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CLINICAL RESEARCH

Factors associated with delay in transfer of patients with ST-segment elevation myocardial infarction from first medical contact to catheterization laboratory: Lessons from CRAC, a French prospective multicentre registry



Facteurs associés au délai de transfert entre le premier contact médical et la salle de coronarographie des patients présentant un infarctus du myocarde avec sus-décalage du segment ST : données issues du registre français prospectif multicentrique CRAC

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Abbreviations: CI, confidence interval; CRAC, Club Régional des Angioplasticiens de la région Centre; CVL, Centre-Val de Loire; EMS, emergency medical services; FMC, first medical contact; ICC, interventional cardiology centre; OR, odds ratio; PPCI, primary percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

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KEYWORDS

ST-segment elevation myocardial infarction;
Percutaneous coronary intervention;
Primary angioplasty;
Preadmission delay

Summary

Background. – It is critical to minimize the time between the first medical contact and primary percutaneous coronary intervention in patients with ST-segment elevation myocardial infarction.

Aims. – To identify factors associated with a delay of > 120 min between first medical contact and primary percutaneous coronary intervention in patients with ST-segment elevation myocardial infarction.

Methods. – Data were analysed from a regional French registry of patients undergoing coronary angioplasty for ST-segment elevation myocardial infarction < 24 h after symptom onset. Patients ($n = 2081$) were grouped according to transfer times from first medical contact to primary percutaneous coronary intervention: > 120 min; or ≤ 120 min. Independent predictors of delay were identified by univariate and multivariable analyses.

Results. – The median transfer time from first medical contact to primary percutaneous coronary intervention was 112 min; 892 patients (42.9%) had a transfer time > 120 min. A delay of > 120 min was significantly associated with: ≥ 75 km distance from interventional cardiology centre at symptom onset (odds ratio 7.9); more than one medical practitioner involved before interventional cardiology centre (odds ratio 4.5); first admission to a hospital without an interventional cardiology centre (odds ratio 2.9); absence of emergency call (odds ratio 1.6); ≥ 90 min between symptom onset and first medical contact (odds ratio 1.3); Killip class at admission > 1 (odds ratio 1.8); lateral ischaemia (odds ratio 1.8); diabetes mellitus (odds ratio 1.6); and hypertension (odds ratio 1.3).

Conclusions. – In ST-segment elevation myocardial infarction, a transfer time from first medical contact to primary percutaneous coronary intervention of > 120 min was associated with geographic, systemic and comorbid factors, several of which appear reasonably actionable.

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MOTS CLÉS

Infarctus du myocarde avec sus-décalage du segment ST ;
Angioplastie coronaire ;
Angioplastie primaire ;
Délai de transfert préhospitalier

Résumé

Contexte. – Réduire les délais de transfert préhospitalier des patients présentant un infarctus du myocarde (IDM) aigu est un enjeu majeur.

Objectif. – Identifier les facteurs associés à un délai de transfert supérieur aux recommandations (> 120 min) entre le premier contact le médical et l'angioplastie coronaire primaire des patients présentant un IDM avec sus-décalage du segment ST.

Méthodes. – Tous les patients du registre prospectif régional CRAC ayant présenté un IDM avec sus-décalage du segment ST de moins de 24 h ont été analysés. Les patients ont été répartis selon leur délai de transfert entre le premier contact médical et l'angioplastie primaire (> 120 min et ≤ 120 min). Les facteurs prédictifs indépendants de transfert retardé (> 120 min) ont été évalués en analyses uni- et multivariées.

Résultats. – Le temps de transfert médian entre le premier contact médical et l'angioplastie primaire était de 112 min et 892 patients (42,9 %) avaient un temps de transfert > 120 min. Un délai > 120 min était significativement associé à : une distance de plus de 75 km entre le lieu de début des symptômes et le centre de coronarographie (odds ratio 7,9) ; le recours à plus d'1 intervenant médical pour le transfert jusqu'au centre de coronarographie (odds ratio 4,5) ; une première admission dans un hôpital sans centre de coronarographie (odds ratio 2,9) ; l'absence d'appel du 15 (odds ratio 1,6) ; un délai ≥ 90 min entre le début des symptômes et le premier contact médical (odds ratio 1,3) ; une classe de Killip > 1 à l'admission (odds ratio 1,8) ; une localisation latérale de l'ischémie myocardique (odds ratio 1,8) ; un diabète sucré (odds ratio 1,6) ; et une hypertension artérielle (odds ratio 1,3).

