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HEALTHCARE-RELATED INFECTIONS AND FACTORS ASSOCIATED TO THE POSTOPERATIVE PERIOD OF LIVER TRANSPLANTATION

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ABSTRACT

Objective: to identify the incidence of healthcare-related infections and their associated factors, during the first postoperative month of adult patients subjected to a liver transplant in a public hospital of Fortaleza.

Method: retrospective, descriptive study with a quantitative approach, performed with 53 liver receptors in the first semester of 2015. The data were collected through medical records, outpatient records and notification of infections.

Results: of the patients assessed, 15 (28.3%) presented infection during the first month, with the most prevalent being clinical sepsis (n=6; 37.4%), followed by respiratory tract infection (n=3; 18.8%), urinary tract (n=3, 18.8%), surgical site (n=3, 18.8%), and bloodstream infection (n=1, 6.2%). Those who presented statistical association in relation to the non-occurrence of infections were the group of married patients and the indication of cirrhosis due to hepatitis C. The average number of days of postoperative hospitalization, the use of mycophenolate mofetil immunosuppressant and the average use of some invasive devices were identified as the factors associated with the occurrence of infections, being statistically significant for p=<0.05.

Conclusion: the identification of the incidence of healthcare-related infections and their associated factors in patients undergoing a liver transplant may support health actions in order to reduce the morbidity and mortality associated with infections and optimize the recovery of these patients.

DESCRIPTORS: Hospital infection. Risk factors. Liver transplant. Epidemiology. Infection control.

INFECCIONES RELACIONADAS CON LA ASISTENCIA PARA LA SALUD Y FACTORES ASOCIADOS AL POSTOPERATORIO DEL TRANSPLANTE HEPÁTICO

RESUMEN

Objetivo: identificar la incidencia de las infecciones relacionadas con la asistencia para la salud y sus factores asociados, durante el primer mes del posoperatorio, de pacientes adultos sometidos a un trasplante hepático, en un hospital público de Fortaleza.

Método: estudio retrospectivo, descriptivo y con abordaje cuantitativa realizado con 53 receptores de hígado, en el primer semestre del año 2015. Los datos fueron recolectados a través de los prontuarios, fichas ambulatorias y notificación de infecciones.

Resultados: de los pacientes evaluados, 15 (28,3%) presentaron infección durante el primer mes en que lo que más prevaleció fue la septicemia clínica (n=6; 37,4%), seguida por infección del tracto respiratorio (n=3; 18,8%), tracto urinario (n=3; 18,8%), sitio quirúrgico (n=3; 18,8%), y por último, infección de la corriente sanguínea (n=1; 6,2%). Los que presentaron asociación estadística en relación a la falta de ocurrencia de infecciones fue el grupo de los pacientes casados y la indicación de cirrosis por hepatitis C. El promedio de días de internación en el postoperatorio, el uso del inmunosupresor micofenolato de mofetil y el promedio del uso de algunos dispositivos invasivos fueron identificados como los factores asociados con la ocurrencia de infecciones, siendo, estadísticamente, significativos para p=<0,05.

Conclusión: la identificación de la incidencia de las infecciones relacionadas con la asistencia para la salud y sus factores asociados en pacientes sometidos al trasplante hepático podrá subsidiar el direccionamiento de las acciones de salud, con la finalidad de disminuir la morbimortalidad asociada con las infecciones y optimizando la recuperación de esos pacientes.

DESCRIPTORES: Infección hospitalaria. Factores de riesgo. Transplante hepático. Epidemiologia. Control de infecciones.

INFECÇÕES RELACIONADAS À ASSISTÊNCIA À SAÚDE E FATORES ASSOCIADOS NO PÓS-OPERATÓRIO DE TRANSPLANTE HEPÁTICO

RESUMO

Objetivo: identificar a incidência das infecções relacionadas à assistência à saúde e seus fatores associados, durante o primeiro mês do pós-operatório de pacientes adultos submetidos ao transplante hepático em um hospital público de Fortaleza.

Método: estudo retrospectivo, descritivo com abordagem quantitativa, realizado com 53 receptores de fígado no primeiro semestre do ano de 2015. Os dados foram coletados através dos prontuários, fichas ambulatoriais e de notificação de infecções.

