Reperfusion Times in a Telemedicine-guided Program for the Management of ST-segment Elevation Myocardial Infarction in the Province of La Pampa

Tiempos de reperfusión de un programa guiado por telemedicina para la atención del infarto agudo de miocardio con elevación del ST en la Provincia de La Pampa

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ABSTRACT

Background: Timing of medical care is a relevant factor for ST-segment elevation myocardial infarction (STEMI) mortality.
Objectives: The aim of the present study is to evaluate reperfusion times in STEMI patients participating in a telemedicine-based cardiology care program in the province of La Pampa between August 2018 and December 2021.
Methods: This program consists of a protocol for the management of patients with acute coronary syndrome (ACS) in the different locations of the province, with 24-hour remote assistance provided by cardiologists, including both diagnostic support and coordination of on-site thrombolysis.
Results: Of a total of 72 STEMI patients evaluated, 44 received thrombolysis as reperfusion therapy, 25 received primary percutaneous coronary intervention, and 3 received thrombolysis followed by rescue percutaneous coronary intervention. Of the 47 subjects who received thrombolysis, only 5 required to be transferred to the referral center for this procedure.
Median door-to-needle time was 24 minutes and door-to balloon-time was 105 minutes. Twenty-eight percent of the subjects with primary percutaneous coronary intervention had a door-to-balloon time < 90 minutes and 53.2% of patients who received thrombolysis fulfilled a door-to-needle time < 30 minutes.
Conclusions: The implementation of a telemedicine-guided program for decentralized management of STEMI patients was associated with a high percentage of compliance with the goals of implementing fibrinolytic-based reperfusion therapy.

Keywords: ST-Segment Elevation Myocardial Infarction - Thrombolysis - Angioplasty - Telemedicine

RESUMEN

Introducción: Los tiempos de atención médica son un factor relevante para la mortalidad por infarto agudo de miocardio con elevación del segmento ST (IAMCEST).
Objetivos: Evaluar los tiempos de reperfusión en pacientes con IAMCEST participantes de un programa de atención médica cardiológica basada en telemedicina en la provincia de La Pampa durante el período transcurrido entre agosto de 2018 y diciembre de 2021.
Material y Métodos: Este programa consiste en la protocolización de la atención de los pacientes que cursan un síndrome coronario agudo (SCA) en las diferentes localidades de la provincia, con asistencia cardiológica remota las 24 horas del día, que incluye tanto la asistencia diagnóstica como la coordinación de las medidas terapéuticas, incluyendo la posibilidad de administrar trombolíticos a nivel local, con asistencia remota.
Resultados: De un total de 72 IAMCEST evaluados, 44 recibieron como terapia de reperfusión trombolisis, 25 angioplastia primaria, y 3 trombolisis seguida de angioplastia de rescate. De los 47 sujetos que recibieron trombolisis, sólo 5 requirieron de traslado al centro de referencia para realizar este procedimiento.
La mediana de tiempo puerta-aguja fue de 24 minutos y el tiempo puerta-balón fue de 105 minutos. El 28% de los sujetos con angioplastia primaria tuvieron un tiempo puerta-balón inferior a los 90 minutos y el 53,2% de los tratados con trombolíticos cumplieron con un tiempo puerta-aguja menor a 30 minutos.
Conclusiones: La implementación de un programa de atención descentralizada guiada por telemedicina se asoció a un elevado porcentaje de cumplimento de las metas de implementación de la terapia de reperfusión basada en fibrinolíticos.

