), cardiac tamponade was the result of myocardial perforation caused by the

TABLE 4
Timing of major postprocedural complications in patients with acute myocardial infarction treated with primary percutaneous coronary intervention (PCI) (n=689)

Complication	Coronary care unit	Ward	Total, n (%)
Cardiac tamponade	7	0	7 (1.0)
Recurrent chest pain	32	0	32 (4.6)
Repeat PCI of infarct-related artery	15	0	15 (2.1)
Reocclusion of infarct-related artery	4	0	4 (0.6)
Vascular/hemorrhagic events	45	0	45 (6.5)
Acute renal failure	10	0	10 (1.4)
Mechanical complications	6	2	8 (1.2)

TABLE 5
Hemorrhagic and vascular complications in 689 patients with acute myocardial infarction treated with percutaneous coronary intervention

Complication	Patients (n=45)
Minor bleeding (n=14)	
Hematoma access site	14
Major bleeding (n=19)	
Gastrointestinal hemorrhage	6
Retroperitoneal hemorrhage	5
Cerebrovascular hemorrhage	0
Hemorrhagic shock	0
Vascular complications (n=12)	
Access site	12
Pseudoaneurysm/atrioventricular fistula	6
Arterial thrombosis	6

temporary pacing catheter. In three patients (42.9%), cardiac tamponade was the consequence of a hemopericardium due to anticoagulant or antiplatelet therapies. Four of these seven patients (57.1%) died because of this complication.

Eight patients (1.2%) developed mechanical complications: four experienced a rupture of the left ventricular free wall, two had acute mitral regurgitation and two had interventricular septum rupture. Six patients (75%) died during the hospital course.

Forty-five patients (6.5%) developed hemorrhagic or vascular complications and therefore had blood transfusions or surgical repair (Table 4). Of these patients, 25 (55.5%) had been treated with GP IIb/IIIa inhibitors. Table 5 shows the specific hemorrhagic and vascular complications observed in the study.

Acute renal failure not related to shock (Table 4) occurred in 10 patients (1.4%), probably due to radiographic contrast agents. This complication was treated with ultrafiltration in seven patients and with medical therapy in three. One patient with diabetes and chronic renal insufficiency received chronic dialysis.

Table 6 shows the timing of orotracheal intubation, IABP, temporary pacing and defibrillation; most of these procedures were performed in the CL and in the prehospital phase.

Table 7 shows the locations and causes of death. Those patients who died were older (77.3 ± 9.2 years versus 65.7 ± 12.5 years, $P < 0.001$), had a longer time to reperfusion of the target vessel (5.12 ± 2.62 h versus 4.38 ± 3.20 h, $P < 0.001$) and had a higher incidence of suboptimal or unsuccessful

TABLE 6
Incidence and timing of orotracheal intubation, intra-aortic balloon pump (IABP) counterpulsation, temporary pacing and defibrillation in patients with acute myocardial infarction treated with primary percutaneous coronary intervention (n=689)

	Prehospital phase	Catheterization laboratory	Coronary care unit	Ward	Total, n (%)
Orotracheal intubation	16	15	11	0	42 (6.1)
IABP	0	94	2	0	96 (13.9)
Temporary pacemaker	0	78	0	0	78 (11.3)
Defibrillation	34	38	3	1	76 (11.0)

angiographic results (TIMI grade 0, 1 or 2 flow post-PCI versus TIMI grade 3 flow post-PCI, $P < 0.001$).

DISCUSSION

In our series of patients, cardiac complications usually associated with AMI (such as tachy- and/or bradyarrhythmias, acute pulmonary edema, or impending and cardiogenic shock) were observed before hospital admission or they manifested in the CL during the dilation of the target vessel. These complications were rarely observed after a successful PCI. Similarly, circulatory and ventilatory support (IABP and mechanical ventilation), as well as temporary pacing and cardiac defibrillation, were used mostly in the prehospital phase or in the CL.

In our series of patients, we documented a low incidence of recurrent ischemia, target vessel revascularization and new onset of cardiogenic shock, which has been previously reported in AMI patients undergoing PCI (2).

Moreover, during the hospital course, we observed complications mainly related to the PCI or to drugs, such as vascular and hemorrhagic complications, and acute renal failure. These data deserve special consideration.

VF

In the present investigation, the overall incidence of VF was 11%, which is higher than that reported by others (12,13). This may be explained by the fact that we included 34 episodes (4.9%) that occurred in the prehospital phase. Taking into account only those episodes observed in the CL (38 of 76) and during the hospital course (four of 76), the incidence of VF in our series of patients was 6%, which is comparable with that of other reports. The episodes of VF observed in the CL may be related to injury secondary to the faster reperfusion obtained with PCI. The link between VF development and the rate of restoration of blood flow after coronary occlusion was previously described in several studies based on experimental models (14-18).

Only four VF episodes were observed later during the hospital course, and all of them were secondary to severe heart failure. It seems likely that the stable flow obtained with a successful PCI may account for the electrical stability and the scarcity of VF during the hospital course.