Conclusions. — Chez les patients atteints d'un infarctus du myocarde avec élévation du segment ST, un délai de transfert retardé > 120 min entre le premier contact médical et l'angioplastie primaire était associé à des facteurs géographiques, systémiques et médicaux, dont certains semblent raisonnablement corrigeables.

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Background

ST-segment elevation myocardial infarction (STEMI) is one of the leading causes of cardiovascular death and disability in the world [1], particularly in ageing populations. Primary percutaneous coronary intervention (PPCI) is the reference treatment [2,3], with well-established beneficial effects on long-term survival and risk of recurrence [4–6]. As myocardial ischaemic time plays a major role in survival [7,8], and the damage from delayed reperfusion is well documented [9], it is critical to minimize the time between first medical contact (FMC) and PPCI; the current target is ≤ 120 min [2,3]. For patients with direct admission to a percutaneous coronary intervention (PCI) centre, the target delay is an aggressive ≤ 60 min.

In real-life conditions, the observed time intervals often exceed the recommendations [10]. To meet the target of ≤ 120 min requires an optimal prehospital medical pathway with the shortest possible transfer time to an interventional cardiology centre (ICC). For patients with STEMI, systematic recording and monitoring of time intervals in the patient care pathway may help to identify bottlenecks and inform targeted measures, to improve and maintain quality of care. To this purpose, the "Centre-Val de Loire" (CVL) region set up the regional Club Régional des Angioplasticiens de la région Centre (CRAC) registry for patients with STEMI in 2014.

The aim of the present study was to identify the key features of pathways for patients with STEMI in the CRAC registry associated with a time interval of > 120 min from FMC to PPCI.

Methods

Registry design and study population

The CRAC observational prospective multicentre registry includes all patients undergoing coronary angiography or coronary angioplasty in one of the six ICCs in the CVL region – an administrative region in central France with around 2.5 million inhabitants and 38 private and public hospitals. The registry is registered on clinicaltrials.org (NCT02778724). Data are collected prospectively by cardiologists during routine coronary angioplasty, using electronic reporting software (CardioReport®; CVX Medical, Croissy-Beaubourg, France). Data are anonymized before automatic transfer to the regional CRAC database. The basic methodology and rationale for the CRAC registry have been described [11].

The current analysis included all consecutive patients with STEMI undergoing primary coronary angioplasty within

24 h after symptom onset between 1 January 2014 and 31 December 2016 in the five ICCs that were part of the CRAC registry since the start. A sixth ICC, which started submitting data in June 2014, was excluded from the study because of incomplete data. Patients undergoing fibrinolysis (8% of angioplasty cases) were excluded.

Data collection and analysis

The CRAC registry collects up to 71 variables for each patient, including demographic characteristics (age, sex, body mass index), risk factors (hypertension, diabetes mellitus, smoking, hypercholesterolaemia, family history of coronary diseases, obesity), medical history and clinical presentation. Preadmission pathway data are collected by emergency physicians: calls to emergency medical services (EMS; numbers 15, 18 or 112); physical location of the patient at onset of pain; time points for onset of pain; FMC (defined as first qualified electrocardiogram) and revascularization; type and number of medical contacts; and first admission to hospital with or without an ICC.

For the analyses, the time intervals from symptom onset to FMC and from FMC to PPCI (defined by guide passage through the culprit coronary artery) were measured. Subjects were divided into two groups according to time from FMC to PPCI: an on-time group (≤ 120 min); and a delayed group (> 120 min). To assess data completion and quality, a dedicated on-site part-time research technician monitored each ICC. Regional data monitoring was coordinated by the CRAC clinical research associate. External independent supervision was carried out by the Regional Epidemiology Unit, which also provided support for quality management and analyses.

