International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

International Journal of Echinococcoses

Journal homepage: www.echinococcoses.org

Original Article

Predictive Ability of Prognostic Markers in Cystic Echinococcosis with Bile Leakage

Salih Kara[1], Ercan Korkut[1], Nurhak Aksungur[1], Necip Altundas[1], Gurkan Ozturk[1], Metin Yildiz[2], Mustafa Yeni[3]

[1]Transplantation Center, Ataturk University, Erzurum, Turkey
[2]Department of General Surgery, Ataturk University School of Medicin, Erzurum, Turkey
[3]Department of General Surgery, Erzurum Regional Education and Research Hospital, Erzurum, Turkey

ARTICLE INFO

Received: February 02, 2022
Accepted: May 15, 2022
Available online: May 21, 2022

CORRESPONDING AUTHOR

Salih Kara, Ataturk University, Transplantation Center, 25240, Erzurum, Turkey
E-mail: slh_kara@hotmail.com
Phone Mobile: +90 442 344 7946

CITATION

Kara S, Korkut E, Aksungur N, Altundas N, Ozturk G, Yildiz M, Yeni M. Predictive Ability of Prognostic Markers in Cystic Echinococcosis with Bile Leakage. International Journal of Echinococcoses. 2022;1(2):38-45. DOI: 10.5455/IJE.2022.01.01

The journal is the official publication of The Turkish Association of Hydatidology

ABSTRACT

Objective: The most important post-surgical complication of cystic echinococcosis (CE) is cystobiliary communication and bile leakage in terms of mortality and morbidity. Therefore, we aimed to predict bile leakage using prognostic markers before the operation.
Materials and Methods: All patients hospitalized with the diagnosis of CE in the Hepatobiliary Surgery Service of Atatürk University Research Hospital between 2011 and 2021 were retrospectively analyzed. Patients who were operated for CE and developed postoperative leakage were included in the study. Prognostic markers were calculated using preoperative laboratory tests. And these values were analyzed according to the recovery time of the patient.
Results: The mean recovery time of postoperative biliary fistula was 13.97 ± 7.33 days. No mortality was observed in the patients. The mean prognostic nutritional index (PNI), the neutrophil–lymphocyte ratio (NLR) and platelet–lymphocyte ratio (PLR) values were 48.68 ± 8.46, 3.09 ± 2.61, and 149.34 ± 86.17, respectively. PLR significantly affected the recovery times. An increase in PLR meant a prolonged recovery period. PNI and NLR had no significant effect on the recovery times of biliary fistula.
Conclusion: In patients with a high PLR value, caution should be exercised in terms of postoperative biliary fistula. PLR can be used as a marker if the cyst is to be intervened in the preoperative period.

Keywords: Liver hydatid cyst, Bile fistula, prognostic markers

INTRODUCTION

Hydatid cysts are caused by the adult or larval stages of tapeworms of the genus Echinococcus. CE is a zoonotic disease caused by *Echinococcus granulosus*. Its incidence varies in different geographies. CE is an endemic disease in the Middle Eastern and Mediterranean countries (1-3). As recommended by the World Health Organization (WHO), medical and surgical treatment strategies are determined based on the cyst size. Various complications, such as symptoms due to compression on neighboring organs, intra-abdominal rupture, and biliary

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

tract rupture, can be observed in untreated cases (4,5). Cystobiliary communication occurs at a rate of 13%–37%, whereas jaundice associated with CE is observed at a rate of 8.9%–17% (5-7). Postoperative bile leakage is the main complication in CE after conservative surgery, which increases the morbidity and mortality (8,9). Cyst diameter is an important predictive factor of biliary fistula (10). In addition, the rate of bile leakage is lower in patients who undergo radical surgery such as liver resection or cystectomy (11).