Resultados: dos pacientes avaliados, 15 (28,3%) apresentaram infecção durante o primeiro mês, em que o mais prevalente foi a sepse clínica (n=6; 37,4%), seguida de infecção do trato respiratório (n=3; 18,8%), trato urinário (n=3;18,8%), sítio cirúrgico (n=3; 18,8%) e por último, infecção de corrente sanguínea (n=1; 6,2%). Os que apresentaram associação estatística em relação a não ocorrência de infecções foram o grupo dos pacientes casados e a indicação de cirrose por hepatite C. A média dos dias de internação no pós-operatório, o uso do imunossupressor micofenolato de mofetil e a média do uso de alguns dispositivos invasivos, foram identificados como os fatores associados à ocorrência de infecções, sendo estatisticamente significativos para p=<0,05.

Conclusão: a identificação da incidência das infecções relacionadas à assistência à saúde e seus fatores associados em pacientes submetidos ao transplante hepático, poderá subsidiar o direcionamento das ações de saúde, com a finalidade de diminuir a morbimortalidade associada às infecções e otimizando a recuperação desses pacientes.

DESCRITORES: Infecção hospitalar. Fatores de risco. Transplante hepático. Epidemiologia. Controle de infecções.

INTRODUCTION

Due to the terminal hepatic failure, a serious clinical condition that usually affects patients with acute or chronic liver disease, the Liver Transplant (LT) is the procedure of choice, which requires the development of specific skills and knowledge of the care team, representing a highly effective therapeutic advance with repercussions on the improvement of the quality of life and survival.[1]

The survival rates of adult patients in Europe, one and five years after the LT are 62% and 81%; and in the United States, 86.9% and 73.4%, respectively.[2] In Brazil, the estimated survival rate is between 80 to 95% in a month and 70 to 90% in one and five years. Much of the morbidity and mortality of the procedure is due to early postoperative complications, such as the no function and primary graft dysfunction, recurrence of hepatitis B and C, vascular and biliary complications, acute cellular rejection and, mainly, the occurrence of infections related to health care.[3]

Liver receptors have a higher incidence of infectious complications due to the seriousness of their condition and the complexity of the surgical procedure, affecting from 8% to 40% of the patients, with a mortality rate of 15% to 36%.[4] The evolution in the immunosuppressive therapy has reduced the incidence of rejection, however, the vulnerability to opportunistic infections and infections by multiresistant pathogens are complications of relevance and significant impact.[3]

The literature shows that during the first postoperative (PO) month, the risk of Health Care-Related Infections (HCRI) predominates. Between the second and the sixth month, the risk of opportunistic infections caused by viral or fungal pathogens predominates. After the sixth month, the risk of infections acquired in the community or the reactivation of chronic infections are the ones that predominate.[3,5]

Conceptually, HCRI are those acquired after the admission of the patient, and that manifest during the hospitalization period or after the discharge, when related to hospital or inpatient procedures. The main ones are related to the surgical site, bloodstream, respiratory and urinary tract.[6] In general, they are associated with the severity profile of patients, use of invasive procedures, immunosuppressive treatment, prolonged hospitalization, colonization by resistant microorganisms, indiscriminate use of antimicrobials and the hospital environment, which favors the natural selection of microorganisms.[7]

Since the HCRI can lead to serious consequences, the identification of these infections and their associated factors may contribute to prevention strategies, screening, diagnosis and treatment of these complications with an adverse impact on the post-transplant survival. Thus, the objective of this study is to identify the incidence of HCRI and their associated factors, during the first month of the PO of adult patients submitted to a LT in a public hospital.

METHOD

Retrospective, descriptive study with a quantitative approach. The research was conducted in a public service of LT of a university hospital, located in the municipality of Fortaleza, in the State of Ceará. The location was chosen for being a reference in the

performance of LT in Brazil, especially to the North and Northeast Region.

The data collection was carried out from October to December 2016. The population was determined by the temporal criterion, consisting by all the individuals who have undergone a LT in the first semester of 2015, at the afore-mentioned hospital. The choice of this period is justified because those are the years when the institution reached record in the accomplishment of LT, since 2002, when they began to perform this type of procedure. In the last five years, the six-month average of LT performed at the service was 60.3.

The following inclusion criteria were used to select the charts of patients included in the sample: age equal to eighteen years old or over, with the purpose of limiting the study to adult and elderly patients; to be a hepatic graft recipient from a living donor with Familial Amyloid Polyneuropathy (FAP) or deceased.

The exclusion criterion was death or loss of graft in less than 24 hours after the surgical procedure, being excluded a patient who died during the intraoperative period. In total, the sample consisted of 53 patients.

