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Effectiveness of the car index as an early predictor of anastomotic dehiscence in patients undergoing emergency gastrointestinal anastomosis

Dfectividad del indice car como predictor temprano de dehiscencia anastomótica en pacientes sometidos a anastomosis gastrointestinal de emergencia

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ABSTRACT

Objective: is to evaluate the effectiveness of the CAR index as an early predictor of anastomotic dehiscence in patients undergoing emergency gastrointestinal anastomosis.
Method: a total of 38 patients submitted to gastrointestinal anastomosis were chosen for this study, under the modality of a descriptive, prospective and longitudinal clinical-epidemiological research.
Results: of the 38 patients, only 4 developed anastomotic dehiscence with an incidence of 10,53 % (4/38), diagnosed most frequently on the 7th postoperative day, with a CAR efficiency of 30,77 %, with a sensitivity of 100 %, specificity 73,53 %, a positive predictive value of 30,77 % and a negative predictive value of 100 %.
Conclusion: that CAR favors early prediction of anastomotic dehiscence given its high percentage of sensitivity; however, it is worthwhile to continue this line of research considering a much larger sample size.

Keywords: Anastomotic Leakage; Serum Biomarks; Gastrointestinal Surgery.

RESUMEN

Objetivo: fue evaluar la efectividad del índice CAR como predictor temprano de dehiscencia anastomótica en pacientes sometidos a anastomosis gastrointestinales de emergencia.
Método: un total de 38 pacientes sometidos anastomosis gastrointestinal fueron elegidos para este estudio, bajo la modalidad de investigación clínica-epidemiológica de tipo descriptivo, prospectivo y longitudinal.
Resultados: de los 38 pacientes, solo 4 desarrollaron dehiscencia anastomótica con una incidencia de 10,53 % (4/38), diagnosticado con mayor frecuencia en el 7mo día del postoperatorio, con una eficacia de CAR de 30,77 %, con sensibilidad del 100 %, especificidad 73,53 %, un valor predictivo positivo 30,77 % y un valor predictivo negativo 100 %.
Conclusión: el índice CAR favorece en la predicción temprana de dehiscencia anastomótica dado su alto porcentaje de sensibilidad, sin embargo, es meritorio seguir esta línea de investigación considerando tamaño muestral mucho más amplio.

Palabras clave: Dehiscencia Anastomótica; Biomarcadores Séricos; Cirugía Gastrointestinal.

INTRODUCTION

Anastomotic dehiscence, defined as a defect in the integrity of the surgical junction between two hollow viscera with communication between the intraluminal and extraluminal compartment, is considered one of the surgical complications of greatest fear by surgeons in the field of digestive surgeries due to its association with increased morbidity and mortality, hospital stay, and, with the latter, high health care costs.[1]

It has a highly variable incidence, depending on the hospital institution and surgical service, ranging from 0,3 - 21 %, resulting in re-interventions, surgical site infections, intra-abdominal abscesses, terminal ostomies, malnutrition, catastrophic abdomen, sepsis, and death. Despite the low incidence, the impact on the patient's quality of life and mental health has been disturbing.[2,3]

The presence of risk factors attributable to patient comorbidities, among the most accepted: pulmonary disease, neoplasms, hypoalbuminemia, anemias, acute peritonitis, perioperative transfusions, and the technique used by the surgeon, may be among the main components for the establishment of anastomotic dehiscence; initial symptomatology, such as abdominal pain and distension, absence of hydrothermal sounds, tachycardia, and tachypnea, non-specific for the diagnosis, or a cardinal clinical sign, such as the presence or leakage of intestinal fluid through drains or surgical wound, considered as a late sign, should be taken into account. In addition to imaging studies such as computed tomography with water-soluble contrasts and endoscopic methods, it is helpful for diagnosis, even though scientific evidence does not ratify it as the most effective method.[2,4,5]

Considering this, early diagnosis of anastomotic dehiscence has been a challenge due to the presence of non-specific signs and symptoms and noneffective imaging methods, being a reason for the investigation of systemic inflammatory biomarkers that could be potentially applicable in clinical practice; the results showed that the presence of high levels of C-reactive protein (CRP) was a good predictor of postoperative complications, while patients who presented anastomotic dehiscence had low levels of serum albumin, in contrast to those who did not present complications. Therefore, recent studies proposed the C-reactive protein/Albumin (CAR) index as a new inflammatory biomarker, clinically useful as an indicator of postoperative complications.[6]

Previous studies have concluded that in the majority of patients undergoing colorectal surgeries between 2012-2015, the C-reactive Protein/Albumin index had a high probability in the diagnosis of postoperative complications, in addition to the greater effectiveness of the index over CRP individually7, and that the CAR index is an economical and widely available method, having as its leading utility the prediction of anastomotic leakage counting with a sensitivity of 79,6 % and specificity of 87,2 %.[6] Similarly, the CAR index contributes to the immediate diagnosis of early anastomotic leaks, especially in patients on their third postoperative day.