Palabras clave: Infarto agudo de miocardio con elevación del segmento ST - Trombolisis - Angioplastia - Telemedicina

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INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) constitutes a relevant public health issue. (1-3) Given that a significant percentage of STEMI-related deaths could be attributed to aspects related to the quality of medical care, (4) it has been suggested that the implementation of an "infarction code", accompanied by increased training and the support of a diagnostic network by means of telemedicine could significantly improve the time and quality of care. (4, 5)

Another key aspect linked to the outcome of STEMI patients is the time between the coronary event and the initiation of reperfusion therapy. (6) Although percutaneous coronary interventions (PCIs) are associated with a better outcome compared with thrombolysis when they are performed early, few hospitals have the possibility of performing them in the emergency department; (7) therefore door-to-balloon times in daily practice are usually longer than those reported in clinical trials, and many patients must be transferred to tertiary level of care facilities to be treated with this intervention, with the consequent delay in reperfusion. (7,8) In our country, the main factor responsible for the delay of the procedure is delay in door-to-balloon time. (9)

The province of La Pampa is the second least densely populated jurisdiction in Argentina, with 2.2 inhabitants/km2; 42% of the people live in towns with less than 10,000 inhabitants. (10) Due to these particularities, a large percentage of the population lives far from the high complexity medical centers. In order to reduce the impact of this situation the Cardio program 365: Infarction Code, was launched in August 2018 as a strategy for decentralized cardiology medical care based on telemedicine. Briefly, this program consists of a protocol for the management of patients with acute coronary syndrome (ACS) in the different locations of the province, with 24-hour remote assistance provided by cardiologists from the referral centers, including both diagnostic support (through remote evaluation of the electrocardiogram) and coordination of the therapeutic measures to be implemented. These include the possibility of on-site administration of thrombolytics (streptokinase) supported by remote assistance (after training the treating staff), and activation of the catheterization laboratory (so that the PCI can be performed without unnecessary delays upon arrival at the referral center).

The aim of the present study is to evaluate reperfusion times in STEMI patients participating in the Cardio 365 program in the province of La Pampa between August 2018 and December 2021.

METHODS

We conducted a retrospective, observational, and descriptive study based on the consecutive registry of patients participating in the Cardio 365 program with a diagnosis of STEMI in the province of La Pampa.

Evaluation of reperfusion times

As part of the internal assessments of the Cardio 365 program, the cardiology team consecutively and anonymously recorded on a previously designed form the place of origin, reason for consultation, definitive diagnosis, time of symptom onset, time of first medical contact, and time of initiation of reperfusion therapy. The list of participating healthcare centers is detailed in Appendix I. For the present study, all the cases registered between August 1, 2018, and December 31, 2021, with a diagnosis of STEMI and with full information regarding the timing of intervention were tracked.

Based on the times recorded, the following variables related to delays in the implementation of reperfusion therapy were calculated:

1) Time to consultation: time from onset of symptoms suggestive of myocardial ischemia and the first medical contact.
2) Time-to-reperfusion: time from the first medical contact to initiation of reperfusion therapy.
3) Door-to-needle time: time interval between the first medical contact and the initiation of thrombolytics.
4) Door-to-balloon time: time interval from the first medical contact and first balloon inflation in the catheterization laboratory.
5) Relative delay in the implementation of primary PCI: difference between the median door-to-balloon time reported in patients undergoing primary PCI and the median door-to-needle time in those who received thrombolysis as a first intervention.
6) Time window: time elapsed between the onset of symptoms and the initiation of infusion (in case of thrombolytic therapy) or balloon inflation (in case of PCI).

Estimated transfer time to the high complexity centers

In order to obtain a measure of the minimum time required to access a high complexity center depending on the place of origin, a theoretical variable called estimated transfer time was created. Briefly, based on the distance (in kilometers) between the first medical institution and the high complexity center, a theoretical transfer time between institutions was calculated (using a public software) assuming that the transfer is made at the maximum speed allowed, without delays. It should be noted that this is a constructed variable since the actual time transfer began and ended was not systematically recorded.

Statistical analysis

Continuous variables with normal and non-gaussian distribution are presented as mean and standard deviation, or median and interquartile range 25-75%, respectively. Discrete variables are expressed as frequencies and percentages. Continuous data with Gaussian distribution were compared with Student's t test. Continuous variables with non-gaussian distribution were compared using the Wilcoxon rank sum test. A p value < 0.05 was considered statistically significant. The software GraphPad Prism 9.1.0 for Windows (La Jolla, California) was used for statistical analysis.