CAVB

In our study, the incidence of CAVB (6.3%) and its relationship with inferior AMI is similar to data previously reported with PCI (12).

However, an interesting finding in the present investigation was the timing of this arrhythmia and its duration. In fact, most episodes of CAVB (38 of 44 [86%]) were observed before or during PCI of the target vessel, and all cases observed in the CL, except for that of one patient who died, showed a complete recovery (35 of 38 [92.1%]) or a partial recovery (two of 38 [5.3%]) without recurrences during the hospital course. Our data strongly suggest that PCI itself may shorten the duration of CAVB, probably by relieving ischemia of the atrioventricular conduction system (19). Moreover, PCI reduces the late incidence of CAVB probably by reducing the late ischemic recurrences and reocclusions (2,13,20).

Shock

In the present investigation, the incidence of cardiogenic shock was 4.2%, with an in-hospital mortality of 55%. These data are comparable with those of many previous papers (5,6,8,21) that reported AMI patients undergoing primary PCI. However, some authors (22-25) reported a higher incidence of cardiogenic shock and a lower mortality in this subgroup of AMI patients. These discrepancies may be related to the definition of 'shock'. In our study, we distinguished, on a clinical basis, between patients with overt cardiogenic shock and those with impending shock. Patients with impending shock have very marginal hemodynamics and may develop full-blown shock quickly if reperfusion is not attained; however, they may have an improved outcome if the shock is identified and treated early. In fact, in our population, patients with overt cardiogenic shock and those with impending shock were mainly characterized by different prognoses, as indicated by a different in-hospital mortality (55% in the cardiogenic shock group versus 10% in the impending shock group).

In the vast majority of our patients (86.2%), cardiogenic shock was already present in the prehospital phase or in the CL (mean time of 4.8 ± 3.5 h from symptom onset); only four patients (13%) developed shock later during the CCU stay. The low incidence of late cardiogenic shock contrasts with the data observed in the pre-PCI era. In the Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries-1 (GUSTO-I) trial (26) and the TRAndolapril Cardiac Evaluation (TRACE) study (27), the majority of patients developed cardiogenic shock later during the hospital course. This finding can probably be explained by the more efficient and stable reperfusion attained with primary PCI compared with thrombolysis.

Other complications

In our study, patients treated with PCI also developed complications linked to drugs usually administered during this procedure (heparin, GP IIb/IIIa inhibitors and contrast medium) or to the procedure itself. Hemorrhagic and vascular events were the most common complications observed during CCU stay (6.5% of patients); this value is comparable with previous reports (28,29). It is known that major hemorrhagic events and hemorrhagic shock are more frequent in patients treated with PCI than in patients treated with thrombolysis (20,30). Because most bleeding sites are located at the site of puncture, lower doses of heparin, small catheters, more skilled physicians and new techniques for percutaneous closures are thought to further reduce the incidence of bleeding events despite the increased use of GP IIb/IIIa inhibitors (2,31).

TABLE 7

Causes and location of death during hospital course in 689 patients with acute myocardial infarction included in the present study

Cause of death	Number of deaths (n=41)	Catheterization laboratory (n=7)	CCU (n=22)	Ward (n=12)
Cardiogenic shock	14	2	6	6
Unsuccessful D-PTCA	3	3	0	0
Severe cardiac heart failure	3	0	1	2
Reinfarction	2	0	2	0
Cardiac arrest on admission to catheterization laboratory	2	2	0	0
Cardiac tamponade	4	0	3	1
Rupture of the free wall	4	0	3	1
Hemorrhagic shock	4	0	3	1
Postanoxic coma	1	0	1	0
Other	4	0	3	1

CCU Coronary care unit; D-PTCA Direct percutaneous transluminal coronary angioplasty

Mortality

In our investigation, in-hospital mortality was 5.9%, which is comparable with that previously described (2,32). Our data confirm that advanced age-associated comorbidities (33), greater delay in the reopening of the infarct-related vessel and unsuccessful myocardial reperfusion (34-36) may be considered the main factors that influence the mortality of patients undergoing primary PCI. Most deaths were related to cardiogenic shock and the reduction in myocardial function caused by AMI. Complications related to the procedure or the drug therapy (hemorrhagic shock, cardiac tamponade) account for the other deaths (eight of 689) in our series of patients. This finding highlights the risk related to PCI itself and stresses the potential of a further reduction of mortality with technical improvements.

CONCLUSIONS

The CL is not only the site of target vessel dilation procedures, it is also where most of the life-threatening cardiac complications are observed and treated, and where emergency devices are more frequently used. The widespread use of primary PCI has transformed the CCU, instituted in the 1960s for the detection and treatment of serious arrhythmias, into postreperfusion units.

The low arrhythmic risk profile and the low incidence of ischemic recurrences observed in AMI patients who have undergone successful primary PCI may lead to early discharge from the CCU and/or early transfer back to hospitals where PCI was initially not available.

In a postreperfusion CCU, the main challenge is the treatment of severe heart failure in patients with extensive MI or of cardiogenic shock or cardiac arrest in those who may require prolonged respiratory and circulatory support.

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