Although Asia is a pioneer in research on the CAR index, little evidence has been found in the Americas. Given the worldwide research where it has been shown that the CAR index is handy in the early diagnosis of anastomotic dehiscence, and more with high probability on postoperative day 39, with a very low cost and high accessibility, this provides greater feasibility of application in the Central Hospital of Maracay, thus providing a notable incidence in avoiding postoperative complications, decreasing the comorbidities that may be added to the patient and improving the patient's quality of life, besides contributing to reduce the costs in public services, since it can become a fast, economic and accessible solution to the entire population.

METHOD

This study was carried out as descriptive, prospective, and longitudinal clinical-epidemiological research in the General Surgery Service of the Autonomous Central Hospital of Maracay, Aragua State, Venezuela, from July 2023 to August 2024.

The selected population consisted of patients who attended the adult emergency room of the General Surgery Service and were assigned to the mentioned hospital. They required gastrointestinal surgery with consequent anastomosis, from which a simple minimum sample of 38 patients was taken. Patients with a history of nephropathies, hepatopathies, consumption of illicit psychoactive substances, who had undergone radiotherapy and chemotherapy, immunodepression, and who were under regular treatment with steroids were excluded from the study.

This research was carried out in the immediate postoperative period of patients who required emergency anastomosis and were instructed to undergo the following biomarkers: complete hematology, quantitative CRP, and total and fractionated proteins to calculate the CAR index. Likewise, a questionnaire was applied at the same time as the patient's postoperative period. This instrument evaluated three parameters: clinical-epidemiological data (age, sex, previous pathologic history), postoperative evolution (Days 3, 5, and 7: CAR index > or < 3,00), and postoperative clinical manifestations (pain, intestinal contents outflow through the operative wound, heart rate).

RESULTS

Among the most important epidemiological characteristics, the mean age was 51,07 years with a standard

deviation of 14,36 years. As age groups, there were similarities between patients aged 46 to 59 years and those over 60 years, representing 34,21 % of each group. On the other hand, the age group under 45 years of age was 31,58 % of the total population (table 1).

As for the predominant gender in this study, male patients were the most common, with 65,79 % of the total population, while female patients accounted for 34,21 % of the final result (table 1).

Table 1. Epidemiological characteristics of the patients who underwent emergency gastrointestinal anastomosis at the Central Hospital of Maracay				
Epidemiological data		N*	%	95 % ci
Age (x+ SD)	51,07± 14,36			
Age (groups)	Less than 45 years old	12	31,58	17,50 - 48,65
	46 to 59 years old	13	34,21	19,63 - 51,35
	Over 60 years old	13	34,21	19,63 - 51,35
Gender	Female	13	34,21	19,63 - 51,35
	Male	25	65,79	48,65 - 80,37
Personal History	DM2	3	7,89	1,66 - 21,38
	HTA	11	28,95	15,42 - 45,90
	HTA / DM2	5	13,16	4,41 - 28,09
	No history	19	50	33,38 - 66,62
Notes: 95 %CI: Confidence Interval at 95 % probability.				

Thus, among the patients who presented anastomotic dehiscence, 75 % were found to be in the age group over 60 years old, accompanied by 25 % represented by the corresponding group of 46 to 59 years old. Likewise, the predominant sex among the patients who presented anastomotic dehiscence or leakage was male, with 4 patients representing 100 %. In this same context, the presence of Arterial Hypertension as the only comorbidity, and also accompanied by Diabetes Mellitus type 2 in the same proportion represented by 50 % (table 2).

