BRIEF ARTICLE

Transfer Times, Characteristics and Evolution of Patients with Acute Myocardial Infarction Referred to Hemodynamic Centers More Than 400 km From San Carlos de Bariloche. An Analysis of the REGIBAR Registry

Tiempos de traslado, características y evolución de los pacientes con infarto agudo de miocardio que requirieron derivación a Centros con Hemodinamia a más de 400 km de San Carlos de Bariloche. Un análisis del registro REGIBAR

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ABSTRACT

Background: This study analyzes transfer times and complications to Hemodynamics centers (PCI-C) of patients from the prospective REGIBAR registry, including all patients suffering a first acute myocardial infarction (AMI) in San Carlos de Bariloche between June 2014 and June 2015.
Methods: Among 114 hospitalized AMI cases, 25 patients were transferred to PCI-C more than 400 km from San Carlos de Bariloche.
Results: Median transfer management time (TMT) for emergency referral, both by ambulance [mobile intensive care unit (MICU)] and by plane, was 480 minutes. Median travel time (TT) by MICU was 407 minutes and by air ambulance, 259 minutes. The sum of management and transfer times, that is, the total time (TOT), was 915 min by emergency MICU and 780 min by plane. The latter saved only 15% of the total travel time.
Conclusions: Transfer times were longer than expected, mainly at the expense of TMT. There was a tendency to transfer those who had post-AMI angina, a higher number of ST-segment elevation leads, heart failure, but also younger patients. There were no complications during transfers.

Keywords: Transfer - Transfer management time - Transfer time - Total transfer time - Acute myocardial infarction - Reperfusion.

RESUMEN

Introducción: Este estudio analiza los tiempos y las complicaciones de los traslados hacia centros con Hemodinamia (C-PCI) de los pacientes del registro prospectivo REGIBAR, que incluyó a todos los pacientes que sufrieron un primer infarto agudo de miocardio (IAM) en San Carlos de Bariloche entre junio de 2014 y junio de 2015.
Material y métodos: Se registraron 114 casos de IAM internados. De ellos, 25 pacientes fueron trasladados a C-PCI a más de 400 km.
Resultados: La mediana de tiempo de gestión del traslado (TGT) para derivación de emergencia, tanto en ambulancia (unidad de terapia intensiva móvil, UTIM) como en avión, fue de 480 minutos. La mediana de tiempo de traslado (TT) con UTIM fue de 407 minutos y con avión sanitario, de 259 minutos. La sumatoria de los tiempos de gestión y de traslado, esto es, el tiempo total (TOT), fue de 915 min con UTIM de emergencia y de 780 min en avión. Este último implicó un ahorro de solo 15% del tiempo total de traslado.
Conclusiones: Los tiempos de traslado fueron más prolongados de lo esperado, principalmente a expensas del TGT. Se tendió a trasladar a quienes tuvieron angina pos-IAM, mayor cantidad de derivaciones con supradesnivel del segmento ST, insuficiencia cardíaca, pero también a los más jóvenes. No hubo complicaciones durante los traslados

Palabras clave: Traslado - Tiempo de gestión de traslado - Tiempo de traslado -Tiempo total de traslado - Infarto agudo de miocardio - Reperfusión

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INTRODUCTION

Cardiovascular (CV) diseases continue to be the leading cause of death in the Western world. (1) According to INDEC data obtained from death certificates in 2017 at a national level, 28.5% of deaths were from cardiovascular diseases. (1) Of these, 23% were deaths from ischemic causes.

The evolution of patients admitted for acute coronary syndromes (ACS) essentially depends on the establishment of an early reperfusion strategy, and when required, it is suggested to implement referral networks to ensure reopening of the culprit artery by the best available method (percutaneous coronary intervention (PCI) or thrombolysis). (1) Today we know that the transfer of patients from centers without hemodynamic services to centers that do have them is safe and feasible, if the stipulated times are respected. (1, 2) However, in common practice, both in developed countries and in Argentina, these times are difficult to meet. (3) In our country, there is a non-negligible number of patients who are not reperfused, and those who are, are often reperfused at much longer times than those recommended by international guidelines. Piombo et al. (4) published data from public hospitals in the City of Buenos Aires that show that only 30% of patients receive thrombolytics within the recommended time intervals and the data are very similar for primary PCI. (1) When the authors analyzed patients who were transferred from a center without primary PCI availability to one that had this service, they found that only 2.9% of the patients were revascularized within 120 minutes.