The prognostic nutritional index (PNI) was originally introduced as an index of nutritional status in nonemergency general surgery patients and has been shown to be associated with the risk of postoperative complications (12). This index was then formulated using peripheral blood lymphocyte count and serum albumin concentration and simplified to assess the immune–nutritional status of patients (13). Recently, PNI has been shown to predict survival in gastrointestinal tract carcinomas (14). the Immune–nutritional status is also evaluated using (15) the neutrophil–lymphocyte ratio (NLR) (16) and platelet–lymphocyte ratio (PLR) in addition to PNI.

This study aimed to examine the effects of PNI, NLR, and PLR in the preoperative period on recovery times and morbidity in CE with biliary fistula.

Patient Selection and Methods

All patients who were hospitalized with the diagnosis of CE in the Hepatobiliary Surgery Service of Atatürk University Research Hospital between 2011 and 2021 were retrospectively analyzed (n = 1.058). Patient data were retrieved electronically from the hospital information system by scanning the patient files. Patients who underwent radical or conservative surgical treatment and developed biliary fistula postoperatively and those with preoperative or perioperative cystobiliary fistula were included in the study. Patients who were treated percutaneously by interventional radiology and those who underwent radical or conservative surgery and did not develop postoperative biliary fistula were excluded (Figure 1).

CE localization, CE classification according to WHO (17), and radical surgical technique (cystectomy and resection) or conservative surgical technique (cystotomy and omentoplasty, tube drainage, partial cystectomy, and bile leak repair) were recorded for all patients included in the study. To calculate PNI, PLR, and NLR values, the latest albumin level as well as platelet, neutrophil, and lymphocyte counts in the preoperative period were recorded. PNI was calculated using serum albumin and peripheral blood lymphocyte count according to the following formula: PNI = [10 × serum albumin level (g/dL)] + [0.005 × total peripheral lymphocyte count (per mm^3)]. NLR was calculated by dividing the neutrophil count in the peripheral blood by the lymphocyte count, and PLR was calculated by dividing the platelet count in the peripheral blood by the lymphocyte count.

The recovery times of the patients who developed biliary fistula in the postoperative period and the degree of biliary fistula according to the Clavien–Dindo classification were recorded. All interventions were also recorded.

CE management

Medical, percutaneous, and surgical treatment is applied depending on the type, localization, and complexity of the cyst in CE. According to WHO classification, medical treatment was applied for CE1 cysts with a diameter of <5 cm, whereas surgical treatment was applied for CE1 with a diameter of > 5 cm, CE2, CE3, and CE4 cysts with with complex fluid content and calcified wall. No intervention was applied to CE5 cysts. Patients who had recurrent cysts or cyst collections in CE1, CE3A, CE3B and some CE2 cysts; those who did not accept surgery; or those whose medical conditions were not suitable for surgical treatment were treated percutaneously via interventional radiology. While emergency surgical treatment was applied for ruptured hydatid cysts in the intraperitoneal area, elective surgical treatment was applied for CE1 cysts that could not be treated percutaneously, CE2, CE3A and CE3B cysts with many daughter vesicles, CE4 cysts with fluid collection, and cysts with cystobiliary communication. Albendazole treatment was initiated 2 weeks before the operation or intervention in all patients and continued for 2 months after the intervention. Andazol was given at 15 mg/kg per day divided into two, with an interval of 12 hours (maximum daily dose was 800mg).

CE surgical procedure

As part of the conservative surgical method, the cyst content was evacuated initially by securing the surrounding tissues with compresses and sponges to prevent intraperitoneal recurrence. Then, the cavity was sterilized by injecting a scolicidal agent into the cavity. Chlorhexidine or 3%–30% NaCl solution were used as the scolicidal agent. The agents were left for 5–10 min in the cavity, and the cavity was then aspirated. Contact with the biliary tract was avoided as much as possible to minimize the risk of cholangitis. After the cavity was sterilized, biliary fistula control was performed. If a cystobiliary duct was visible and it was not the main bile duct, the duct was sutured carefully. If there was no visible duct and there was bile in the cyst, leakage was checked by injecting 0.9% NaCl from the cystic duct via cholecystectomy. Partial cystectomy, tube drainage, and omentoplasty were used for cavity management. Hepatectomy and cystectomy were performed as radical surgical techniques.