Table 2. Epidemiological characteristics of patients who underwent emergency gastrointestinal anastomosis at the Central Hospital of Maracay				
Epidemiological data		DA	%	95 %CI
Age (x+ SD)	60,71± 9,91			
Age (groups)	Less than 45 years old	0	0	0
	46 to 59 years old	1	25	0,63 - 80,59
	Over 60 years old	3	75	19,41 - 99,37
Gender	Female	0	0	0
	Male	4	100	39,76 - 100
Personal History	DM2	0	0	0
	HTA	2	50	6,76 - 93,24
	HTA / DM2	2	50	6,76 - 93,24
	No History	0	0	0

Regarding the frequency of dehisced anastomosis with respect to the postoperative day of the population evaluated, it is highlighted in this research that on postoperative day 5, there was dehiscence in 5,26 % of those studied, while 94,74 % of the sample maintained indemnity at the site of the anastomosis. Finally, on postoperative day 7, there was anastomotic dehiscence in 10,53 % of the patients. However, the indemnity of the surgical technique was maintained in 89,47 % of the results (table 3).

Table 3. Frequency of gastrointestinal anastomotic dehiscence with respect to the postoperative day					
			n*	%	95 %CI
Anastomotic Dehiscence	3 POD	Yes	0	0	0 - 0
		No	38	100	90,75 - 100
	5 POD	Yes	2	5,26	0,64 - 17,75
		No	36	94,74	82,25 - 99,36
	7 POD	Yes	4	10,53	2,94 - 24,80
		No	34	89,47	75,20 - 97,06

Regarding the CAR index, with 3,00 as the cut-off point, and related to the clinical manifestations of the patients who presented anastomotic dehiscence, it was determined that 100 % of these patients presented operative wound expense, with a perfect concordance represented by a Chi-square equal to 0, and a true null hypothesis (P: 1) (table 4). Next, relating this biomarker to the visual analog pain scale (VAS), it was determined that, in patients with the result above its cut-off point, moderate to severe abdominal pain was established in 100 % of the sample with good statistical representation (P: 1) (table 4). Similarly, it is noteworthy that in patients with a CAR index score greater than 3,00, 75 % of the cases presented a heart rate greater than 85 beats per minute, while only 25 % of those studied showed a heart rate between 65 and 85 beats per minute (P: 1) (table 4).

Table 4. Relating the CAR index to the clinical presentation of patients with anastomotic dehiscence undergoing gastrointestinal anastomosis		CAR <3,00 N=0 N (%) *	CAR >3,00 N=4 N (%) *	X^2	P
Operative Wound Expense	Yes	0 (0)	4 (100)	0	1
	No	0 (0)	0 (0)		
Abdominal Pain (VAS)	Less than 5	0 (0)	0 (0)	0	1
	Greater than 5	0 (0)	4 (100)		
Heart Rate	Less than 65	0 (0)	0 (0)	0	1
	65 - 85	0 (0)	1 (25)		
	Greater than 85	0 (0)	3 (75)		
Notes: N (%) *: Frequency (Percentage). P: Probability value. VAS: Visual Analog Pain Scale.					

Regarding the patients who presented anastomotic dehiscence, all of them male, the results of the analysis showed average values of albumin on the third postoperative day of 3,15 gr/dl, as well as on the fifth and seventh day with values of 3,0 gr/dl (table 5). Similarly, the average C-reactive protein values were highest on postoperative day 5 with values of 15,2 g/dL, followed by the third day with 13,5 g/dL and finally 12,5 g/dL on postoperative day 7. In this way, it was possible to demonstrate that the highest average CAR index in these individuals was on the fifth postoperative day, followed by the third postoperative day and, with a lower value but above the cut-off point, on the seventh postoperative day (table 5).

Table 5. Efficacy of the CAR index as an early predictor of gastrointestinal anastomotic dehiscence									
	Values x Albumin			Values x CRP			Values x CAR		
POD	3POD	5POD	7POD	3POD	5POD	7POD	3POD	5POD	7POD
M	3,15	3,0	3,00	13,5	15,2	12,5	4,28	5,06	4,16
F	0	0	0	0	0	0	0	0	0
Notes: M: Male F: Female POD: Postoperative day CRP: C-Reactive Protein CAR: C-Reactive Protein/Albumin Ratio									

It can be specified that 25 patients (65,79 %) of the sample studied presented a CAR index below the cut-off point, and did not develop the disease, at the same time, 13 patients (34,21 %) presented a CAR value above the cut-off point, where 9 of them (69,23 %) did not present anastomotic dehiscence, in turn, 4 patients (30,77 %) did manifest the disease.