For the data collection a validated form was used[8] and adapted to the proposed theme, elaborated based on the guidelines and definitions of the National Criteria of Infections related to Health Care,[6] belonging to the *Agência Nacional de Vigilância Sanitária*, selecting the possible factors associated with the occurrence of HCRI according to the literature.

The instrument consisted of information referring to personal and demographic data, clinical data, post-surgical and surgical, invasive procedures and time of use of the devices. As data sources, the outpatient records of pre and post-LT follow-up, as well as the medical records of the respective patients were used.

To identify the occurrence of HCRI within 30 days after the LT, the last part of the instrument was composed of information related to the amount of episodes of infection within that period, type of infection and isolated pathogens associated with the infection. For this purpose, the HCRI notification forms of the Hospital Infection Control Commission (HICC) were used as data source.

In the institution of the study, the surveillance of HCRI in transplanted patients is performed by the HICC nurse, through a daily visit to the sector, and the diagnosis is defined by the medical team, through signs, symptoms and complementary exams, based on the guidelines and definitions of the National Health Care-Related Infection Criteria.

For the analysis of the data, the variables were divided into groups (sociodemographic characterization, clinical epidemiological characterization, characterization of the devices and invasive procedures and incidence of HCRI), being arranged in tables. Numerical variables were described in mean, Standard Deviation (SD), median and 25 and 75 percentiles. The categorical variables were described in frequency and prevalence. The normality of the data was checked using the Shapiro-Wilk's test.

In the investigation of the association between the categorical variables (gender, marital status, region of origin, blood group, comorbidities, indication of transplant, re-transplant, type of donor, transfusion of blood products, immunosuppressive use, death after transplant, diagnosis of infection, type of infection, type of pathogen isolated and the following invasive procedures: orotracheal tube, tracheostomy, nasogastric/nasoenteral tube, central venous catheter, peripheral venous catheter, dialysis catheter, delayed bladder catheter, suction drain, invasive blood pressure, surgical re-approach and graft biopsy), Pearson's Chi-square test and Fisher's exact test were used.

On the comparison of the numeric variables (age, body mass index, days of waiting list, severity indicator Model for End-Stage Liver Disease-MELD, duration of surgery, hot and cold ischemia, inpatient days and days of use of the following invasive devices: orotracheal tube, tracheostomy, nasogastric/nasoenteral tube, central venous catheter, peripheral venous catheter, catheter for dialysis, vesicular probe of delay, suction drain and invasive blood pressure) among groups of infection, the Mann-Whitney's test was used.

The tests that presented p-value <0.05 were considered significant. For the statistical analysis, the Statistical Package for the Social Sciences (SPSS) 22.0 program was used.

All the ethical and legal principles governed by research on human beings were obeyed, after obtaining approval issued by the Ethics and Research Committee of the afore-mentioned hospital, under CAAE registration number: 57929316.1.0000.5045.

RESULTS

Of the 53 patients enrolled in the study, 15 (28.3%) presented HCRI during the first month of the PO. In the demographic characterization, there

was a predominance of males (35; 66.0%); average age of 51.8 years old and standard deviation (SD) of 14.1. Most were married or in stable union (24; 45.3%); and from the northeast region (33; 62.2%). The comparison of the sociodemographic characteristics among patients who developed and did not develop infection in the PO is detailed in table 1.

Table 1 - Sociodemographic characterization of stratified liver transplant patients with and without health care-related infection up to 30 days post-surgery. Fortaleza, CE, Brazil, 2015. (n=53)

Variables	Without infection (n=38)		With infection (n=15)		p-value
	% (n) or mean [P25-P75] *	DP †	% (n) or mean [P25-P75] *	DP †	
Gender					0.56
Male	68.4 (26)		60.0 (9)		
Female	31.6 (12)		40.0 (6)		
Age	54.2 [46-64]	12.6	45.7 [31-65]	16.4	0.08
18-39 years old	15.8 (6)		33.3 (5)		
40-59 years old	44.7 (17)		40.0 (6)		
60-74 years old	39.5 (15)		26.7 (4)		
Marital status					0.002
Married/stable union	57.9 (22)		13.3 (2)		
Single	13.2 (5)		60.0 (9)		
Divorced	2.6 (1)		0 (0)		
Non-existent or unavailable data	26.3 (10)		26.7 (4)		
Region of origin					0.7
Northeast	63.1 (24)		60.0 (9)		
North	21.1 (8)		33.3 (5)		
Southeast	10.5 (4)		6.7 (1)		
South	5.3 (2)		0 (0)		

*[P25-P75]: 25 and 75 percentile; †SD: standard deviation.