Ethical aspects

This study was conducted according to contemporary clinical practice guidelines and French regulations (Advisory Committee in Information Processing Regarding Research; CCTIRS n° 13.245). The ethical evaluation committee of INSERM (IRB00003888) approved the study protocol (agreement n° 15-231). Data file collection and storage were approved by the Commission Nationale Informatique et Liberté (CNIL n° 2014-073). All patients were informed of the aims of the survey. All included patients gave their informed consent to participate before data collection.

Statistical analyses

Factors associated with a delay from FMC to PPCI of > 120 min were identified using a logistic regression model. Relevant variables were defined as those with a statistical significance

of $P < 0.20$ in the univariate analyses. A multivariable analysis was performed, adjusted for age, sex, diabetes mellitus, hypertension, Killip class at admission, ischaemia location, EMS call, time between symptom onset and FMC, care pathway, first admission to hospital with or without an ICC and distance from location of onset of pain to ICC. Age and sex were not significant in the model, but were maintained in the analysis because these are clinically relevant variables. For each of the major significant predictors, the association between the variable and median and mean delays from FMC to PPCI is reported descriptively. For this last analysis, and to keep the box-plot readable, we excluded patients with a delay from FMC to PPCI of > 12 h ($n = 34$ outliers). Statistical analyses were performed using SAS software for Microsoft Windows, version 9.3 (SAS Institute, Cary, NC, USA).

Results

During the study period, 2665 (15.0%) of the 17,749 patients undergoing coronary angioplasty were treated for STEMI within 24 h after symptom onset. After exclusion of incomplete data ($n = 370$) and patients treated by thrombolysis ($n = 214$), 2081 patients were included in the analysed population (Fig. 1). A time from FMC to PPCI of > 120 min was recorded for 892 subjects (42.9%).

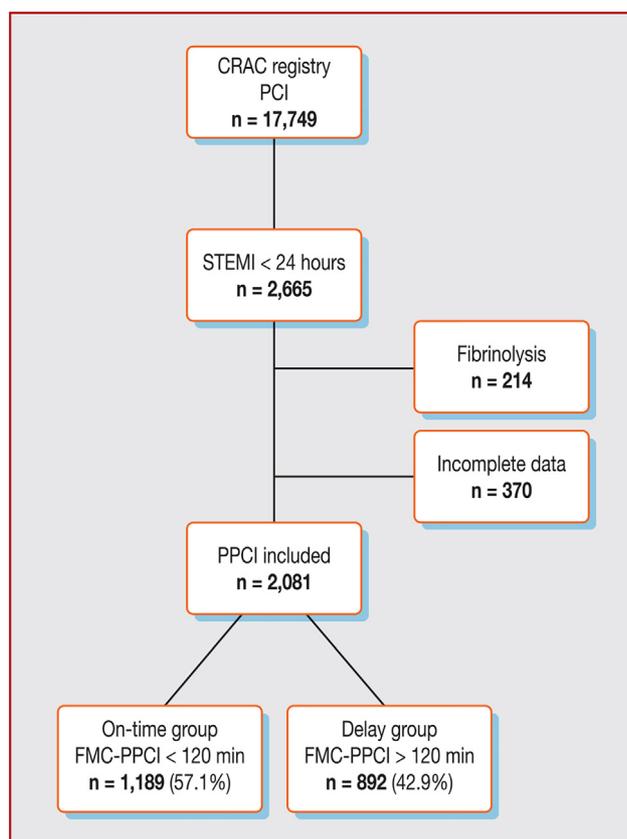


Figure 1. Flow chart of the study population. CRAC: Club Régional des Angioplasticiens de la région Centre; FMC: first medical contact; PCI: percutaneous coronary intervention; PPCI: primary percutaneous coronary intervention; STEMI: ST-segment elevation myocardial infarction.