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

Table 1: Patients Characteristics

		Frequency	p value
Age		40.78 ± 15.48 (20-83)	
Gender	Female	82 (% 56.6)	0.513
	Male	63 (% 43.4)	
PNI		48.68 ± 8.46 (27.5-72.7)	
NLR		3.09 ± 2.61 (0.7-19.8)	
PLR		149.34 ± 86.17 (45-552)	
Localization	Right Lobe	95 (% 65.5)	0.662
	Left Lobe	17 (%11.7)	
	Bilobar	10 (% 6.9)	
	Centre	21 (% 14.5)	
	Caudat	2 (% 1.4)	
WHO Classification	CE 1	27 (%18.6)	0.667
	CE 2	56 (%38.6)	
	CE 3A	30 (% 20.7)	
	CE 3B	22 (%15.2)	
	CE 4	10 (% 6.9)	
Surgical Tecnique	Cystotomy	68 (%46.9)	0.559
	Partial cystectomy+Cholecystectomy+Cysticostomy	2 (%1.4)	
	Partial cystectomy+Cholecystectomy+Omentoplasty	2 (% 1.4)	
	Partial cystectomy	18 (% 12.4)	
	Cystotomi + Omentoplasty	20 (%13.8)	
	Cystotomy + Cholecystectomy	16 (% 11)	
	Cystotomy+ cholecystectomy+cysticostomy	5 (% 3.4)	
	Cystotomy+cholecystectomy+omentoplasty	6 (% 4.1)	
	Cystotomy+cholecystectomy+omentoplasty+	4 (% 2.8)	
	cysticostomy	1 (% 0.7)	
	Partial cystectomy+omentoplasty	3 (%2.1)	
Bile leak repair in operation	Partial cystectomy+Cholecystectomy	123 (%84.8)	
	Yes	22 (%15.2)	
Radiologic prevention	None	13 (% 9)	
	Percutan intervention	132 (%91)	
surgical prevention	None	136 (%93.8)	
	None	6 (%4.1)	
	Abscess Drainage	2 (%1.4)	
	Wound Debridement	1 (0.7)	
Endoscopic prevention	Hepaticojejunostomy	94 (% 64.8)	
	none	4 (% 2.8)	
	preoperative sphincterotomy	10 (%6.9)	
	preoperative sphincterotomy + stent	26 (% 17.9)	
	sphincterotomy	11 (%7.6)	
Bile Fistula Type	sphincterotomy + stent	131 (%90.3)	
	Occult	14 (%9.7)	
Recovery Time	Frank	13.97 ± 7.33 (3-41)	

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

Table 2: Multivariate Linear Regression Analyse

		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	8.430	5.505		1.531	.128					
	PNI	.040	.092	.046	.430	.668	-.135	.036	.035	.583	1.716
	NLR	.122	.293	.044	.417	.677	.175	.035	.034	.609	1.643
	PLR	.022	.010	.254	2.173	.031	.251	.180	.177	.487	2.054

Table 3: Binary Logistic Regression

Variables in the Equation

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	highplr(1)	-1.891	.767	6.077	1	.014	.151	.034	.679
	Constant	2.197	.745	8.690	1	.003	9.000		

a. Variable(s) entered on step 1: highplr.