To characterize the clinical epidemiological profile, there was a greater proportion of patients belonging to blood type group O (29; 54.7%). According to the calculation of the body mass index, 28 people were found (56.0%) with the ideal weight before the transplant and seven (14.0%) were obese. Regarding the other pre-transplant comorbidities, 15 (28.3%) were hypertensive and only seven (13.2%) were diabetic. The main cause for the indication of the transplant was cirrhosis due to viral hepatitis (31; 58.4%) with predominance of the C virus (21; 67.7%); among them, two (9.5%) were re-transplants due to virus recurrence.

Regarding the other indications for transplant, which totaled four (7.5%), fulminant hepatitis, primary sclerosing cholangitis, primary and secondary biliary cirrhosis were identified (Table 2).

Table 2 - Clinical epidemiological characterization of stratified liver transplant patients with and without health care-related infection up to 30 days post-surgery. Fortaleza, CE, Brazil, 2015. (n=53)

Variables	Without infection (n=38)		With infection (n=15)		p-value
	% (n) or mean [P25-P75]*	DP†	% (n) or mean [P25-P75]*	DP†	
Blood group					1.0
O	52.6 (20)		60.0 (9)		
A	34.2 (13)		33.3 (5)		
B	10.6 (4)		6.7 (1)		
AB	2.6 (1)		0 (0)		
Body Mass Index	24.67 [22.49-26.30]	3.73	25.58 [23.03-29.05]	4.05	0.05
Ideal weight	60.5 (23)		33.3 (5)		

Variables	Without infection (n=38)		With infection (n=15)		p-value
	% (n) or mean [P25-P75]*	DP†	% (n) or mean [P25-P75]*	DP†	
Overweight	18.4 (7)		46.7 (7)		
Obesity degree I	13.2 (5)		13.3 (2)		
Low weight	0 (0)		6.7 (1)		
Non-existent or unavailable data	7.9 (3)		0 (0)		
Comorbidities ‡					
Hypertension	31.6 (12)		20.0 (3)		0.77
Diabetes	15.8 (6)		6.7 (1)		0.84
Heart Disease	5.3 (2)		6.7 (1)		1.0
Non-existent or unavailable data	5.3 (2)		6.7 (1)		
Indication of the transplant ‡					
Viral Hepatitis	63.2 (24)		46.7 (7)		
Hepatitis B	12.5 (3)		42.8 (3)		0.33
Hepatitis C	79.2 (19)		28.6 (2)		0.01
Hepatitis D	8.3 (2)		28.6 (2)		0.56
Hepatocellular carcinoma	39.5 (15)		33.3 (5)		0.67
Alcohol	21.1 (8)		26.7 (4)		0.66
Cryptogenic	18.4 (7)		30.0 (3)		0.89
Familial amyloid polyneuropathy	5.3 (2)		6.7 (1)		1.0
Others	5.3 (2)		13.3 (2)		

*[P25-P75]: 25 and 75 percentile; †SD: standard deviation; ‡ Some patients presented more than one disease.

The predominance was of deceased donors (51; 96.2%) with mean waiting time in the transplant list of 87 days (SD=110), and the MELD severity score on the day of surgery was 24.8 points (SD=6.4). The mean time of the surgical procedure in the transplant, in hours, was 5.8 (DP=1). The mean time of cold ischemia of the transplanted organ was 5.5 (SD=1.4), and the warm ischemia time in minutes was 29.8 (SD=4.6).

Of the patients assessed, 23 (43.4%) received transfusion of blood products before the surgical procedure, and almost half (25; 47.2%); were transfused within 30 days after the transplant. The mean number of days of hospitalization up to 30 days before the surgery was 3.7 (SD=6.2) and, within 30 days after the surgery, it was 17.6 (SD=20.0) .

Regarding the use of immunosuppressant during the first month after the transplant, all the patients assessed were taking tacrolimus and corticoid; the minority (5; 9.8%) used mycophenolate sodium, and some (19; 37.2%) used mycophenolate mofetil.

Until the first month after the transplant, seven (13.2%) patients died. Considering that the study was retrospective, it was possible to verify that, in the first year of surgery, 12 (22.6%) patients died, as can be seen in table 3.