Baseline characteristics

The demographic, clinical and geographic characteristics of subjects at baseline are shown in Table 1. Age, sex distribution and the prevalence of comorbidities were unremarkable for a STEMI population. The median time from symptom onset to FMC was 92 min, and the median time from FMC to PPCI was 112 min. At the onset of pain, 24.9% of patients were located in an administrative department without an ICC, but only 5.5% were > 75 km from an ICC (Fig. 2). The proportion of first admissions to a hospital without an ICC was 30.7%. An emergency hospital unit was the FMC for 28.5% of patients. Patients had called EMS in 58.9% of cases. FMC was outside standard working hours for approximately half of the population. Many patients (54.9%) did not encounter an optimized care pathway (defined as more than one medical practitioner involved before PPCI).

Predictors of time from FMC to PPCI > 120 min

Significant clinical predictors of time from FMC to PPCI > 120 min in the multivariable analysis (Table 2) were lateral ischaemia (odds ratio [OR] 1.8, 95% confidence interval [CI] 1.1–2.9; $P = 0.01$), Killip class > 1 at admission (OR 1.8, 95% CI 1.3–2.5; $P = 0.0003$), diabetes mellitus (OR 1.6, 95% CI 1.1–2.2; $P = 0.01$) and hypertension (OR 1.3, 95% CI 1.01–1.7; $P = 0.02$). Geographic and organizational factors associated with a delay from FMC to PPCI were non-optimized care pathways (OR 4.5, 95% CI 3.4–6.0; $P < 0.0001$), first admission to a hospital without an ICC (OR 2.9, 95% CI 2.1–3.9; $P < 0.0001$), absence of EMS call (OR 1.6, 95% CI 1.2–2.1; $P < 0.001$), ≥ 90 min from symptom onset to FMC (OR 1.3, 95% CI 1.1–1.7; $P = 0.016$) and greater geographic distance from an ICC ($P < 0.0001$). A 5-fold increase in OR was found for subjects located 50–75 km from an ICC at the time of the event, and an 8-fold increase for a distance ≥ 75 km.

Differences between the populations were also found for age, sex, smoking, history of coronary artery disease, history of stroke and renal failure, but none of these factors remained significant in the multivariable analysis. No significant association with time to transfer was found for day/night shifts, weekends or bank holidays.

FMC to PPCI time intervals

Significantly longer average times from FMC to PPCI were observed in cases where no EMS call was made (159 vs 115 min; $P < 0.0001$), as well as in centres without an optimal care pathway (167 vs 92 min; $P < 0.0001$) and in cases of first admission to a hospital without an ICC (192 vs 107 min; $P < 0.0001$) (Fig. 3). Time to PPCI was also longer when onset of pain occurred within a department without an ICC (172 vs 119 min, $P < 0.0001$). The greater the distance from the location of onset of pain to the catheterization laboratory, the longer the delay between FMC and PPCI: 175 min for a distance ≥ 75 km versus 106 min for a distance < 25 km.

Table 1 Characteristics of patients with ST-segment elevation myocardial infarction who underwent primary percutaneous coronary intervention, and univariate analysis of factors associated with a first medical contact to primary percutaneous coronary intervention time > 120 min.