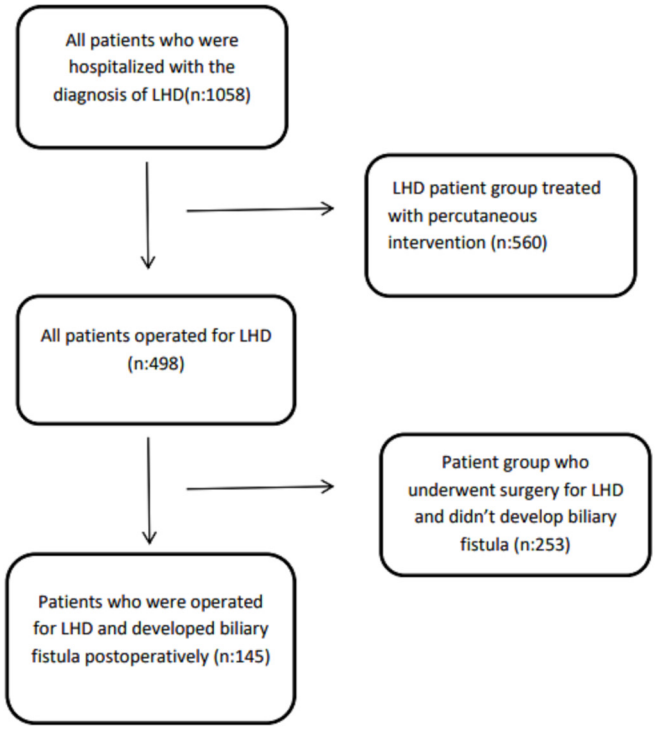

Figure 1. Patient selection

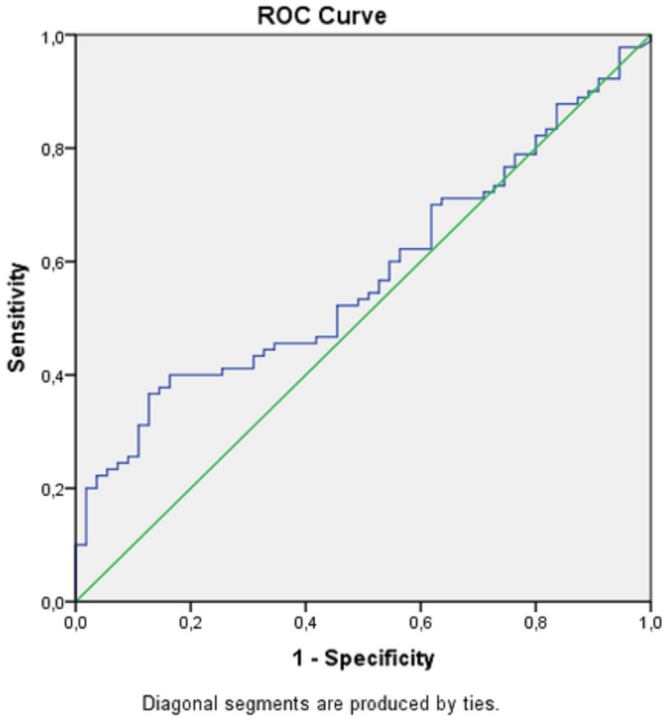

Figure 2. Area under curve

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

Biliary fistula management

Biliary fistula is also defined as intrabiliary rupture and is one of the most common complications of CE. In the present study, we managed patients with cystobiliary communication applying an algorithm developed in our clinic based on patient data by Öztürk, Yildirgan (18). Accordingly, patients with CE who had jaundice and cholangitis in the preoperative period primarily underwent sphincterotomy with endoscopic retrograde cholangiopancreatography (ERCP). When ERCP failed, it was repeated or emergency surgery was performed. Elective surgery was performed in those who underwent sphincteromy with ERCP. In patients with postoperative biliary fistula, if there was bilioma, the collection was evacuated by percutaneous drainage and the patient was followed-up. In patients with bile leakage from the drain due to biliary fistula, sphincterotomy with ERCP was performed if the drainage did not fall below 100 mL/day on the postoperative 7th day. If drainage continued, a stent was inserted. The stent and drain were removed after the biliary fistula closed. If a major bile duct opened into the cyst and a biliary fistula developed, irrigation and drainage were performed in the cyst with a nasobiliary stent. When the amount of drainage fell to <10 mL/day and there was no collection in the radiological imaging, the drain and nasobiliary drainage (NBD) were removed. If endoscopic methods were unsuccessful and sepsis developed, surgery was performed.