Table 3 - Epidemiological clinical characterization of stratified liver transplant patients with and without health care-related infection up to 30 days post-surgery. Fortaleza, CE, Brazil, 2015. (n=53)

Variables	Without infection (n=38)		With infection (n=15)		p-value
	% (n) or mean [P25-P75]*	DP†	% (n) or mean [P25-P75]*	DP†	
Re-transplant	2.6 (1)		6.7 (1)		0.49
Type of donor					0.07
Deceased donor	100.0 (38)		86.7 (13)		
Living donor	0 (0)		13.3 (2)		
Waiting list days	88 [15-109]	120	85 [19-134]	85	0.76
MELD‡ fixed	24.1 [20-27]	5	26.5 [21-27]	9	0.47
Duration of the surgery§	5.9 [4.9-6.5]	1.1	5.8 [5.4-6.5]	0.7	0.98
Duration of cold ischemia§	5.5 [4.3-6.5]	1.3	5.6 [4.4-6.4]	1.5	0.94
Duration of warm ischemia††	29.4 [26-32]	4.5	30.9 [26-34]	4.9	0.37

Variables	Without infection (n=38)		With infection (n=15)		p-value
	% (n) or mean [P25-P75]*	DP†	% (n) or mean [P25-P75]*	DP†	
Transfusion of blood products					
Before transplant	36.8 (14)		60.0 (9)		0.1
Intra or postoperative	42.1 (16)		60.0 (9)		0.35
Non-existent or unavailable data	21.1 (8)		0 (0)		
Days of hospitalization					
Preoperative	3.8 [0-5]	6.6	3.2 [0-6]	5.3	0.78
Postoperative	11.9 [7-12]	11.7	32.2 [14-38]	28.3	<0.001
Immunosuppressant**					
Tacrolimus	94.7 (36)		100.0 (15)		1.0
Corticoid	94.7 (36)		100.0 (15)		1.0
Mycophenolate mofetil	21.1 (8)		73.3 (11)		0.002
Mycophenolate sodium	7.9 (3)		13.3 (2)		0.8
Non-existent or unavailable data	5.3 (2)		0 (0)		
Deaths					0.77
Up to 30 days	15.8 (6)		6.7 (1)		
Up to 1 year	23.7 (9)		20.0 (3)		

*[P25-P75]: 25 and 75 percentile; †SD=standard deviation; ‡MELD: model for end-stageliver disease; §Time in hours; **all patients used more than one immunosuppressant; †† time in minutes.

Regarding the characterization of invasive devices and procedures, 41 patients from this sample were assessed due to inconsistency or lack of registration in any of the charts consulted, limiting the number of data in these variables. It should be highlighted that all patients made use of peripheral venous access; however, due to the lack of information recorded by professionals related to the time of use and subsequent punctures, the variable was excluded from the study.

All of them used the orotracheal tube (average usage=1.7; SD=2.7), nasogastric/nasoenteral tube (average usage=4.5; SD=6), Central Venous Catheter (CVC) (average usage=7.7; SD=4.7), Urinary Catheter (UC) (average usage= 6.5; SD=5.6), suction drain (average usage=4; SD=2) and Invasive Blood Pressure (IBP) (average usage=3; SD=1), however, the mean time of use was higher in patients who acquired HCRI.

The only patients (2; 4.8%) that needed to be tracheostomized (average usage=17; SD=12.7), have been diagnosed with HCRI. The dialysis catheter (average usage 10.3; SD=8.7) was the device used by four (9.7%) of the patients analyzed, these three have acquired HCRI. The surgical approach was necessary in two (4.8%) due to surgical wound hemorrhage and one of the recipients had to undergo the same procedure twice, presenting HCRI immediately after (Table 4).

