

Impact of routine crossmatch blood tests before cholecystectomy

Impacto de las pruebas cruzadas de compatibilidad sanguínea de rutina antes de una colecistectomía

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Cholecystectomy, erythrocyte concentrate, transfusion, bleeding.

Palabras clave:

Colecistectomía, concentrado eritrocitario, transfusión, sangrado.

ABSTRACT

Introduction: In Mexico, several institutions perform routine blood cross-matching (CM) before a cholecystectomy to ensure one unit of erythrocyte concentrate (EC, 230-330 ml) in case of a bleeding event (450 ml) in case of a bleeding event requiring urgent transfusion. Some studies do not support this practice. **Objective:** To evaluate the probability of requiring a transfusion and the need of a CM prior to a cholecystectomy. **Material and methods:** A retrospective study was done of patients who underwent cholecystectomy. A comparison was performed between cases that required, or did not require a blood transfusion. Reasons for transfusion and cost analysis were included. **Results:** Of the 503 evaluated cholecystectomies, four (0.8%) required transfusion and only one (0.2%) was considered urgent. Of the four patients who required transfusion, three (75%) underwent laparoscopic cholecystectomy and all four (100%) were obese, required longer surgical time and hospital length of stay. The cost of performing 503 routine CM in our institution was \$53,212 dollars. **Conclusion:** CM tests prior to a cholecystectomy should be done selectively. Each institution should have its own guidelines to ensure safe, quick and less expensive protocols.

RESUMEN

Introducción: En México, varias instituciones realizan pruebas cruzadas de compatibilidad sanguínea (PC) de rutina antes de una colecistectomía para tener disponible una unidad de concentrado eritrocitario (CE, 230-330 ml) en caso de hemorragia que requiera transfusión urgente. Algunas publicaciones previas no apoyan esta práctica. **Objetivo:** Evaluar la probabilidad de necesitar una transfusión y el requerimiento de PC para una colecistectomía. **Material y métodos:** Se llevó a cabo un estudio retrospectivo en pacientes a quienes se les realizó una colecistectomía. Los casos que no precisaron transfusión y los que sí fueron evaluados y comparados. Se incluyeron las razones de las transfusiones y un análisis de costos para realizar PC de rutina antes de una colecistectomía. **Resultados:** Se evaluaron 503 colecistectomías; del total, cuatro (0.8%) requirieron transfusión y sólo una (0.2%) necesitó transfusión considerada como urgente. De las cuatro que precisaron una transfusión, tres (75%) se realizaron por laparoscopia y cuatro de esos pacientes (100%) tenían obesidad y requirieron mayor tiempo quirúrgico y estancia intrahospitalaria. El costo de realizar 503 PC de rutina en nuestra institución fue de \$1,064,020 pesos (\$53,212 dólares). **Conclusión:** La solicitud de PC antes de una colecistectomía debería realizarse de manera selectiva. Cada institución debería crear sus guías de práctica para generar protocolos seguros, rápidos y menos costosos.

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INTRODUCTION

The object of having a unit of erythrocyte concentrate (EC, 230-330 mL) available before a cholecystectomy is readiness for an immediate transfusion. For this, it is necessary to complete pretransfusion tests (PTTs). Two

types of PTTs are used in our institution: a) blood compatibility tests (CTs), which are used to confirm the compatibility between the patient's blood and that of the donor, and to decrease the probability of post-transfusion reactions. This test has three phases and takes between 20 and 60 minutes to complete,

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depending on each institution;¹ b) rapid saline test (RST), which is used to determine ABO and Rh type and perform an antibody test. This process lasts between five and 10 minutes. CTs are considered safer to prevent transfusion reactions, but they are more expensive and take longer to process than RST.^{2,3} In 1981, the Food and Drug Administration (FDA) reported that the probability of not detecting an antibody incompatible with RST is one in 17,000 cases, and in 1984, the American Association of Blood Banks (AABB) recommended that CTs be replaced by RST as the gold standard, and that CTs should be made only if incompatibility was detected.⁴ This practice has become popular in the United States, and costs have been reduced without compromising patient safety. In Mexico, the Official Mexican Standard (*Norma Oficial Mexicana, NOM*) establishes that an urgent transfusion does not exempt CTs; however, a EC can be transfused with a previous RST, as long as the corresponding CTs are performed later.⁵ Many institutions still use CTs as the gold standard prior to any transfusion. In our institution, the common practice is to request CTs before every cholecystectomy in order to have a EC available in the event of bleeding that requires an immediate transfusion.

