

Analysis of Interhospital Transfer of Critically Ill Patients to the Coronary Care Unit of a Highly Complex Hospital

Análisis de traslados interhospitalarios de pacientes críticos a un área de unidad coronaria de un hospital de alta complejidad

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ABSTRACT

Background: Interhospital transfer of critically ill patients is frequent in our country. However, despite the existence of emergency medical transfer services both in public and private settings, no scientific publications have been generated regarding the transfer of critically ill patients to understand their operation, planning and results.

Objective: The aim of this study was to describe the conditions of interhospital transfer of cardiovascular disease patients.

Methods: This was an observational, prospective, multicenter design study, analyzing interhospital land transfer of patients admitted to a third level coronary care unit between April 2014 and April 2015. The transfer physician was surveyed. Complications related to hospital transfer and mortality were also recorded.

Results: A total of 214 transfers were analyzed. Median transfer time was 30 minutes (IQR 18.5-50). Among all transfers, 16.1% of cases were considered to be at high risk, 71.2% at moderate risk and 12.7% at low risk, according to a validated score. The main diagnoses were acute coronary syndrome (66.8%), heart failure (8.9%) and bradyarrhythmia or blockade (3.7%). In 73.5% of high-risk transfers, high complexity ambulances were used, and in low- and moderate-risk transfers (30.8% and 28.9%, respectively), they were carried out with low complexity ambulances. Fifty percent of transfers were performed by resident physicians; 10.8% of cases presented with some complication during the transfer and/or during the first hour. Complications were more frequent in high-risk transfers and were associated with in-hospital mortality. There was no association between estimated increased risk of transfer and greater ambulance complexity ($p=0.6$).

Conclusion: Transfer scheduling was not adequate. The calculated risk of transfers was predominantly low, with a high proportion of severe complications, which impacted in in-hospital mortality.

Key words: Patient Transfer - Patients - Cardiovascular Diseases

RESUMEN

Introducción: Los traslados interhospitalarios de pacientes críticos son frecuentes en nuestro medio; sin embargo, a pesar de la existencia de servicios de traslados médicos de emergencia tanto en el ámbito público como privado, no se han generado publicaciones científicas relacionadas con traslado de pacientes críticos que permitan conocer su funcionamiento, planificación y resultados.

Objetivo: Describir las condiciones de traslado interhospitalario de pacientes con patología cardiovascular.

Material y métodos: Estudio de diseño observacional, prospectivo, multicéntrico. Se relevaron los traslados interhospitalarios por vía terrestre de pacientes ingresados a una unidad coronaria de tercer nivel entre abril de 2014 y abril de 2015. Se encuestó al médico de traslado. Se relevaron además las complicaciones relacionadas con el traslado y la mortalidad hospitalaria.

Resultados: Se analizaron 214 traslados. Mediana de tiempo de traslado: 30 minutos (IIC 18,5-50). El 16,1% de los traslados se consideraron de riesgo alto, el 71,2% de riesgo moderado y el 12,7% de riesgo bajo, según un puntaje validado. Los principales diagnósticos fueron síndrome coronario agudo (66,8%), insuficiencia cardíaca (8,9%) y bradiarritmia o bloqueo (3,7%). El 73,5% de los traslados de riesgo alto se realizaron con móviles de alta complejidad y entre los de riesgo bajo y moderado, el 30,8% y el 28,9%, respectivamente, se efectuaron con móviles de baja complejidad. El 50% de los traslados fueron realizados por médicos residentes. El 10,8% presentaron alguna complicación durante el traslado y/o durante la primera hora. Las complicaciones fueron más frecuentes en traslados de riesgo alto y se asociaron con mortalidad hospitalaria. No existió asociación entre mayor riesgo de traslado estimado y mayor complejidad del móvil ($p = 0,6$).

Conclusión: La programación de traslados no fue adecuada. El riesgo calculado de los traslados fue predominantemente bajo, con una elevada proporción de complicaciones graves, que impactaron en la mortalidad hospitalaria.