Patient characteristics	Missing data	Overall population (n=2081)	FMC to PPCI ≤ 120 min (n=1189; 57.1%)	FMC to PPCI > 120 min (n=892; 42.9%)	P (univariate analysis)
Time from FMC to PPCI (min)	0	112	86	170	
Age ≥ 65 years	0	928 (44.6)	487 (41.0)	441 (49.4)	< 0.001
Age (years)	0	62 [18–97]	61 [18–95]	64 [29–97]	
Women	0	518 (24.9)	259 (21.8)	259 (29.0)	< 0.001
BMI ≥ 25	3	1318 (63.4)	752 (63.2)	566 (63.7)	0.84
Diabetes mellitus	13	283 (13.7)	131 (11.1)	152 (17.1)	< 0.0001
Hypercholesterolaemia	38	771 (37.7)	423 (36.3)	348 (39.6)	0.13
Hypertension	17	825 (40.0)	425 (36.0)	400 (45.2)	< 0.0001
Current smoker	13	796 (38.5)	482 (40.8)	314 (35.4)	0.05
Family history of coronary artery disease	57	434 (21.4)	257 (22.3)	177 (20.3)	0.29
History of myocardial infarction	6	153 (7.4)	103 (8.7)	50 (5.6)	0.01
Previous PCI	0	247 (11.9)	173 (14.6)	74 (8.3)	< 0.0001
Previous CABG	0	30 (1.4)	16 (1.3)	14 (1.6)	0.67
History of CAD ^a	0	287 (13.8)	191 (16.1)	96 (10.8)	< 0.001
History of PAD	3	68 (3.3)	35 (2.9)	33 (3.7)	0.34
History of stroke	2	53 (2.5)	23 (1.9)	30 (3.4)	0.04
History of chronic kidney disease	18	34 (1.6)	14 (1.2)	20 (2.3)	0.06
Killip class at admission > 1	5	344 (16.6)	172 (14.5)	172 (19.3)	< 0.01
Ischaemia location	22				< 0.01
Inferior		1106 (53.7)	653 (55.4)	453 (51.4)	
Anterior		816 (39.6)	464 (39.4)	352 (40.0)	
Lateral		137 (6.7)	61 (5.2)	76 (8.6)	
Absence of EMS call	77	821 (41.0)	323 (28.2)	498 (57.9)	< 0.0001
FMC	1				< 0.0001
EMS		1186 (57.0)	840 (70.7)	346 (38.8)	
Emergency hospital unit		593 (28.5)	227 (19.1)	366 (41.0)	
Other		301 (14.5)	121 (10.2)	180 (20.2)	
Last transport to ICC	0				< 0.0001
Ambulance		1229 (59.1)	777 (65.3)	452 (50.7)	
Helicopter		358 (17.2)	123 (10.3)	235 (26.3)	
Stretcher (emergency room)		238 (11.4)	172 (14.5)	66 (7.4)	
Stretcher (cardiology ICU)		256 (12.3)	117 (9.8)	139 (15.6)	
≥ 90 min from symptom onset to FMC	2	1054 (50.7)	522 (43.9)	532 (59.7)	< 0.0001
Time from symptom onset to FMC (min)	0	92	80	120	
Not optimal care pathway ^b	0	1143 (54.9)	397 (33.4)	746 (83.6)	< 0.0001
First admission to hospital without ICC	0	639 (30.7)	118 (9.9)	521 (58.4)	< 0.0001
Distance from location of onset of pain to ICC	20				< 0.0001
< 25 km		861 (41.8)	666 (56.6)	195 (22.0)	
25–50 km		621 (30.1)	333 (28.3)	288 (32.5)	
50–75 km		466 (22.6)	148 (12.6)	318 (35.9)	
≥ 75 km		113 (5.5)	29 (2.5)	84 (9.5)	
Location of onset of pain	1				< 0.0001
Department with ICC		1518 (73.0)	1013 (85.3)	505 (56.6)	

Table 1 (Continued)

Patient characteristics	Missing data	Overall population (n=2081)	FMC to PPCI ≤ 120 min (n=1189; 57.1%)	FMC to PPCI > 120 min (n=892; 42.9%)	P (univariate analysis)
Department without ICC		518 (24.9)	153 (12.9)	365 (40.9)	
Outside CVL region		44 (2.1)	22 (1.9)	22 (2.5)	
Time of FMC overnight (8 p.m. to 8 a.m.), weekend or bank holiday	0	1107 (53.2)	625 (52.6)	482 (54.1)	0.49

Data are expressed as median with/without [range] or number (%). BMI: body mass index; CABG: coronary artery bypass graft; CAD: coronary artery disease; CVL: Centre-Val de Loire; EMS: emergency medical services; FMC: first medical contact; ICC: interventional cardiology centre; ICU: intensive care unit; PAD: peripheral arterial disease; PCI: percutaneous coronary intervention; PPCI: primary percutaneous coronary intervention.

^a Combination of the three previous variables.

^b An optimal care pathway is a pathway with only one medical practitioner before coronary angiography.