Ethical considerations

The study was conducted following the ethical principles of the Declaration of Helsinki, with special focus on protecting the confidentiality of the information and was approved by the Provincial Council on Bioethics.

RESULTS

During the period evaluated, 60 towns in the province of La Pampa participated in the Cardio 365 program. A total of 1975 consultations were recorded that, according to the treating physician's criteria, required cardiological evaluation. After evaluation by the Cardio 365 program, only 464 (23.49%) required referral to a high complexity center for further evaluation or treatment. While 921 consultations were for suspected ACS, the rest included evaluation of arrhythmias (mainly atrial fibrillation and atrioventricular block), decompensated heart failure, syncope, hypertension or other cardiovascular diseases.

A total of 240 ACS were identified, 88 (36.6%) were STEMI and 152 (63.4%) were non-ST-segment elevation ACS.

Of the 88 STEMI, reperfusion times were reliably recorded in 72 patients which constitute the basis of this report. Forty-four (61.1%) patients received thrombolysis as reperfusion therapy, 25 (34.7%) underwent primary PCI, and 3 (4.2% %) were treated with thrombolysis followed by rescue PCI. Of the 47 subjects who received thrombolysis, only 5 required to be transferred to the referral center for this procedure, while 42 received thrombolysis at the primary level of care facility.

Times related to delays in the implementation of reperfusion therapy

Table 1 shows the main time intervals linked with the implementation of reperfusion therapy.

Median time to consultation was 73 minutes, with 73.6% (53/72) of patients having a first medical contact within the first two hours after symptoms onset.

The median time reported between the first medical contact and the initiation of reperfusion was 40 minutes, with a median door-to-needle time of 24 minutes for those who received thrombolysis and a door-to-balloon time of 105 minutes in those who treated with PCI as the initial procedure.

The estimated time difference between median door-to-needle time and door-to-balloon time was 81 minutes favoring door-to-needle time.

Only 28% of subjects who received primary PCI (7/25) had a door-to-balloon time < 90 minutes, and the door-to-balloon time was < 60 minutes in only 20% (5/25).

A door-to-needle time < 30 minutes was achieved in 53.2% of the subjects who received thrombolysis as the first intervention (25/47).

The median time window estimated was 150 minutes. All the patients analyzed had a time window < 8 hours and 63.9% had a time window < 2 hours.

The time window was 135 minutes for patients who received thrombolysis as the first intervention, and 180 minutes for those who received primary PCI.

Comparison between door-to-needle time and estimated transfer time to the high complexity center.

Figure 1 shows that the time interval between the first medical contact and the initiation of thrombolysis was 72.6% shorter than the time estimated for transporting the patient to the high complexity center, calculating that the median time saved was at least 61 minutes for on-site thrombolysis.

DISCUSSION

The present study shows the reperfusion times observed with the implementation of a telemedicine-based care program focused on facilitating the management of STEMI patients who have their first medical contact in a primary or secondary care level facility.

Originally this program was conceived as a strategy to improve the management of STEMI patients, but the local demand for care has led the use of this program to facilitate the initial management of other cardiovascular diseases in a large province with long distances between the different locations and the high complexity centers. Another remarkable aspect is that because of the on-site evaluation by means of telemedicine, 3 out of every 4 consultations that would have required transportation to a high complexity center for their assessment were managed on-site, which would result in significant savings of resources and would reduce the risks related with emergency transportation from one location to another.