Palabras clave: Transferencia de pacientes - Pacientes - Enfermedades cardiovasculares

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Abbreviations

CCTU	Critical care transport unit	IQR	Interquartile range
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INTRODUCTION

Interhospital land transfer of critically ill patients is frequent in our setting. The conditions under which transfers are carried out have a direct impact on patients' prognosis, (1) and require a coordinated scheme between hospitals and transport for a safe transfer. (2, 3) The level of human resource training and transportation planning are very important determinants of uncomplicated transfers. (4, 5) However, multiple studies evaluating different aspects related to transfers have shown that, in many cases, they are not carried out with the required planning or do not have all the necessary elements for the patient's maximum security. (6)

The type of transport selection should be based on the patient's risk. It is accepted that the transfer of high-risk patients should be carried out in high complexity ambulances, preferably by specialized transfer teams. (7-9)

Some randomized clinical trials comparing fibrinolysis at the referral hospital with transfer and primary angioplasty showed that interhospital transfer of patients with acute ST-segment elevation coronary syndrome for reperfusion therapy is safe, with a very low complication rate. (10) However, out of this context, there is little information in the medical literature related to interhospital transfer of patients with acute cardiovascular disease. In Argentina, despite the existence of emergency medical transfer services in both public and private areas, there have been no scientific publications related to the transfer of critically ill patients, to know their procedure, planning and results.

Our hospital, as a high complexity center of a hospital network, receives patients referred from other network or extra-network institutions after being transferred, mostly, by land. It does not currently have its own ambulance system coordinated by the network; therefore, the transfer of patients to the hospital is carried out by ambulance services of different sanitary regions, municipalities or, to a lesser extent, private, with great heterogeneity in complexity level, equipment, medical training and even knowledge of the medical history of the transferred patient by the professionals in charge.

The purpose of the study is to describe the general transfer conditions of cardiovascular disease patients admitted to the coronary care unit of our hospital, associated with the complexity of the transfer ambulances, academic training of doctors in charge of the transfer, complications during the transfer and hospital complications related to the transfer.

METHODS

An observational, prospective, unicentric study was conducted between April 2014 and April 2015. All patients admitted

to the coronary care unit of a third-level university hospital, referred from other hospitals by land, (patients who were totally or partially transported by air were excluded), were included in the study.

On admittance of the referred patient, the transfer physician was submitted to a short, anonymous, voluntary survey inquiring about the type of ambulance (the type of ambulance used was based on the transfer physician's response, with an additional inquiry on the transport resources such as respirator, oximeter, external defibrillator, etc. to objectively define its complexity). This could be a critical care transport unit (CCTU), or a low complexity transport unit. The survey also included human resources (doctor, nurse or both), equipment available in the transport (defibrillator, monitor, respirator, pulse oximeter), transport origin (municipal, health region, private), training of physician in charge of the transfer (general practitioner, specialist, resident), physician knowledge of the clinical case referred (treating doctor or not, diagnosis, current treatment, patient's clinical history) and complications that occurred during the transfer.

Death, resuscitated cardiorespiratory arrest, hypotension requiring medical intervention, severe arrhythmias (requiring cardioversion), onset or increase of intravenous inotropic drugs, need for orotracheal intubation, and auto-extubation were considered transfer complications.

All the documentation related to the transfer was gathered: hospitalization summary, complementary studies made before the transfer in the referring center, and informed consent of the transfer.

The risk of complications during the transfer was estimated for each patient using a previously validated score, and was classified as low, moderate and high risk according to whether the score was 0-2, 3-6 and >6, respectively.(8)

Clinical examination was used to evaluate patient condition on admission (vital signs, oxygen saturation, basic hemodynamic parameters, neurological status, basic laboratory parameters), and complications related to the transfer during the first hour of hospital stay were recorded. Complications related to the transfer were those occurring during the first hour of arrival, and included onset of noninvasive ventilation, orotracheal intubation, introduction of inotropic agents, severe arrhythmias requiring electrical cardioversion, successfully resuscitated cardiorespiratory arrest and death.

Statistical analysis

Continuous variables were expressed as mean and standard deviation or as median and interquartile range (IQR) according to their distribution. Categorical variables were expressed as numbers and percentages.