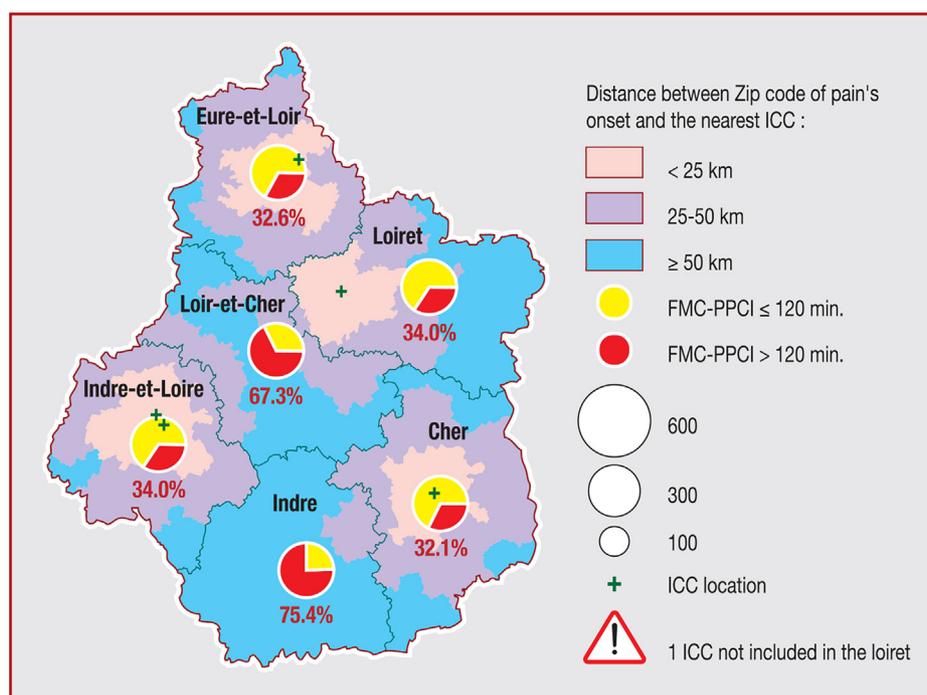


Figure 2. First medical contact (FMC) to primary percutaneous coronary intervention (PPCI) time, according to the distance between the location of onset of pain and the nearest interventional cardiology centre (ICC) in the Centre-Val de Loire region, 2014–2016.

Discussion

Timely reperfusion therapy is critical to reduce mortality in patients with STEMI, but the recommended target of ≤ 120 min from FMC to PPCI is often exceeded. Global data indicate that the task of shortening the delay is highly challenging, with geographic location and patient transfer among the strongest predictors of prolonged delay [12]. The present analysis of data from a French registry confirmed the high percentage of missed targets seen in other studies in Europe and the USA [10,13], and identified a number of factors associated with delayed time to angioplasty. Geographical and organizational factors were more important predictors of delay than a high-risk patient profile with comorbidities. This identification of possibly actionable

factors represents a first step towards improvement of the care pathway and the prognosis of patients with STEMI in rural France. The National Registry of Information and Knowledge about Swedish Heart Intensive Care Admissions demonstrated that the implementation of a “patients with STEMI” registry with assessment of quality indicators was associated with an increased use of evidence-based treatments, better adherence to treatment guidelines and a large and sustained reduction in mortality [14].

In the CRAC cohort, initial admission to a hospital without an ICC was strongly associated with greater delay (adjusted OR 2.9). Lack of EMS call was associated with a markedly delayed time from FMC to PPCI (adjusted OR 1.6), as has been reported by other studies [15]. The lack of an optimal care pathway, another factor noted previously to

Table 2 Multivariable analysis of factors associated with a first medical contact to primary percutaneous coronary intervention time of > 120 min in patients with ST-segment elevation myocardial infarction (Centre-Val de Loire region, 2014–2016).