Several factors, such as delays in medical consultation, in the initial interpretation of the diagnosis, during the decision-making process of the best reperfusion method, unjustified delays in the decision to refer or not the patient, and possible administrative delays by the health system managers have been listed as responsible for these deferrals. (1)

At the time of preparing the REGIBAR study (5) -a prospective registry of all patients who suffered their first acute myocardial infarction (AMI) between June 1, 2014 and May 31, 2015 in San Carlos de Bariloche-, this city did not have CATH-LAB with the ability to perform 24/7 PCI, (1) resulting in the need to transfer many complex patients to the Upper Río Negro Valley, more than 420 km from Bariloche.

To our knowledge, there are no data in our country on the reality and evolution of patients with ACS who have required transfers more than 400 km away, either to receive rescue PCI or to stabilize complications in their immediate evolution. A subanalysis of the ARGENIAM-ST registry that evaluated patients transferred to hemodynamics centers (6) shows a time to revascularization below 350 minutes, which allows inferring that the distances were shorter than in the present case. This is why a prospective analysis was carried out within the context of the REGIBAR study, in order to evaluate the times and complications of patients transferred more than 400 km to centers with hemodynamics service (PCI-C).

METHODS

Data acquisition. All consecutive native and non-native patients admitted with a first acute myocardial infarction (AMI) in all medical centers in the city of Bariloche between June 2014 and June 2015 and included in the previously published REGIBAR registry were considered for this study. (6)

For this prospectively designed substudy, patients who were transferred to more complex centers were identified, and the indication for referral was at the discretion of the treating physician. It is important to note that none of the patients with ST-segment elevation was referred with the intention of performing a primary PCI. Complications and travel times were recorded using spreadsheets to be completed by the responsible physicians, and subsequently, the data were uploaded to a specifically designed database.

Definitions

Transfer management time (TMT) was defined as the time elapsed from the first telephone call to request a referral until the patient left for the receiving center. Similarly, transfer time (TT) was defined as the time between the patient's departure from the center requesting the referral and the arrival at the receiving center, and the total time (TOT) as the sum of both. An emergency transfer was considered as the one carried out within 4 hours and a scheduled transfer as the one that could be made between 4 and 24 hours.

Means of transfer

The means of transfer used were air ambulance, conventional ambulance (with oxygen and a doctor) or mobile intensive care unit (MICU) (with a doctor, oxygen, cardioverter-defibrillator, portable respirator, and infusion pump).

Statistical analysis

All data were entered into specifically designed databases. Categorical variables are expressed as percentage and continuous variables as mean±SD or median and interquartile range (IR), as appropriate. For categorical variables, the hypothesis tests used were the chi-square test or Fisher's exact test, and for continuous variables Student's t test or the Mann-Whitney test, as appropriate. Statistical significance was defined for a p value <0.05 using Epi Info 7 software.

Ethical considerations

The protocol was accepted by the Ethics Committee of Hospital Zonal Bariloche "Ramón Carrillo" and all the patients admitted, or their relatives, depending on the case, signed an informed consent.

RESULTS

Among the 114 hospitalized AMI cases, 25 (21.9%) were referred to a PCI-C. Mean age of transferred patients was 55.7±10.6 years and 21 cases (84%) corresponded to men. Figures 1 and 2 describe patient characteristics according to the need for transfer. Referred cases more frequently presented post-AMI angina (20% vs. 4.49%; p=0.034), had greater number of leads with ST-segment elevation (5.23 vs. 4.27; p=0.0004) (Fig. 2A), were younger (55.7 years vs. 68.3 years; p <0.0001) and presented a lower rate of nor-

mal left ventricular ejection fraction (LVEF) (31.8% vs. 63.6%; p=0.016). A statistically significant difference was noted in favor of transferring patients under 60 years of age (p=0.013) (Fig. 2B).