Table 4 - Characterization of invasive devices and procedures in stratified liver transplant patients with and without health care-related infection, up to 30 days post-surgery. Fortaleza, CE, Brazil, 2015. (n=41)

Invasive device or procedure	Without infection (n=28)			With infection (n=13)			p-value
	% (n)	Average days of use [P25-P75] *	DP†	% (n)	Average days of use [P25-P75] *	DP†	
Orotracheal tube	100.0 (28)	1.1 [1-1]	0.3	100.0 (13)	3.2 [1-2.5]	4.7	0.17
Tracheostomy	-	-	-	15.4 (2)	17 [8-26]	12.7	
Nasogastric/nasoenteral tube	100.0 (28)	2.9 [2-3]	1.9	100.0 (13)	8.3 [2-14]	9.7	0.31
Central venous catheter	100.0 (28)	6.6 [5-7]	2.7	100.0 (13)	10.1 [6-10]	7	0.06
Dialysis catheter	3.6(1)	8	-	23.0 (3)	11 [4-23]	10.4	1.0
Urinary Catheter	100.0 (28)	4.9 [4-5]	2.6	100.0 (13)	9.9 [5-7]	8.5	0.002
Suction drain	100.0 (28)	4 [3-5]	1	100.0 (13)	5 [4-6]	2	0.01
Invasive blood pressure	100.0 (28)	3 [2-3]	1	100.0 (13)	4 [3-4]	1	0.03
Surgical Approach	3.6 (1)	1*	-	7,7,0 (1)	2‡	-	1.0
Graft biopsy	3.6 (1)	1*	-	-	0‡	-	1.0

*[P25-P75]: 25 and 75 percentile; †SD=standard deviation; ‡Amount of times the procedure was performed.

Of the 15 patients diagnosed with HCRI up to 30 days after the transplant, one presented two types of HCRI, totaling 16 diagnoses. Of these, the most prevalent was the clinical sepsis, with six (37.4%) cases. Regarding the type of Surgical Site Infection (SSI), all were classified as organ/cavity. The only case of Bloodstream Infection (BI) was associated with the CVC insertion.

Of the 16 infections, nine (56.3%) were identified laboratory pathogens, and the others were diagnosed based on clinical criteria. Of the 10 isolated microorganisms, the majority (9; 90.0%) was Gram-negative, with prevalence of *Escherichia coli,* according to table 5.

Table 5 - Incidence of health care-related infections and etiologic agents isolated up to 30 days postoperatively in liver transplant patients. Fortaleza, CE, Brazil, 2015. (n=53)

	% (n)
Diagnosis of infection	30.2 (16/53)
Type of infection	
Clinical sepsis	37.4 (6/16)
Respiratory tract infection	18.8 (3/16)
Urinary tract infection	18.8 (3/16)
Surgical site infection	18.8 (3/16)
Bloodstream infection	6.2 (1/16)
Infections associated to pathogens	56.3 (9/16)
1 pathogen	889 (8/9)
2 pathogens	11.1 (1/9)
Isolated pathogens	62.5 (10/16)
Gram-positive	10.0 (1/10)
Staphylococcus aureus	100.0 (1/1)
Gram-negative	90.0 (9/10)
Enterobacteria	77.8 (7/9)
Escherichia coli	57.2 (4/7)
Klebisiella pneumonia	28.5 (2/7)
Serratiamarcescens	14.3 (1/7)
Pseudomonas aeruginosa	11.1 (1/9)
Acinetobacterbaumanni	11.1 (1/9)

It can be observed that the marital status variable was statistically significant (p=0.002) for the occurrence of HCRI, indicating that married men were less susceptible if compared with the Group of single or divorced men. The variable that also showed less susceptibility to the occurrence of infections was the group of patients with indication for hepatitis C cirrhosis (p=0.01). The variables that presented statistical significance for the occurrence of HCRI were the postoperative days of hospitalization (p=0.001), use of the immunosuppressant mycophenolate mofetil (p=0.002) and the average usage of the UC devices (p=0.002), suction drain (p=0.01) and IBP (p=0.03).

None of the variables that presented statistical significance showed correlation with other variables of the study.

DISCUSSION

The group of married patients showed statistical significance regarding the non-occurrence of HCRI. This finding may be related to the presence of social support, which is associated with a greater therapeutic adherence among the liver receptors.[9]

A study showed the concern of the families with the safety of their relatives during the care performance while monitoring the hospitalization, with regards to the control of infections. In addition, the family can sediment the healing through commitment and support, strengthening relationships, motivating and giving hope of recovery.[10]

Among the fifteen patients who had HCRI in the first month after the transplant, the majority (7; 46.7%) presented overweight before surgery. A study carried out with kidney transplant patients points to high body mass index as one of the risk factors for SSI.[11] In addition to obesity, the literature also points to malnutrition as a risk factor for the occurrence of infections in liver receptors,[12] being relevant their nutritional monitoring.