Categorical variables were compared using contingency tables. The association between the risk score prior to transfer and the complexity of the transfer ambulance was assessed using the chi-square test for trend evaluating the percentage of CCTU used for each range of the risk score. ROC curves were used to assess the discrimination ability of the risk score applied for events occurring during the transfer and calibration was evaluated using the Hosmer-Lemeshow test

STATA 13.0 (StataCorp LP, College Station, Texas) and Epi Info 3.5.1. software packages were used for statistical analyses.

Ethical considerations

The protocol was approved by the Ethics Committee and the Scientific Committee of the hospital.

Informed consent to perform the survey was requested from the physicians responsible for the transfer. Patients' informed consent was not requested as no interventions were performed on them.

RESULTS

A total of 214 transferred patients were included in the study. Median age was 55 years (IQR 48.5-61.5) and 72.9% were men. The main characteristics of the population are summarized in Table 1. A total of 5 transfer physicians (2.3%) refused to answer the survey. Median transfer time was 30 minutes (IQR 18.5-50). According to the score used, 16.1% were considered high-risk, 71.2% moderate risk and 12.7% low-risk transfers (Table 1). In two patients the score could not be calculated due to lack of information. The main diagnoses were acute coronary syndrome in 143 patients (66.8%), heart failure in 19 patients (8.9%), and bradyarrhythmia or blockade in 8 patients (3.7%). In 58.5% of cases patients were referred from emergency rooms and in 26.1% from intensive care units. The reasons for referral were need for higher complexity in 190 patients (88.8%) and lack of beds in the referring center in 24 patients (11.2%). In 57.1% of cases, the ambulance belonged to the referring hospital, in 18.4% to the health region, in 17.4% to the corresponding municipality, in 5.2% to private companies, and in 1.2% its origin was unknown by the transfer doctor. In 69.4% of cases, the physicians in charge of transportation reported having performed the transfer with a CCTU and 28.7% with low complexity ambulances. The complexity of the ambulance used was unknown by 1.9% of physicians performing the transfer. Transfers made by CCTU were high risk in 17.2% of cases. Of those performed with low complexity ambulance, 15% were high risk, 71.7% moderate risk and 13.3% low risk. Among high-risk patients, 73.5% were transferred by CCTU, and among low-and moderate risk patients, 30.8% and 28.9%, respectively, were performed with low-complexity ambulances (Figure 1). However, when analyzing the available resources in the ambulance according to the transfer physician's declaration in the survey, and considering the regulations for medical land transfer of the National Ministry of Health, only 45.2% of the ambulances declared by transfer physicians as high complexity transports or CCTU met the criteria to be considered as such (presence of doctor and nurse, respirator, defibrillator, pulse oximeter, among other resources). (11) Considering the type of ambulance according to the transport resources, only 33.3% of high-risk transfers were carried out with CCTU, and the percentage of high complexity ambulances used in the moderate risk group was 32.4% and in the low-risk group 21.7%.

In 50% of cases transfers were made by resident physicians, 31.9% by specialist physicians and 18.1% by general practitioners. High-risk patients were transferred less frequently by residents ($p=0.02$) (Figure 2).

There were complications during the transfer in 3.7% of cases (8 patients), and in 8.9% of cases (19 patients) complications related to the transfer occurred in the first hour of hospitalization (Table 2). A total of 23 patients (10.8%) presented some complication during the transfer and/or during the first hour after arrival. There was a significant association between the transfer risk estimated by the score and related complications during the first hour of transfer or later ($p < 0.001$) (Figure 3). However, there was no significant association between the estimated risk of complications during the transfer and the use of CCTU ($p=0.6$). For this reason, the rate of complica-

Table 1. Main population characteristics

Variable	Median (IQR)
Age, years	55 (48.5-61.5)
Risk, score	5 (3.5-6.5)
Transfer time, minutes	30 (18.5-50)
	n (%)
High-risk transfer	34 (16.1)
Moderate risk transfer	151 (71.2)
Low-risk transfer	27 (12.7)
Men	156 (72.9)
Network referral	141 (65.9)
Diagnosis	
Acute coronary syndrome	141 (67.8)
Heart failure	19 (9.1)
Bradyarrhythmia blockade	5 (2.4)
Tachyarrhythmia	3 (1.4)
Other	40 (19.2)