Nine emergency transfers (6 by air ambulance, 2 by MICU and 1 by conventional ambulance) and 16 scheduled transfers (1 by air ambulance, 14 by MICU and 1 by conventional ambulance) were carried out. No complications were recorded during transfers. Median TMT for all transfers was 630 (IR: 450) minutes; for emergency transfers, both by ambulance and air ambulance 480 (IR: 271) minutes and for scheduled transfers 810 (IR: 330) minutes (p=0.06). When analyzed by type of transport, TMT for air ambulance was 480 (IR: 750) minutes and for MICU and conventional ambulance 750 (IR: 450) minutes (p: NS).

Mean TT for referral by ambulance was 407±148 minutes and by air ambulance 274±67 min (p <0.01) (Fig. 3).

Median TOT in the global population was 1095

(IR: 540) minutes; for cases referred by ambulances 1222 (IR: 420) minutes [915 minutes for emergency cases (IR: 1005) and 1245 minutes for scheduled cases (RI: 405)] and for those referred by air ambulance it was 780 (IR: 810) minutes (Fig. 4) (difference between airplane and ambulances, p: NS).

DISCUSSION

Lack of a PCI-C in our city (the closest one is 420 km away) explains two specific aspects of this series of cases with AMI: reperfusion was always with thrombolytics and only cases with complications were referred for PCI. This was unlike data shown in the substudy of referrals presented by the ARGENIAM-ST registry (6) and other studies (3, 7, 8), which analyzed urgent referrals in the context of reperfusion. The absence of information regarding long-distance transfers in complicated AMI cases led us to design this prospective registry, since these transfers had been carried out for years and we had no data on the time involved or their safety.

Fig. 1. Clinical data and referral of patients hospitalized for their first AMI in San Carlos de Bariloche from June 1, 2014 to May 31, 2015 (n=114
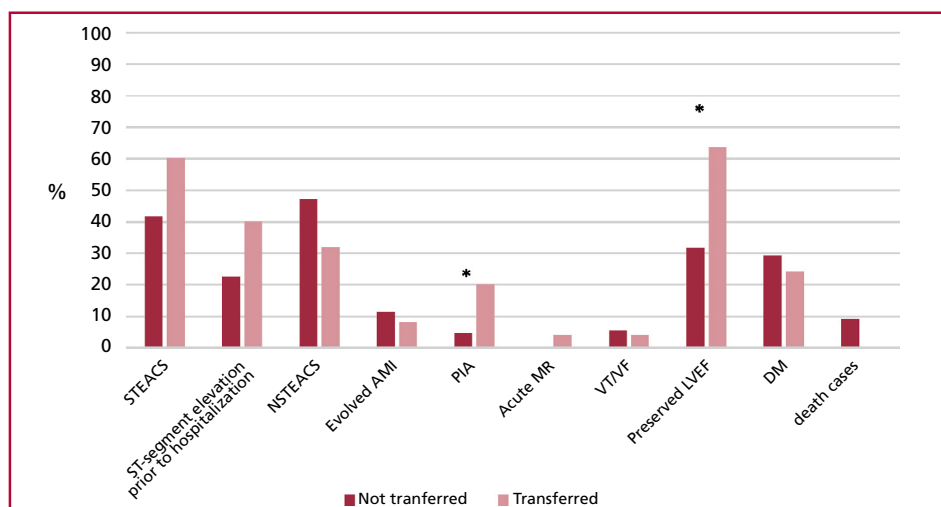
* p <0.05 ACS (acute coronary syndrome); STEACS: ST-segment elevation acute coronary syndrome; NSTEACS: Non-ST-segment elevation acute coronary syndrome AMI; acute myocardial infarction; PIA: Post infarction angina; MR: Mitral Regurgitation; VT/VF: Ventricular tachycardia/ventricular fibrillation; LVEF: Left ventricular ejection fraction; DM: Diabetes mellitus.