Cholecystectomy is one of the most common major surgeries in second and third level hospitals worldwide. In 2007, around 70,000 cholecystectomies were performed in the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social, IMSS*) only.⁶ In Mexico, before any cholecystectomy, many institutions routinely request CTs as PTTs. This is done as a preventive measure to protect the patient's health; however, it leads to higher cost and job stress. The objective of this study is to assess the probability of transfusion and the CTs requirement for a cholecystectomy.

MATERIAL AND METHOD

A retrospective study was conducted from January 2014 to December 2016. This article was reported online according to the STROCCS criteria⁷ and a research record was obtained. Each patient who underwent conventional or laparoscopic cholecystectomy, elective or not, was included at the Boca del Rio General

Hospital, a public hospital in Veracruz, Mexico. Each procedure was performed by hospital surgeons, assisted by undergraduate interns and/or medical students. No surgical resident participated in the procedures. For each patient, CTs were requested prior to surgery to guarantee an available EC in case a transfusion was necessary; on some occasions, for those cases with a higher risk of bleeding more than one EC was requested to be available. The following variables were documented: age, sex, type of approach (conventional or laparoscopic), type of intervention (elective or non-elective) and percentage of participation of each surgeon. The conventional or laparoscopic approach was chosen based on the availability of laparoscopy equipment. A procedure was considered non-elective when the patient was admitted via the Emergency Department and operated in the same hospitalization event. The cases in which one or more EC were transfused were documented, as well as the cause of the transfusion. The criteria for whether or not to transfuse were based on the decision of the treating medical team (anesthesiologist and surgeon) at the time of the event, based on the data (demographic, clinical, and laboratory) of each patient. These data are grouped in *Table 1*. A comparison was made between patients who did not require a transfusion and those who did. The comparison was carried out with a Fisher test for quantitative variables and a χ^2 for nominal variables. A p value of ≤ 0.05 was considered significant. A cost analysis was carried out. These were obtained directly from the blood bank of the hospital, and included the material necessary to perform the CTs, as well as the costs generated from the admission of the patient one day before surgery (in our institution, patients are admitted the day before an elective cholecystectomy to perform the CTs and have an EC available). The costs derived from human resources (laboratory personnel), office supplies, work stress and loss of productivity generated by the request of the CTs (doctors, nurses, administrative personnel, laboratory personnel, etc.) were not taken into account. The costs are shown in Mexican pesos (MXN) and US dollars, at the exchange rate at the time of writing this article.

Table 1: Characteristics of the four patients who required a transfusion.

Patients	1	2	3	4
Sex	Female	Female	Female	Female
Age (years)	33	42	61	27
Body mass index (kg/m ²)	40.6	33.8	37.5	31.5
Prior conditions	None	None	Hypertension, diabetes, one previous C-section	Three previous C-sections
Type of intervention	Elective	Non elective	Elective	Elective
Approach	Laparoscopic	Conventional	Laparoscopic (converted)	Laparoscopic
Reason for transfusion	Trans-operative hemorrhage of an aberrant artery.	Trans-operative hemorrhage of the cystic artery.	Low hemoglobin due to an adenocarcinoma.	Postop hemorrhage due to a hepatic laceration.
	Transfused 24 hours after surgery.	Transfused in the recovery room.	Transfused 58 hours after surgery.	Transfused during intervention.
	No hemodynamic instability	No hemodynamic instability	No hemodynamic instability	Presented with hemodynamic instability
Hemorrhage (ml)	400	1,100	No bleeding	3,500
Surgical time (minutes)	90	120	150	90
Surgeon	2	2	1	1
Final diagnosis	Acute cholecystitis	Cholelithiasis	Adenocarcinoma of the gallbladder with dissemination	Emphyema of the gallbladder
Days of hospital stay	5	2	3	7

RESULTS

503 cholecystectomies were performed in our hospital during the evaluated period. Of these, 96.4% were performed by three surgeons, with the following distribution: a) surgeon one performed 298 (59.3%), b) surgeon two performed 104 (20.6%), c) surgeon three performed 83 (16.5 %); 18 (3.6%) cases were performed by three other surgeons assigned to the night shift. The most common diagnosis was asymptomatic cholelithiasis (in 57.3% of cases), calculous cholecystitis (in 24.7%), choledocholithiasis (in 5.8%), biliary pancreatitis (in 3.9%), and other diagnoses (in 8.3% of cases). 82.3% were women and 17.7% men. The average age and body mass index were 40.8 ± 16.2 years and 28.0 ± 5.6 kg/m², respectively.