Unlike what has been reported in other national (11) and international (12) registries, in which PCI prevailed, thrombolysis was the main reperfusion strategy adopted. This was not a deliberate strategy but arose from the decision of each treating physician. In this sense, it is worth hypothesizing that the possibility of performing on-site thrombolysis with remote assistance provided by the cardiology team may have

Table 1. Times related to delays in the implementation of reperfusion therapy

Variable	Median (IQR 25-75)
Pain-to-consultation time (min)	73 (41.25-120.0)
Door-to-needle time (min)	24 (15-55)
Door-to-balloon time (min)	105 (76.25-221)
Time window (min)	150 (90-194)
Time window to thrombolysis (min)	135 (80-180)
Time window to percutaneous coronary intervention (min)	180 (120-291)

Data are presented as median and interquartile range (IQR).
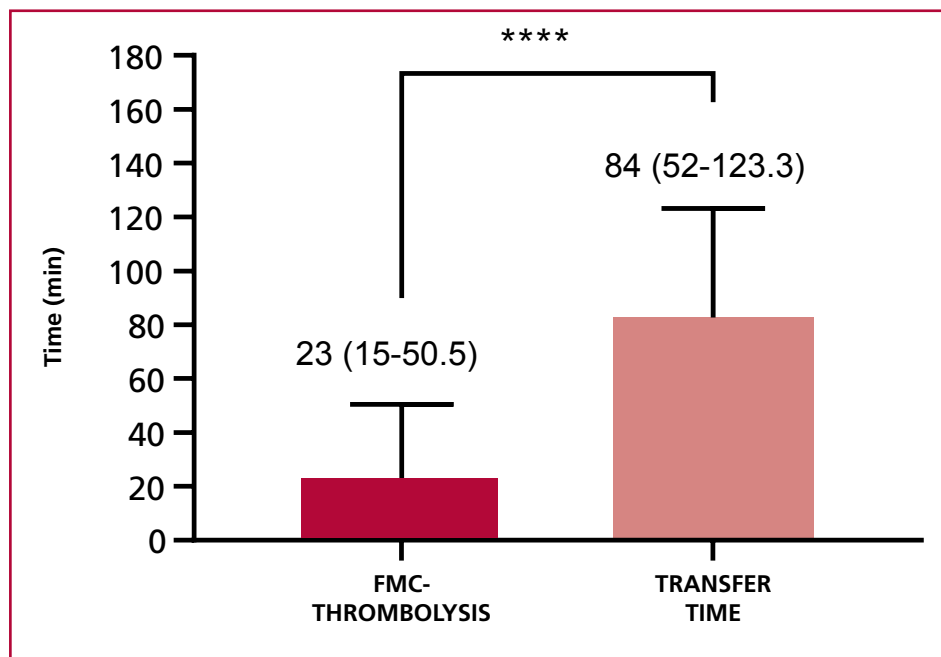
Fig. 1. Comparison between the time elapsed since the first medical contact until the initiation of thrombolysis and the estimated transfer time to the high complexity center. Data are expressed as median (IQR 25-75) **** p<0.001. FMC-THROMBOLYSIS: time from the first medical contact to initiation of thrombolysis

influenced in favor of thrombolysis as the main strategy in the patients who participated in the program. However, as the underlying reasons for the therapeutic decision were not directly assessed, future studies should address these aspects.

Although PCI would have advantages over thrombolysis in STEMI patients, (13, 14) on-site fibrinolysis, compared with transfer of patients for primary PCI, could be a beneficial strategy, especially when inter-hospital transfer is long (13) or when the time to PCI is estimated to exceed 120 minutes. (15) It has also been suggested that when reperfusion therapy is initiated within 3 hours after symptom onset, similar results are obtained with the use of thrombolytics or PCI, (15) possibly because the greatest chances of mortality reduction with thrombolysis are observed within the first 2 to 3 hours from symptom onset, (16) whereas the comparative benefits of PCI would be lost as the delay increases. (7,17,18)

In the present study, 28% of the subjects undergoing PCI had a door-to-balloon time < 90 minutes. Although these results are lower than those reported in the ARGEN-IAM-ST Registry, where 35% of patients met this target, (11) the median door-to-balloon time observed in the present analysis (115 minutes) was significantly lower than that reported in the ARGEN-IAM-ST Registry for patients who initially consulted a primary or secondary care facility and required referral (192 minutes).