Fig. 2. Number (average) of ST-segment elevation leads of transferred vs. not transferred patients (p=0.0004) (A) and percentage of transferred patients older and younger than 60 years (p=0.013) (B)
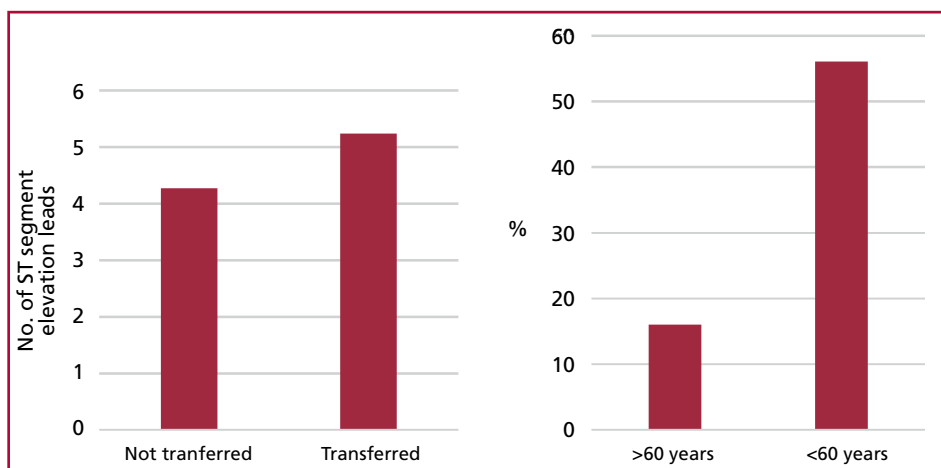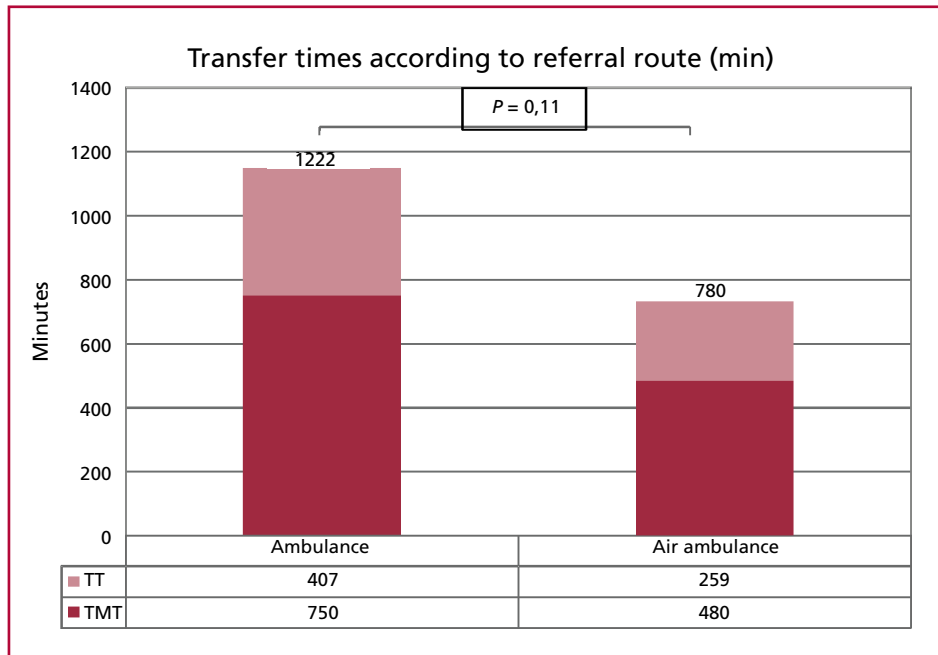
Fig. 3. Total transfer time according to travel mode

Transfer times according to referral route (min)

	Ambulance	Air ambulance
TT	407	259
TMT	750	480

P = 0,11

TT= Transfer time; TMT: Transfer management time.
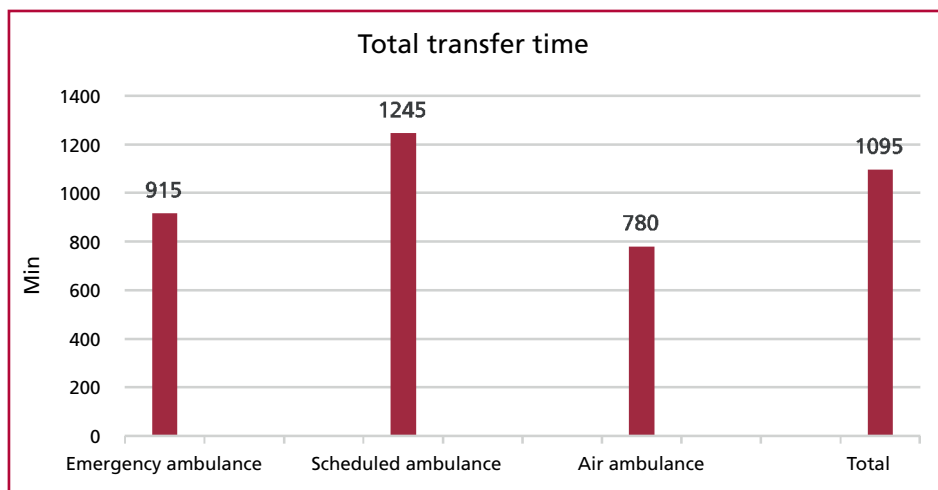
Fig. 4. Total transfer time in minutes according to mean of transport (median).