The average surgical time was 70.1 ± 47.7 minutes. A conventional approach was performed in 66.6% of the cases, 20.7% were non-elective surgeries. The average hospital stay was 1.5 ± 1.2 days. Of the total cholecystectomies performed, four (0.8%) required transfusion; only in one (0.2%) was an immediate transfusion required. When the patients who required a transfusion (four cases [0.8%]) were compared with those who did not (499 cases [99.2%]) no significant difference was found in any of the parameters evaluated (*Table 2*). In our institution, the approximate cost of each set of CTs is \$ 1,560.00 MXN (\$ 78.00 US). In elective surgeries, when an extra day of hospitalization was required before surgeries to perform the CTs, the cost increased to \$ 2,260 MXN (\$ 113 US) (*Table 3*).

Table 2: Comparison between patients who did not required transfusion versus those who did.

Variable	Total	Transfusions	p
Number	499	4	
Women/Men	411 (82.3%)/88 (17.7%)	4 (100%)	0.946
Age	40.8 ± 16.2	40.7 ± 14.8	0.991
Body mass index (kg/m ²)	28.0 ± 5.6	35.8 ± 4.0	0.662
Laparoscopic	165 (33.0%)	3 (75%)	0.079
Elective	396 (79.3%)	3 (75%)	0.822
Surgical time (min)	70.1 ± 47.7	112.5 ± 28.7	0.439
In-patient time (days)	1.5 ± 1.2	4.2 ± 2.2	0.057

DISCUSSION

This study evaluated the cost required to ensure the availability of an EC before a cholecystectomy. Of the 503 cases studied, four (0.8%) required the transfusion of at least one EC, but only one (0.2%) presented a bleeding that caused hemodynamic instability and required an immediate transfusion (patient 4 in *Table 1*). The rest of the patients did not show hemodynamic instability, so the transfusion was not done immediately (patients 1, 2 and 3 in *Table 1*). None of the subjects had a history of bleeding disorders. However, although the comparative analysis (*Table 2*) showed no significant difference, all four patients transfused were obese (based on body mass index) and had a longer than average surgical time and a longer hospital stay.

It is mentioned in the literature, that for certain procedures, CTs requested before surgery surpass the real needs.⁸ CTs are intended as preparedness in case of an urgent transfusion; however, based on some recommendations, selecting cases for CTs could reduce unnecessary laboratory work and costs.⁹ Specifically, in 1983 it was proposed that the practice of requesting PTTs for certain procedures should be constantly evaluated based on the unique needs and characteristics of each institution.¹⁰ This topic is not new, and has been analyzed by various authors. In 1997, Bhutia et al. found that of 608 patients who underwent different procedures, in 90% of cases the request for PTTs was unnecessary.

Table 3: Approximate costs required to perform a cross test at our institution.

Product	Cost (pesos MXN/ dollars US)
Reagents for the donor (proportional part) (a)	\$ 560.00/\$ 26.60
Blood unit (proportional part) (b)	\$ 500.00/\$ 23.80
Reagents for the cross-match (gel card) (c)	\$ 500.00/\$ 23.80
Admission one day prior to surgery (d)	Approx. \$ 600.00/\$ 28.60
Total	\$ 2,160.00/\$ 102.80

- a) Costs generated by the tests carried out on the donors; these costs are divided by five, which is the number of times a blood unit can be crossed before being discarded.
- b) Costs generated by the storage and production of a unit of blood divided by six, which is the number of times that a blood unit can be crossed before being discarded.
- c) Reagents necessary to perform the crossing.
- d) Costs generated by medications, intravenous solutions, use of room in the ward, among others. Cost is included only in patients who had elective surgery and were admitted the day before their cholecystectomy to perform the cross-tests.
- *Costs may vary depending on the institution.