Likewise, evaluation of the diagnostic test was applied, where a sensitivity of the study of 100 % was generated, with a specificity of 73,53 %, demonstrating the capacity of this index for the diagnosis of leakage or anastomotic dehiscence. Obtaining a positive predictive value of 30,77 % and a negative predictive value of 100 %, in addition to this, it presented a Kappa Cohen's value of 0,369 indicating a regular reliability (table 6).

Table 6. Efficacy of the CAR index as an early predictor of gastrointestinal anastomotic dehiscence							
Anastomotic Dehiscence	Yes N=4 N (%) *	No N=34 N (%) *	S	E	PPV	NPV	KpC
CAR >3,00	4 (30,77)	9 (69,23)	100 %	73,53 %	30,77 %	100 %	0,369
CAR <3,00	0 (0)	25 (100)					
Notes: N (%)*: Frequency (Percentage). S: Sensitivity. E: Specificity. PPV: Positive Predictive Value. NPV: Negative Predictive Value KpC: Cohen's Kappa.							

DISCUSSION

Anastomotic dehiscence is the most serious and common complication following gastrointestinal anastomosis, so researchers must explore risk factors to predict it accurately. Some studies agree that the male sex is a risk factor for the presence of anastomotic dehiscence, based on the hormonal theory associated with estrogen, where there is a change in microvascularization concerning the irrigation of the gastrointestinal system.[8]

Likewise, age has played an essential role in the development of anastomotic leaks, given the affection in the healing process due to the physiological changes that occur in the metabolism of its precursors, added to the presence of comorbidities that generally accompany them; it is said that for every 1 year, it is associated with an increase of 1 046 of the risk and a significant association between age (>70 years) and the risk of dehiscence,[9] which shows that age plays a vital role as a risk factor for the development of this complication.

At the same time, the presence of diabetes mellitus and systemic arterial hypertension has been the subject of many studies due to the impact they have on the immune response and irrigation of the anastomotic site, even though it is known that the etiopathogenesis of anastomotic dehiscence has not yet been fully elucidated, many consider them a risk factor,[10] however, in this study the absence of comorbidities was the majority in patients undergoing gastrointestinal anastomosis, despite this, in patients who presented anastomotic dehiscence the presence of arterial hypertension was noted, at the same time as diabetes mellitus. Demonstrating that comorbidities represent a risk factor in developing anastomotic leakage.

The evidence shows that the diagnosis of anastomotic leakage has been reflected in the first two weeks after gastrointestinal anastomosis, with diagnostic findings more than 30 days after the patient's discharge from the surgical unit, with an average between the 7th and 12th postoperative day).[11] Other studies report that the highest incidence occurs between the 3rd to 4th postoperative day and although they show a higher recurrence in the days after the 7th day, it could present a hypothesis regarding the differential nutritional status, given the tendency in the country to the presence of a considerable state of malnutrition in patients of the age group studied. Given this finding, it is necessary to conduct a thorough follow-up, considering that the patients on that day after surgery have already been discharged from the general surgery service.

The clinical manifestations developed by anastomotic leakage are non-specific in the initial evolution, with several symptoms up to the most severe ones. Nevertheless, moderate or severe abdominal pain after surgery is considered a high-risk factor for its development. Also, cardiovascular symptoms (cardiac arrhythmias, among others) and outflow through the operative wound or drains are considered possible clinical manifestations of anastomotic dehiscence,[10] contrasting with this study, where patients presented moderate to severe abdominal pain. Likewise, there was no outflow through the operative wound until postoperative day 7. Also, a heart rate greater than 85 beats per minute was evidenced as the most relevant cardiovascular symptom, demonstrating a correlation between the presence of these symptoms and the suspicion and/or diagnosis of anastomotic dehiscence.

The high sensitivity and specificity of the CAR index for predicting anastomotic dehiscence have served as a driving force for the development of many investigations. It is proving to be a representative biomarker for the inflammatory and nutritional status of the patient before or during intestinal anastomosis.

CONCLUSION

The results of this study suggest that the CAR index can become an important tool for the diagnostic prediction of anastomotic dehiscence, with a special suspicion on postoperative day 7, without overlooking demographic factors that could make the suspicion more relevant. These findings underline the importance of a rigorous follow-up and the implementation of prevention strategies in the perioperative management of these patients, thus contributing to improve surgical outcomes and quality of care in the context of gastrointestinal anastomoses.

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