The low median door-to-needle time reported in the present report explains the high percentage of subjects who achieved a door-to-needle time < 30 minutes. This differs from reported in the ARGEN-IAM-ST registry, where only 20% of patients received fibrinolytics within this time window (compared to 53.2% reported in the Cardio 365 program) with a median door-to-needle time of 60 minutes. (11) The PRIAMHO II study, carried out in Spain using fibrinolysis as the main reperfusion strategy, reported a median door-to-needle time of 48 minutes. (19)

In the present registry, the relative delay of PCI compared with thrombolysis was 81 minutes, a time interval in which the efficacy of both types of intervention is expected to be comparable. (7, 17,18)

Another aspect to consider is the time elapsed from the onset of symptoms. It has been suggested that there would be an advantage in favor of fibrinolytics administered within 2 hours after symptom onset. (20) On the contrary, when the consultation is performed late, PCI presents advantages, even with longer delays in its implementation. (21) In this sense, the fact that the median time between symptom onset and the first medical contact was 73 minutes and that 3 out of 4 patients had the first medical contact within the first 2 hours after symptom onset emphasizes the importance of implementing this strategy at the referral site.

To facilitate the understanding of the impact of the geographic characteristics on care times, we estimated the transfer times to the nearest high complexity center. Considering that, even if there were no delays between the first medical contact and patient's transfer, the distances between locations would justify a median transfer time > 80 minutes. For this reason, the implementation of a strategy such as the one reported, which facilitates on-site thrombolysis remotely guided by specialized staff, results in valuable time savings for the implementation of a reperfusion strategy at a critical moment.

The observational and retrospective nature of the

present study is its main limitation because there is no information available on the clinical outcome of patients in terms of survival and the development of complications. The lack of a comparator group as local reference limits the interpretation of the results. Therefore, beyond the abundant evidence demonstrating that shorter reperfusion times are associated with a better clinical outcome in STEMI patients (7,17,18,20,22,23), future prospective studies should evaluate these aspects to define the actual impact of this program of care.

CONCLUSIONS

The implementation of a telemedicine-guided program for decentralized management of STEMI patients was associated with a high percentage of compliance with the goals of implementation of a fibrinolytic-based reperfusion therapy and contributed to the optimization of the use of health care resources.

Conflicts of interest

None declared.

(See authors' conflict of interests forms on the web/Additional material.)

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APPENDIX I.