	Multivariable analysis ^a (n = 1938)		
	Adjusted OR	95% CI	P
Age ≥ 65 years	1.2	0.9–1.5	0.15
Female sex	1.2	0.9–1.6	0.22
Diabetes	1.6	1.1–2.2	0.01
Hypertension	1.3	1.01–1.7	0.02
Killip class at admission > 1	1.8	1.3–2.5	0.0003
Site of ischaemia			
Inferior	Reference		
Anterior	1.1	0.8–1.4	0.54
Lateral	1.8	1.1–2.9	0.01
Absence of EMS call	1.6	1.2–2.1	0.001
Time from symptom onset to FMC ≥ 90 min	1.3	1.1–1.7	0.016
Not optimal care pathway ^b	4.5	3.4–6.0	< 0.0001
First admission to hospital without ICC	2.9	2.1–3.9	< 0.0001
Distance from location of onset of pain to ICC			
< 25 km	Reference		
25–50 km	2.2	1.7–2.9	< 0.0001
50–75 km	5.1	3.6–7.0	< 0.0001
≥ 75 km	7.9	4.4–14.0	< 0.0001

CI: confidence interval; EMS: emergency medical services; FMC: first medical contact; ICC: interventional cardiology centre; OR: odds ratio.

^a C-statistics (area under the curve ROC) = 0.86.

^b An optimal care pathway is a pathway with only one medical practitioner before coronary angiography.

be associated with delayed PPCI [16], was also a powerful predictor (adjusted OR 4.5).

Conceptually, these factors may be associated with the rural nature of the CRAC centres' catchment areas. Living in a rural area is a known predictor of longer treatment delay [17]. A comparison with other data from France confirms this. In FAST MI 2015 study – a French STEMI registry covering a large part of the national territory and large urban areas – the median time from electrocardiogram to PPCI was 88 min [18,19] versus 112 min in our CRAC population. In EMUST, which focused on the Paris area with initial EMS transport, the median time from FMC to PPCI was lower still (81 min) [20]. Conversely, the Stent for Life France registry, which includes five departments located in rural or semirural areas, reported a median time from FMC to PPCI of 120 min [21], close to that for our population.

It is difficult to tease out the factors associated with greater delays that are specific to rural areas. The average time from FMC to PPCI increased when the admission hospital did not have an ICC (+85 min or 72%) and when the department did not have an ICC (+53 min or 50%). As in other reports [22,23], distance was highly relevant: delays of > 120 min from FMC to PPCI were 8-fold more frequent if symptom onset occurred > 75 km from an ICC. However, distance alone is not likely to be a major factor. France has a good network of ICCs, which is illustrated by the low percentage of patients (5.5%) with STEMI > 75 km from an ICC, with 22.6% of patients being 50–75 km from an ICC. Moreover, physical distance itself is only a proxy for transport

time. The benefits of air transport would need to be specifically assessed. In the current dataset, although there were differences in rates of helicopter and ambulance transport between the cohorts, the variables were too closely linked to the variable EMS calls to be included in the multivariable analysis. The mean time from FMC to PPCI increased strongly when the patient did not call the EMS (+44 min or 33%) or when the optimal care pathway was not followed (+75 min or 56%). These factors are not necessarily linked to the rural nature of the registry.

It is also notable that an interval of ≥ 90 min between symptom onset and FMC was independently associated with a delay of > 120 min between FMC and PPCI. This association has not always been found in the literature [24]. It is possible that less severe clinical presentation reduces the perceived urgency at both symptom onset and FMC, which would extend both intervals. Atypical symptom presentations (e.g., diabetes, hypertension, Killip class > 1) or atypical electrocardiogram (lateral infarction) can complicate the diagnosis and increase delays, as has been observed for these variables in the CRAC registry and other studies [25–27]. Other studies in French populations have suggested that individual patient risk and time to presentation may be major confounding factors when analysing the impact of reperfusion delay on mortality [28]. The question of symptom onset to FMC delay would need specifically designed studies to clarify this further.

Reduced time from symptom onset to FMC has proved difficult to achieve, despite intense public information