IQR: Interquartile range

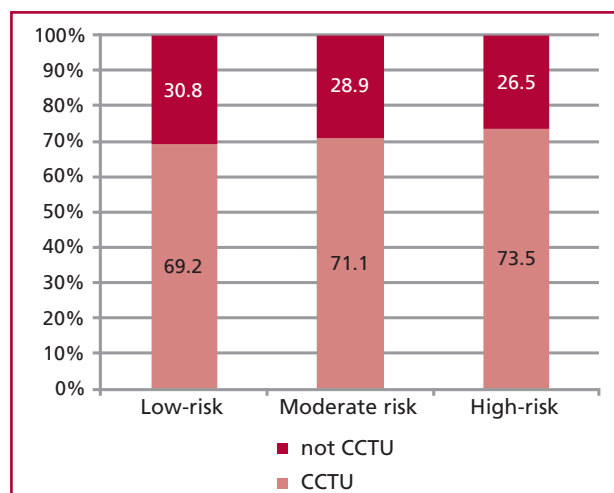


Fig. 1. Percentage of critical care transport unit (CCTU) use in each risk stage.

tions during transfer was similar with both types of transports (4.1% in CCTU vs. 3.3% in low complexity ambulances). Complications related to transfer were significantly associated with in-hospital mortality (p=0.049) (Figure 4). There was a car accident, which

did not affect the patient. In 87.1% of cases, transfers were performed without a previous systematized assessment.

The discrimination capacity of the score used to stratify the risk of complications associated with patient transfer (C statistic) was 0.74, and the model

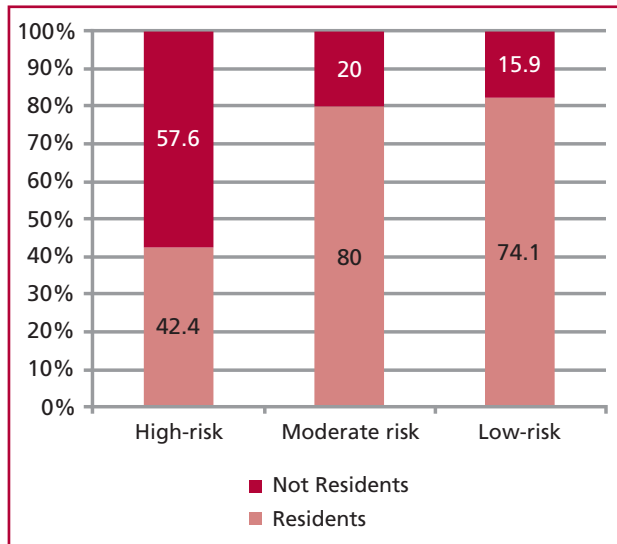


Fig. 2. Percentage of residents performing transfers.

Table 2. Transfer-related complications

Complications during tranfer	n (%)
Any	8 (3.7)
Hypotension	5 (2.3)
Onset of inotropic agents (other causes)	3 (1.4)
Complications during the first hour of hospitalization	
Any	19 (8.9)
Death	7 (3.3)
Successfully resuscitated CRA	2 (0.9)
Intubation and MV	6 (2.8)
Arrhythmia requiring ECV	3 (1.4)
Onset of IV inotropic agents	9 (4.2)
Non-invasive ventilation	5 (2.3)

CRA: Cardiorespiratory arrest. MV: Mechanical ventilation. ECV: Electrical cardioversion. IV: Intravenous.