Total transfer time

Emergency ambulance	Scheduled ambulance	Air ambulance	Total
915	1245	780	1095

This substudy of the REGIBAR registry shows a low number of transfers, only 21.9% of hospitalized AMI, and these corresponded, mainly, to young, male patients. According to the criteria of the treating physician, most of these transfers could be made within 24 hours (scheduled, 64%), but when the transfer was considered an emergency (6 in 9 cases), the trip was made by air ambulance and the destination was the City of Buenos Aires.

All ambulance transfers were made to the cities of Cipolletti, General Roca or Neuquén, which are located more than 420 km from San Carlos de Bariloche. Travel times (TT) were similar to those that can be estimated from network maps, with a median of 407 minutes. (1) The longer than expected time was transfer by air ambulance, which exceeded 4 hours. In this

study we found excessively prolonged TMT: a median of 8 hours since requesting the emergency transfer (either by MICU or air ambulance) until the patient left the medical center.

Both in the medical community and in patients, there is an installed concept that transfers by air ambulance allow an important saving of time in the access to tertiary centers, with the consequent optimization of care times. However, in our study, we observed that the choice of these means of transport implied a saving of time of only 15% of TOT, if we compare it with that of MICU requested in emergency.

We did not find studies evaluating the transfer of patients with AMI to centers more than 400 km away. Nicholson et al. (9) evaluated transfer of patients with ST-segment elevation AMI for primary PCI initially as-

sisted in centers without hemodynamics availability. Those who had to be transferred more than 240 km were not considered for the analysis. The median travel distance was 51 km. They transported those who were less than 64 km away by ambulance and those who were farther away from the tertiary center by air ambulance. Transfer duration was estimated according to the time established by the Google Maps application.

Lambert L. et al. (10) analyzed 988 patients with ST-segment elevation AMI who arrived at a hospital without hemodynamics availability and who were transferred for primary PCI. Median length of stay at the initial center was 51 minutes. Only 14% of the patients stayed less than 30 min. The main cause of this delay was transfer decision making and its management.

In our country, we have data indicating significant delays. García Escudero et al. (11) evaluated 313 patients referred to Argerich Hospital for primary and rescue PCI (72% and 28%, respectively). In both groups, only one third of the time until balloon deployment corresponded to the "patient-time" (delay in consulting), while the remaining two thirds, the "medical-care time", was consumed by management and transfer.

In our study, the most frequent causes that motivated referral were the need for rescue PCI and complications, such as congestive heart failure or the estimated high risk associated to AMI extent based on the number of affected electrocardiogram (ECG) leads.

We found that in our record, transfer was safe, with no patient complications. This finding could be reflecting a bias in the selection of less serious patients by the treating physicians; however, it should be considered that the transferred patients had more ST-segment elevation leads, more post-AMI angina, and more ventricular function impairment, despite they were younger.

Finally, we consider that this study exposes the problem of ACS management in regions distant from centers with hemodynamic services, by revealing that most of the delay is due to the time it takes to manage transfer. Two aspects emerge to be considered: on the one hand, at the individual level of decision making (the physician in the event of an emergency), he/she must decide taking into account the real transfer time, not just the net travel time that can be calculated with on-line maps; on the other hand, on a broader level related to health management, the gap between calculated times and actual referral times should be considered when setting up heart attack networks in very large areas of the country.

CONCLUSIONS

In this study we found that the transfer of selected patients who suffer a first AMI to centers more than 400 km away is safe. Transfer times were longer than expected, mainly at the expense of the time it took to manage them (more than 8 hours). Finally, the time saving when transferring patients by air ambulance was negligible.

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/ Supplementary material)

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