They concluded that a program should be implemented that selects patients who require PTTs.¹¹ Another study conducted in Brazil reported that only 2% of the EC requested before a cholecystectomy were used, while in

the repair of inguinal hernias or mastectomies non were used.¹²

Turienzo-Santos and his group published a study in 2006 in which they analyzed different variables to improve the cost and quality of cholecystectomies performed at their institution. They detected four key points. One of them was to avoid PTTs before surgery.¹³ Usal and colleagues¹⁴ evaluated 2,589 laparoscopic cholecystectomies over a period of six years and found that only 0.46% of patients required a transfusion. However, when they analyzed the reasons for the transfusions, they noticed that only two of those patients (0.07%) had no risk factors for bleeding, while the other 10 (0.38%) did have previous conditions that increased their risk of bleeding (such as sickle cells, end-stage kidney disease and iron deficiency anemia). These authors reported savings of \$ 79,800.00 over a six-year period simply by eliminating routine PSRs in patients without risk factors for bleeding prior to cholecystectomy. Similar data were reported for other procedures such as caesarean sections¹⁵ and deliveries,¹⁶ where only 0.07 and 0.02% of the patients without risk factors for bleeding required an immediate transfusion. Some publications even mention that it is safe to perform complex high-risk surgeries, such as cardiac surgery, without an EC available, and that this should only be requested for specific cases.¹⁷

Various health institutions around the world have developed guidelines and algorithms based on specific needs and are striving to reduce routine use of PTTs. With this practice resource savings have been achieved, without sacrificing patient safety.^{18,19} In 1980, Mead and his team²⁰ defined the probability of requiring a blood transfusion for the first time. In 2006, Lim et al.²¹ completed this definition with the following formula: (number of transfused patients divided by the number of procedures performed) multiplied by 100. These authors mentioned that a number below 5% can be consider safe, and in such cases routine PTTs is not necessary. Based on Lin's formula and using this information, the probability of needing a transfusion was 0.79%. Such figure

is much lower than what the authors reported as safe (< 5%).

For the present study, CTs were previously requested for each cholecystectomy performed, which generated a cost of \$ 901,780.00 MXN (\$ 45,089 US) for elective cholecystectomies and \$162,240.00 MXN (\$ 8,112 US) for non-elective cholecystectomies; which produced a total of \$1,064,020.00 MXN (\$ 53,212 US) during a three-year study period. The costs generated in our institution could vary in other institutions depending on factors such as resource fund (public or private), contracts with providers and the type of economy of the community where the evaluation is carried out.

In this study, only the direct costs of requesting an EC were estimated, while the indirect costs (administrative work, filling out documents and handling products) were not considered; total costs may rise if these variables are included. It can be inferred that, if the CTs request is reduced, indirect costs would also decrease and, consequently, it would contribute to decrease work stress, increase hospital productivity and quality of patient care.^{22,23}

The true reasons for PTTs prior to a cholecystectomy are cases where unexpected bleeding causes hemodynamic instability and requires an urgent transfusion. If a transfusion could wait between 10 and 60 minutes, which is the time needed to process a PTTs, the requirement for these tests would not be necessary.

In this study, 0.8% of patients required transfusion, but only 0.2% required immediate transfusion. The probability of requiring an immediate or urgent transfusion is very low; however, correct medical practices promote adopting an action protocol in the remote case in which an immediate transfusion is required, and there are no previously requested PTTs.

Based on these scenarios, several studies have been reported, where a frozen type-O EC without prior PTTs can be transfused with a very small risk of post-transfusion reaction.²⁴⁻²⁷

Finally, considering the retrospective design of this study as the main limitation, based on previous publications and the data

presented in this series, we can consider that requesting an available EC before each cholecystectomy is a practice that should be avoided. Instead, a selective method should be considered, such as requesting availability of an EC only in cases where risk factors for bleeding exist (such as hematological diseases and cirrhosis), when a “difficult gallbladder” or one with a prolonged surgical time are suspected (such as cases of severe obesity or acute cholecystitis) and laparoscopic cholecystectomies performed by surgeons in training or with little experience. Each institution should create its own clinical guidelines to generate safe, fast, and less expensive protocols. With these actions, we believe that it is possible to guarantee patient safety, save resources that can be used in more vulnerable people, and reduce workload and stress to both medical and laboratory personnel.

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