Of the 27 diagnoses of chronic viral hepatitis, 21 came from virus C, resulting in the main indication for LT according to national and international literature.[2,12-15] Recurrence of hepatitis C is still common, persisting as the main problem of patients who are transplanted due to viral hepatitis, in need of effective treatment and, even, retransplant.[15]

Among the fifteen patients who were notified with HCRI, only two were diagnosed with hepatitis C, presenting statistical significance in relation to the non-occurrence of HCRI, different from what has been found in an international study with univariate analysis, whose sample comprised 17 liver receptors with infection, and 34 without infection. After comparing the data of the two groups, hepatitis C and hepato-carcinoma were identified as significant factors for the development of Klebsiella pneumoniae, carbapenem resistant in liver receptors.[16]

After statistical tests, the hepatitis C group had no correlation with the other variables of this study.

This research found no significant association in relation to the transfusion of blood products. This fact may be associated with the small number of transfusions in the sample or with autologous transfusion, which is performed during the LT of the hospital institution of this study, through a process of blood collection and reinfusion, with the objective of reducing and, if possible, eliminating the need for allogeneic blood transfusion, reducing the probable infectious and noninfectious complications.[17]

Researches carried out with liver receptors have identified that the transfusion of blood products was associated with the development of PO infection, which contributes to increased morbidity and mortality after LT.[4,12,18]

The length of stay in the PO was greater among patients who have acquired HCRI in comparison to those who have not acquired it, showing statistically significant association. These findings corroborate the result of another study that points to the prolonged time of hospitalization as a risk factor for the development of HCRI in liver recipients, conducted in a university hospital located in Korea, where 144 patients were assessed. Of these, 55.6% (n=80) developed infections after the transplant.[19] A prolonged pre-transplant stay longer than one week was also related to infection after the LT.[12]

This finding can be evidenced by the fact that the more hospital days, the more patients will be exposed to selective pressure in the hospital environment, using more antimicrobials and being touched more by health professionals, who, when there is no adherence to good practices of infection prevention, can favor the colonization and development of HCRI.[20]

The success of the transplant depends on immunosuppression, which predisposes the individual to a low immunity, which can lead to various pathologies. Both excess and dose deficiency can cause harm to patients, producing infections or allowing rejection.[5]

The results of this study showed a statistically significant association regarding the use of mycophenolate mofetil with the occurrence of HCRI. Divergent results were obtained in a study conducted in Germany, which found a trend towards lower infection rates in patients using this immunosuppressant. However, possibly due to the small number of the sample, there was no statistical significance. The authors did not find a conclusive explanation for the reduced risk of infections in these patients.[21]

No articles were found in the literature with similar results, and new research is needed to show the relationship between the mycophenolate mofetil and HCRI. After statistical tests, the group showed no correlation with other variables of this study.

The survival rate of the participants of this study in a year was 77.3%. In the international literature, transplanted patients presented a rate of 82.5%.[13] Research conducted at a single European center examined the survival of 313 liver receptors within two decades after the transplantation, pointing to infection as one of the most common causes of death after the surgical procedure. Of the patients analyzed, 141 died up to twenty years after the transplant, being 29 (20.6%) caused by various infections.[22]

The literature associates infections with invasive devices and procedures in liver receptors,[12] corroborating the results of this research.

A study carried out between 2009 and 2011, aimed to determine the mortality and risks associated with the death of adult patients with HCRI admitted to a teaching hospital. Of the 889 patients diagnosed with HCRI, 341 died, and more than half of the deaths (55.0%) occurred in patients with invasive procedures, mainly tracheostomized, with a frequency of 78.6%. This procedure was significantly associated to the death, increasing the risk of death for patients with HCRI in four times.[23]

Of the tracheostomized patients, one presented Respiratory Tract Infection (RTI), being reported with Mechanical Ventilation Associated Pneumonia (VAP) and the isolation of *Pseudomonas aeruginosa*. The other tracheostomized patient was diagnosed with SSI organ/cavity. Most of RTIs are associated with VAP, which was the case of two patients in this study, in which there is still no gold standard for their diagnosis, since most of the definitions used do not have sufficient specificity and sensitivity.[24]

In disagreement with these data, a study analyzed 303 patients submitted to LT, of which 15 (5.0%) presented twenty episodes of *Pseudomonas aeruginosa* infection, the blood stream being the most common source of infection. Of these, seven deaths have been attributed to the pathogen.[25]

SSI is a serious pathology related to bacteremia with up to 35% lethality, accounting for 10 to 20% of HCRI.[7] This type of infection associated with CVC is related to important unfavorable health

outcomes, and it is considered as the HCRI with the greatest preventive potential, since up to 70% of the cases could be prevented by adopting appropriate measures, such as adherence to bundles of good practices, insertion and maintenance of vascular devices.[24]

A study points to the surgical approach after the liver transplant as one of the risk factors related to HCRI[12] corroborating this research, in which the patient who twice underwent the surgical approach was diagnosed with SSI organ/cavity type without an etiologic agent alone.