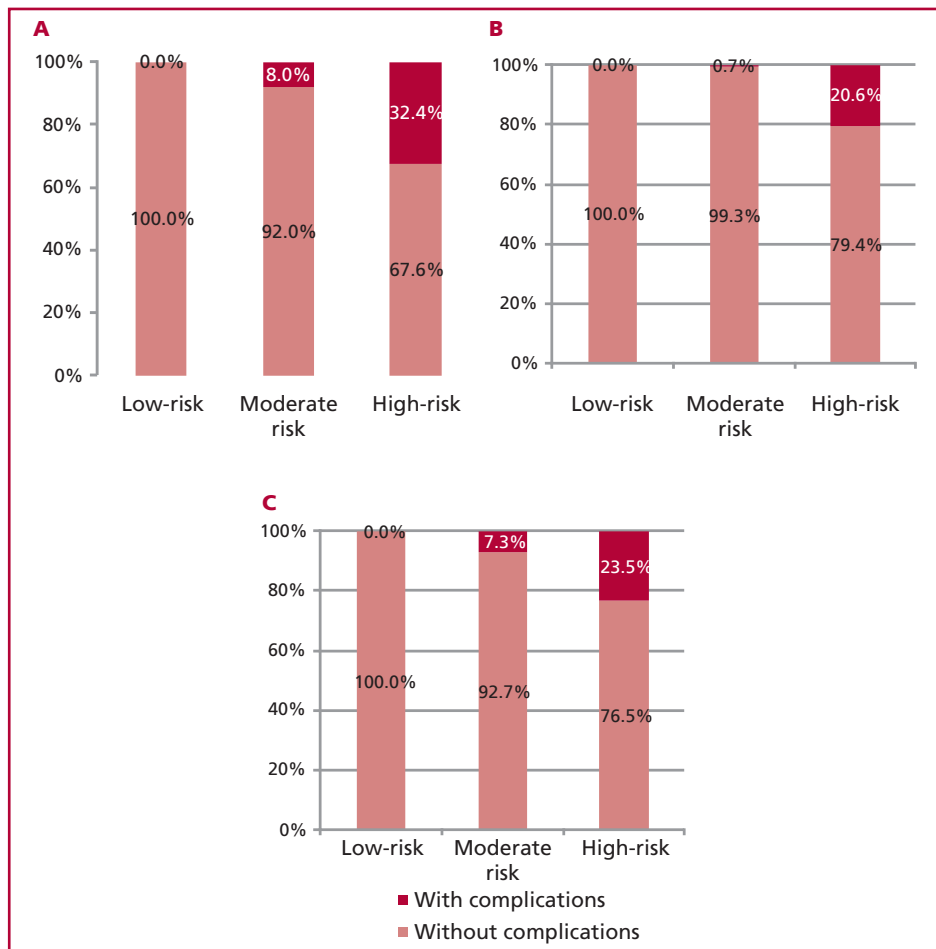


Fig. 3. Surgical results and outcome at one year follow-up according to the aortic valve replacement technique used

calibration was adequate (Hosmer Lemeshow test $p=0.7$).

DISCUSSION

Although patient transfers are frequent in all health environments, in our hospital, due to the distinctiveness of being a networking referral center, the proportion of patients admitted after a transfer is more frequent than in other institutions, accounting for 50% of admissions during the study period. For this reason, and due to the clinical repercussion related to an inadequate transfer and its potential complications, we considered it was a priority to study the characteristics of patient transfer admitted to our institution. Based on different aspects, we will discuss and compare the results found with previous studies.

General Characteristics of Patients and Transfers

Our results show that compared with other institutions, a high percentage of patients was admitted after an exclusively inter-hospital land transfer. In the United Kingdom, for example, most hospitals transfer less than 20 patients per year. (5) We do not have information on the percentage of severe patients transferred in institutions of our country.

Transfers were short, generally with a median duration of 30 minutes. Less than 25% of the transfers took more than one hour. This was due to the fact that 65.9% of patients admitted were transferred from the network hospitals, with a shorter transfer distance.

All the patients admitted to our study were adults with diagnosis of cardiovascular disease. This differentiates them from those of other inter-hospital transfer

studies, which mostly correspond to critical patients mainly with diagnoses of non-cardiovascular pathology, with approximately 10% of cardiovascular patients and a variable percentage of pediatric patients. (4, 8, 12) Our population had an estimated lower risk of transfer than that reported in other publications, since only 16.1% of transfers were considered as high risk; therefore, we can say that our population was of lower risk and with shorter transfers than in other publications. (4, 8)

Transport complexity and human resource training

Transfer physicians reported using a high complexity ambulance in 69.4% of cases. There was no significant association between increased risk of transfer and greater use of high complexity ambulance. This suggests an overuse of this type of transport. However, when analyzing the resources available in the ambulance based on what was stated by the survey physician, the percentage of high complexity transports that transferred low- and moderate risk patients was lower, but there was greater underutilization of high complexity vehicles among high risk patients. It should be noted that a high percentage of transfers were performed by resident physicians, although they predominantly transferred low- or moderate risk patients.