Statistical analyses

SPSS (version 22) statistical software was used for all analyses. Multivariate linear regression was used to examine the effects of PNI, NLR, and PLR on the recovery times of biliary fistula. $P < 0.05$ with a 95% confidence interval was considered significant for the regression model and meant that at least one variable was effective. Receiver operating characteristic (ROC) analysis was then performed to determine the cutoff value of the significant factors. Binary logistic regression was used to predict recovery times exceeding 10 days by dividing PNI, NLR, and PLR into high and low categories according to the cutoff values determined. Furthermore, the chi-squared test was used to analyze the differences between low-grade and high-grade complications according to the Clavien–Dindo classification in the high and low PNI, NLR, and PLR categories. $P < 0.05$ was accepted as statistically significant in all analyses.

RESULTS

The general characteristics of the patients are shown in Table 1. Of the 145 patients with cystobiliary fistula, 131 (90.3%) were of the occult type and 14 (9.7%) were of the frank type. Of the patients with occult type biliary fistula, 23(%17.6) were CE1, 52(%39.7) CE2, 28 (%21.4) CE3A, (%14.5)19 CE3B and 9 (%6.9) CE4 cysts. Also, 82 (56.6%) patients were female and 63 (43.4%) were male. The mean age of the patients was 40.78 ± 15.48 years (20–83 years). The mean recovery time of postoperative biliary fistula was 13.97 ± 7.33 days. No mortality was observed in the patients. The mean PNI, NLR, and PLR values were 48.68 ± 8.46, 3.09 ± 2.61, and 149.34 ± 86.17, respectively. The cysts were in the right lobe in 95 (65.5%) of the cases and in the left lobe in 17 (11.7%) of the cases. The cysts were bilobed in 10 (6.9%) of the cases and centrally located in 21 (14.5%) of the cases. Two (1.4%) patients had a cyst located in the caudate lobe. Surgical treatment was applied to CE1, CE2, CE3A, CE3B, and CE4 cysts according to the WHO classification. The most common cystobiliary fistula was CE2 cyst with 56 (38.6%) cases. Among the patients who developed cystobiliary fistula, 27 (1.6%) were CE1, 30 (20.7%) were CE3A, 22 (15.2%) were CE3B, and 10 (6.9%) were CE4 hydatid cysts. Conservative surgical treatment was applied to all patients. Cystotomy was applied to 68 (46.9%) patients, and it was the most common surgical technique. Intraoperative biliary fistula repair was performed in 123 (84.8%) patients owing to cystobiliary fistula. No intraoperative repair was performed in 22 (15.2%) of the patients. Percutaneous intervention was performed in 13 patients (9%) because of cavity abscess. Surgical drainage was performed in six (4.1%) patients owing to cavity abscess. Long-term hepaticojejunostomy was performed in one (0.7%) patient for biliary stricture. While postoperative endoscopic intervention was performed in 37 (25.5%) patients, preoperative endoscopic intervention for cystobiliary fistula was performed in 14 (9.7%) patients.

To examine the effects of categorical variables on the recovery times of biliary fistula, each variable was analyzed using the chi-squared test. Pearson chi-squared value was evaluated in cases with a large enough sample size, and Fisher's exact value was calculated in cases with an insufficient sample size. Those with $P < 0.05$ were considered significant. Accordingly, it was found that only endoscopic interventions had a positive and significant effect on the recovery time of biliary fistula (Fisher's exact $P = 0.001$).

Multivariate linear regression analysis was performed to determine the effects of PNI, NLR, and PLR on the recovery time of postoperative biliary fistula in patients with liver hydatid cysts. Regression analysis revealed that the independent variables explained 4.5% of the variance in the dependent variable ($F (3, 141) = 3.27$, $P < 0.023$, $R2adjusted = 0.045$). According to the regression analysis, PLR significantly affected the recovery times ($\beta = 0.25$, $t (141) = 2.17$, $P < 0.03$, $pr2 = 0.03$). An increase in PLR meant a prolonged recovery period. PNI and NLR had no significant effect on the recovery times of biliary fistula (P

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

= 0.66 and 0.67, respectively; Table 2).