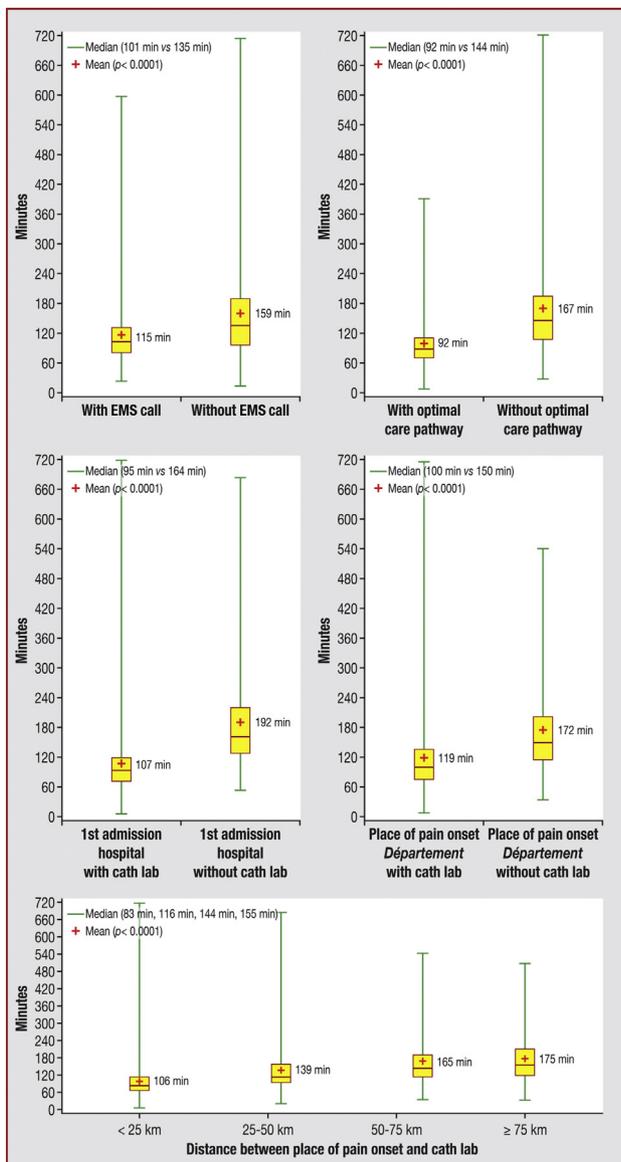


Figure 3. Mean and median first medical contact to primary percutaneous coronary intervention time intervals. Cath lab: catheterization laboratory; EMS: emergency medical services.

campaigns [21]. How to increase the use of EMS calls is a related problem. On the side of the care provider, it may be possible to speed up the diagnosis of late atypical STEMI and associated decision making by more systematic use of telemedicine, as has been demonstrated in Denmark [23]. Transmission of electrocardiogram via smartphone may shorten the time of transfer [29,30]. Technological developments are rapid in this area, but without a clearer picture of influencing factors, symptom onset to FMC remains a challenging part of the STEMI pathway.

There seem to be clearer scope for reducing the FMC to PPCI transfer time by improving healthcare organization and pathways. A first suggestion would be to direct every STEMI patient to a hospital with an ICC, even if the symptom onset occurs > 50 km from an ICC. In rural France, these patients are currently often transferred to the nearest hospital for an initial assessment, which loses valuable time. Reducing

the number of medical practitioners involved before PPCI is a management issue that should be actionable.

Study limitations

This study has several limitations. Causation cannot be demonstrated in a registry analysis. The study population did not include patients with fibrinolysis preceding angioplasty in order to specifically analyse the time between FMC and PPCI. This is not a major source of bias, as fibrinolysis was performed in only 214 out of the 2295 STEMI cases. The large and rural nature of the CVL region meant that our results differed slightly from other French registry studies, and national conclusions cannot be inferred from the CRAC results. Moreover, as focus was on time delays, the impact of the various factors on mortality was not analysed.

Conclusions

In conclusion, the CRAC regional registry, implemented in 2014, identified several factors associated with delays in the care pathway of patients with STEMI in the CVL region, and potential for improvement. Almost 43% of patients with STEMI transferred for PPCI failed to reach the European Society of Cardiology guidelines' target time from FMC to PCI of ≤ 120 min. Delays were strongly associated with pathway variables, whereas clinical variables played a less prominent role. The CRAC regional registry will extend to two other French regions in 2018 (Normandie and Auvergne-Rhône Alpes) and should cover the entire French territory in 2022. This will empower French healthcare providers to identify and address factors delaying transfer to PPCI, to improve the prognosis of patients with STEMI.

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Disclosure of interest

The authors declare that they have no competing interest.

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