Transfer planning and associated complications

The results of our study indicate that transfers were not adequately planned. Only 13% of transfers were performed after a systematic checkup and 17.2% of patients transferred in high complexity ambulances were high risk, showing an overuse of this resource. In addition, the use of CCTU was similar between high- and low-risk patients. Although this fact may be due to the availability of this type of units in the hospital network rather than to the programming of individual transfers, both elements are part of the planning process.

The proportion of complications during transfer was 3.7%, 20.6% in the high-risk group, and less than 1% in the low and moderate risk jointly. Although the total percentage was similar or lower than that reported in other publications, our transfers were shorter and only serious complications that occurred at a higher rate than in other publications were reported. The rate of complications related to the transfer during the first hour of hospital stay was higher (8.9%). Although it is difficult to assert whether a complication is due to the transfer or critical condition of a patient, regardless of the transfer, the lack of transfer planning may have influenced the incidence of total complications. Some studies found no association between complications related to the transfer and hospital mortality. This may have been due to the fact that complications of all kinds were reported, many of them of less clinical importance. (4, 13) In our case, complications were related to in-hospital mortality, probably due to their severity.

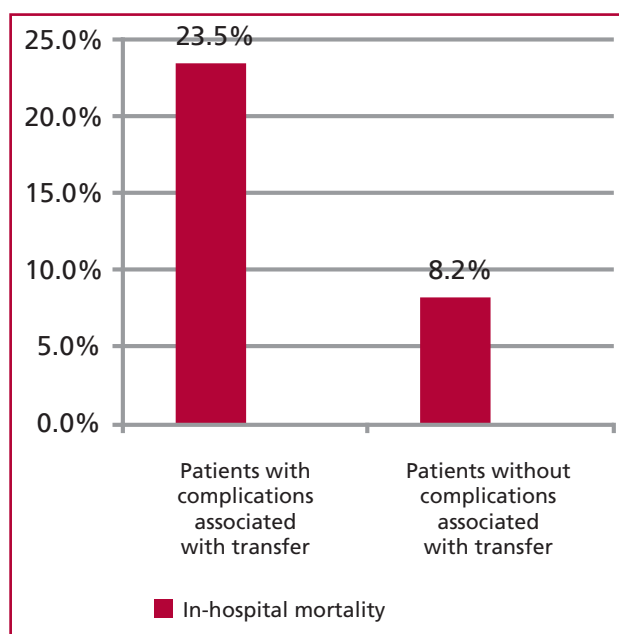


Fig. 4. In-hospital mortality

Complication rates during transfer and related to transfer during the first hour were similar with both types of transports, as was hospital mortality, even in the high-risk group. This would suggest that the type of higher complexity transport did not diminish complications during and after transfer, or hospital mortality. The low statistical power of the study for this purpose and the lack of random assignment of the vehicle do not allow supporting this hypothesis.

Limitations

The main limitations are related to the design selected for the objective presented in our study. Since it is an observational study, we cannot evaluate whether the use of CCTU was associated or not with lower risk of complications, or pre-hospital morbidity and mortality.

In our country, the absence of scientific publications and public information related to the subject of the study does not allow us to infer if our sample is representative of national reality or of other regions.

Only the referrals that came to our hospital were reviewed. We cannot rule out with absolute certainty the existence of ongoing referrals that did not arrive at our center due to serious complications during the transfer. However, only one referral accepted by our center did not materialize, without being canceled by the referring hospital.

CONCLUSIONS

We conclude that the transfers were performed without adequate planning, and without an assignment of transport complexity according to the risk of patients. In 50% of transfers a resident physician was in charge of the transfer. Patients' risk was predominantly low, with a high proportion of serious complications, which impacted in in-hospital mortality.

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Conflicts of interest

None declared. (See authors' conflicts of interest forms on the website/Supplementary material).

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