ROC analysis was used to determine a cutoff value for PLR in predicting the recovery time (Figure 2). The cutoff value for PLR was determined as 216 with 20% sensitivity and 98% specificity (AUC = 0.576, lower bound = 0,483, upper bound = 0.668, LR = 11). Patients were classified into high and low PLR groups according to the cutoff value (PLR ≥ 216 and PLR < 216). Patients were also classified into two groups according to recovery time (long and short according to recovery exceeding 10 days). Binary logistic regression analysis was performed for these groups. This analysis showed that high PLR according to the cutoff value could predict recovery time exceeding 10 days, and a one unit increase in PLR prolonged the recovery time by 0.15 units (B = −1.89, exp (B) = 0.15, P = 0.014; Table 3).

According to the cutoff value obtained in the ROC analysis, patients were classified into two groups as those with PLR > 216 and those with PLR < 216. These two groups were compared with respect to high-grade and low-grade complication groups according to the Clavien–Dindo classification, and the effect of high PLR on complications was analyzed via the chi-squared test. No significant difference was found between the groups (Pearson's chi square P = 0.204). Thus, it was determined that high PLR had no effect on complications.

DISCUSSION

Cystobiliary communication manifests itself as an occult type in the postoperative period at a rate of 10%–37%. (19). This type of biliary fistula is bile leakage in minor biliary tract determined in the intraoperative procedure. Flank type biliary fistula is determined preoperative period for CE with using laboratory tests and radiological imagine tecniques. Bile leakage developing after conservative surgical procedures for CE is one of the main causes of morbidity and mortality (8, 9). It is mostly observed after conservative surgical methods(20). In the patient series examined in this study, bile leakage was not detected in the postoperative period in any of the patients who underwent radical surgery. However, bile leakage was detected in 30% of the patients who underwent conservative surgery. This high rate is likely due to the fact that our center is the tertiary treatment center in our region and that complicated cases are referred to us from other centers.

Prophylactic sphincterotomy provides shorter hospital stay and drain removal time after partial cystectomy (19). So it can be said that endoscopic sphincterotomy performed in the preoperative period in patients with frank-type cystobiliary communication has a positive effect on the recovery times of biliary fistula. In the present study, only endoscopic interventions had a positive effect on the recovery time of biliary fistula (P < 0.001). In patients with cystobiliary communication, preoperative endoscopic interventions accelerate the flow of bile into the duodenum, thereby reducing the pressure on the small bile ducts in the cyst. Thus, the accumulation of bile in the cyst decreases and the closure of the minor bile ducts of the cystobiliary communication is ensured.

It is more difficult to manage patients without cholangitis in the preoperative period and whose laboratory parameters do not indicate a cystobiliary communication but are detected to have a cystobiliary communication in the intraoperative period. In this patient group, determining the location of the cystobiliary communication and ligation with primary suture can reduce bile leakage. However, it is not always easy to locate the cystobiliary communication. There are several techniques for this as well. By placing white gauze in the cyst cavity and waiting for a few minutes, the location of the leak can be determined by stains on the gauze. In another technique, cholecystectomy is performed and the cystic duct is catheterized, and the location of the leak can then be determined with pressurized isotonic solution.(21,22) Cholangiography can also be performed in conjunction with this method to understand whether the leaking duct is a major or minor duct. Thus, a more careful repair can avoid complications such as biliary stricture. If the bile leakage is from a major duct, it is safer not to ligate to avoid possible complications. In the present study, intraoperative cystobiliary communication ligation was performed in 123 (84.8%) patients with biliary fistula. Cholecystectomy was performed in 38 (26.2%) patients, and the cystic duct was removed by cysticostomy in 11 (7.5%) patients using a feeding catheter. The biliary tract had no statistically significant effect on the recovery time in these patients (P = 0.11). Accordingly, if the communication point is not ideal for repair and if it is not a minor branch, we do not recommend repair because of possible complications. In fact, Roux-en-Y hepaticojejunostomy was performed in one of our patients owing to the development of stricture during long-term follow-up.