The SSI can be classified as a superficial incisional, reaching only the subcutaneous tissue; deep incisional, when it reaches fascia and muscles or can be classified into organ/cavity,[24] which was the case of all the patients with SSI of our sample.

The main risk factors for SSI reported in the literature in liver recipients are blood transfusion, MELD>35, hyperglycemia, use of vasopressor drugs, ventilatory support and prolonged surgical time, among others. Among the similar variables analyzed in this study, none showed statistical association to the presence of infection.[26]

Sepsis, which had the highest number of infections in this study, represents the largest cause of morbidity and mortality worldwide.[27]A study performed in Germany with 201 liver recipients, revealed an overall incidence of 18.9% of sepsis after transplant, showing an association with a higher mortality rate if sepsis was acquired in patients with a high MELD score (>30).[28]

An international research afore-mentioned related 20.6% of deaths from liver receptors to the presence of infections, in which the prevalent cause was sepsis (n=13).[22]

Another frequent type of infection is the Urinary Tract Infection (UTI), one of the causes of great preventive potential, since the majority is related to UC, and the time of stay is the crucial factor for colonization and infection. In this type of infection, Gram-negative bacteria are the most frequent etiological agents,[24] fact that is evidenced in the present study, where *Escherichia coli* and/or *Klebsiella pneumoniae* were found in all cases of UTI.

A multicentric research performed with 4388 solid organs recipients analyzed the frequency and characteristics of the bacterial UTI. A total of 192 (4.4%) patients presented 249 episodes of UTI, of which the majority were kidney recipients (n=156) and only 36 were recipients of heart, lung and liver. Corroborating this study, the most frequent associated pathogen was *the Escherichia coli* (57.8%). The risk factors found in non-kidney transplant recipients were age, gender, and diabetes.[29] In the sample from this study, the majority of cases of ITU were female (n=2).

The incidence of infection during the first 30 days post LT, in a sample composed of 101 patients, was 28.7% (n=29) in an international study already mentioned. Of the infected patients, sixteen (55.1%) were associated with pathogens, while the remaining thirteen patients had only clinical signs of infection.[4] These findings corroborate the data from the present study, which presented a 28.3% infection rate among the study participants, and the majority (56.3%) had positive culture results.

Similar to the results of this study, researches show that most of the etiologic agents isolated in liver receptors after the transplant are Gram-negative.[14,30] Regarding the types of infection, the SSI[4,30] and the RTI[31] fare the most prevalent in studies performed with liver receptors, differing from the current study, in which the majority of the sample presented clinical sepsis, followed by RTIs, UTI, ISC, and finally SSI.

CONCLUSION

In the case of the 53 liver recipients, 28.3% presented HCRI during the first month of the transplantation PO, and there was a higher incidence of clinical sepsis, followed by RTIs, ITUs and SSI. Most of the infections were associated with Gram-negative bacteria. The factors that presented statistical association, in relation to the non-occurrence of HCRI were the married patients group and the indication of cirrhosis due to hepatitis C. The variables hospitalization days in the PO, the use of mycophenolate mofetil immunosuppressant and the average usage of some invasive devices were identified as the factors associated with the occurrence of HCRI, being statistically significant.

Regarding the use of invasive devices, the mean number of days of use of patients who were diagnosed with HCRI was higher than the other patients, but the only devices that presented statistical significance were the UC, the suction drain, and the IBP.

The present study has some limitations that should be considered. In addition to the retrospective nature of the analysis, it was not possible the access to some medical records during the collection

period, besides the absence of registration in some of the medical records consulted, limiting the number of data in some variables.

Despite the limitations, the identification of the incidence of HCRI and its associated factors in the patients submitted to the LT could subsidize the direction of the health actions, with the purpose of reducing the morbi-mortality associated to the infections and optimizing the recovery of these patients in the post-transplant period. It is recommended that other studies related to this theme are carried out, so other factors can be identified.

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