Participant centers of the Cardio 365 program:
ESTAB. ASISTENCIAL 'DR. [fuzzy]Left LACOSTE' - EDUARDO CASTEX; ESTAB. ASISTENCIAL 'LUISA PISTARINI' – VICTORICA; ESTAB. ASISTENCIAL 'DR. PEDRO NOVICK' – DOBLAS; ESTAB. ASISTENCIAL 'DR. GUILLERMO RAWSON' – TRENEL; ESTAB. ASISTENCIAL 'AMADA GATICA' – CATRILO; ESTAB. ASISTENCIAL 'DR. MANUEL PEREZ' - SANTA ISABEL; ESTAB. ASISTENCIAL 'PADRE BUODO' - GENERAL ACHA; ESTAB. ASISTENCIAL 'DR. ATILIO CALANDRI' - QUEMU QUEMU; ESTAB. ASISTENCIAL 'REUMANN ENZ' - INTENDENTE ALVEAR; ESTAB. ASISTENCIAL 'DR. SEGUNDO TALADRIZ' – TOAY; ESTAB. ASISTENCIAL 'DR. JORGE AHUAD' - 25 DE MAYO; ESTAB. ASISTENCIAL 'DR. HERACLIO LUNA' – MACACHÍN; ESTAB. ASISTENCIAL 'DR. M. FREIRE' – GUATRACHE; ESTAB. ASISTENCIAL 'WILFRID BARON' - COLONIA BARON; ESTAB. ASISTENCIAL 'DR. E. [fuzzy]Left J. FERRETI' – ALPACHIRI; ESTAB. ASISTENCIAL 'DR. LUIS AGOTE' - GRAL. SAN MARTIN; CENTRO SALUD 'SAMUEL HALFON' - EMBAJADOR MARTINI; ESTAB. ASISTENCIAL 'LUIS A. PETRELLI' – CALEUFU; ESTAB. ASISTENCIAL 'DR. ARMANDO PARODI' – PARERA; ESTAB. ASISTENCIAL 'VIRGINIA GHIODI' - LA MARUJA; CENTRO SALUD VERTIZ – VERTIZ; ESTAB. ASISTENCIAL 'DR. ATILIO CRENNA' - INTENDENTE ALVEAR; ESTAB. ASISTENCIAL 'DR. JOSE PADROS' – RANCUL; CENTRO SALUD CHACHARRAMENDI – CHACHARRAMENDI; ESTAB. ASISTENCIAL 'DR. JOSE CURCI' – ANGUIL; ESTAB. ASISTENCIAL 'DR. R. CARRILLO' - ATALIVA ROCA; ESTAB. ASISTENCIAL 'DR. PABLO LECUMBERRY' – LONQUIMAY; ESTAB. ASISTENCIAL 'DRA. CECILIA GRIERSON' – TELEN; CENTRO SALUD 'PADRE CASTELLARO' – METILEO; ESTAB. ASISTENCIAL 'VIRGILIO T. URIBURU' – REALICO; ESTAB. ASISTENCIAL 'DR. JUAN MUNUCE' - JACINTO ARAUZ; ESTAB. ASISTENCIAL 'FRANCISCO DEL CALLEJO' – CONHELLO; ESTAB. ASISTENCIAL 'DR. R. AMICARELLI' – BERNASCONI; CENTRO SALUD 'DOMINGO CABRED' – SPELUZZI; ESTAB. ASISTENCIAL 'DR. JUSTO FERRARI' - INGENIERO LUIGGI; CENTRO SALUD PUELCHES – PUELCHES; CENTRO SALUD SRTA. MECHA - EDUARDO CASTEX; ESTAB. ASISTENCIAL 'DR. ANTONIO OLAIZ' - MIGUEL RIGLOS; ESTAB. ASISTENCIAL 'DR. JULIO TAPIA' – URIBURU; ESTAB. ASISTENCIAL 'JUAN B. SMITH' – WINIFREDA; ESTAB. ASISTENCIAL 'DR. DIEGO B. MORON' – ROLON; ESTAB. ASISTENCIAL 'DR. LUIS MAZA' - BERNARDO LARROUDE; CENTRO SALUD LA REFORMA - LA REFORMA; CENTRO SALUD MONTE NIEVAS - MONTE NIEVAS; CENTRO SALUD ALG. DEL AGUILA - ALG. DEL AGUILA; CENTRO SALUD BARRIO NORTE – TRENEL; CENTRO SALUD LA ADELA - LA ADELA; ESTAB. ASISTENCIAL 'DR. FRANCISCO LIÑON' - LUAN TORO; CENTRO SALUD CASA DE PIEDRA - CASA DE PIEDRA; CENTRO SALUD LA HUMADA - LA HUMADA; CENTRO SALUD LIMAY MAHUIDA - LIMAY MAHUIDA; CENTRO SALUD 'ROBERTO PIBOTTO' - GENERAL ACHA; ESTAB. ASISTENCIAL 'ARISTIDES GRANDA' – ARATA; ESTAB. ASISTENCIAL 'DR. LUIS COLOSIO' - MAURICIO MAYER; CENTRO SALUD DORILA – DORILA; CENTRO SALUD 'DR. NESTOR SCHANTON' - ALTA ITALIA; CENTRO SALUD EVITA - SANTA ROSA; CENTRO SALUD PICHI HUINCA - PICHI HUINCA; ESTAB. ASISTENCIAL 'ALEJANDRO ROST' - SANTA TERESA; ESTAB. ASISTENCIAL 'DR. ANGEL CIVALERO' - VILLA MIRASOL; ESTAB. ASISTENCIAL 'DR. J. FACCA' - GENERAL CAMPOS.