PLR is a novel marker of systemic inflammation. An increase in the severity of inflammation has been shown to be associated with an increase in platelet activity. (23) It has been shown that inflammation risk and inflammation may increase in high PLR levels even without thrombocytosis.(24, 25) In addition to being a marker of systemic inflammation, it has been shown to be a predictor of prognosis and response to treatment in various malignancies.(26, 27) In the present study, we attempted to determine the predictive power of prognostic markers on recovery times of biliary fistula after CE surgery. The results showed that only PLR can be used as a prognostic marker for this purpose. Accordingly, recovery times may be prolonged in patients with high PLR values. This, in

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

turn, will prolong the length of hospital stay and increase the frequency of rehospitalization. Therefore, the patient should be followed-up and treated more carefully if the PLR value is higher than the cutoff value. In particular, in patients with minimally elevated cholestasis enzyme levels and who are hesitant to undergo preoperative endoscopic intervention, PLR can be used as a marker and can be considered in decision-making. As shown in the present study, endoscopic interventions have positive effects on the recovery times. However, they should be performed with caution as they are invasive. In such cases, PLR may contribute as a secondary marker in decision-making in addition to cholestasis enzyme levels. Furthermore, PLR had no effect on complications.

Although PNI and NLR are other inflammation and prognostic markers, our analyses could not demonstrate any effect on the recovery time of biliary fistula in patients with CE. However, as prognostic markers are also inflammation and immunity indicators, further studies can be conducted on their effects on CE. We believe that this study will act as a guide for such future studies.

CONCLUSION

We concluded that high PLR value prolongs the biliary fistula recovery time. In patients with a high PLR value, caution should be exercised in terms of postoperative biliary fistula. PLR can be used as a marker if the cyst is to be intervened in the preoperative period.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: Ethical Committee for Clinical Research of Ataturk University School of Medicine (24.02.2022-Approval number 2-7)

REFERENCES

1. Akther J, Khanam N, Rao S. Clinico epidemiological profile of hydatid diseases in central India, a retrospective and prospective study. Int J Biol Med Res. 2011;2:603-6.
2. Motie MR, Ghaemi M, Aliakbarian M, Saremi E. Study of the radical vs. conservative surgical treatment of the hepatic hydatid cyst: a 10-year experience. Indian Journal of Surgery. 2010;72:448-52.
3. Grosso G, Gruttadauria S, Biondi A, et al. Worldwide epidemiology of liver hydatidosis including the Mediterranean area. World journal of gastroenterology: WJG. 2012;18:1425.
4. Anand S, Rajagopalan S, Mohan R. RETRACTED: Management of liver hydatid cysts–Current perspectives. Med J Armed Forces India. 2012;68:304-9.
5. Avgerinos E, Pavlakis E, Stathoulopoulos A, et al. Clinical presentations and surgical management of liver hydatidosis: our 20 year experience. Hpb. 2006;8:189-93.
6. Demircan O, Baymus M, Seydaoglu G, et al. Occult cystobiliary communication presenting as postoperative biliary leakage after hydatid liver surgery: are there significant preoperative clinical predictors? Canadian J Surg. 2006;49:177.
7. Duta C, Pantea S, Lazar C, et al. Minimally invasive treatment of liver hydatidosis. JSLS. 2016;20:e2016.00002.
8. Balik AA, Başoğlu M, Celebi F, et al. Surgical treatment of hydatid disease of the liver: review of 304 cases. Arch Surg. 1999;134:166-9.
9. El Malki HO, El Mejdoubi Y, Souadka A, et al. Predictive factors of deep abdominal complications after operation for hydatid cyst of the liver: 15 years of experience with 672 patients. J Am Coll Surg. 2008;206:629-37.
10. Baraket O, Moussa M, Ayed K, et al. Predictive factors of morbidity after surgical treatment of hydatid cyst of the liver. Arab J Gastroenterol. 2014;15:119-22.
11. Yagci G, Ustunsoz B, Kaymakcioglu N, et al. Results of surgical, laparoscopic, and percutaneous treatment for hydatid disease of the liver: 10 years experience with 355 patients. World J Surg. 2005;29:1670-9.
12. Buzby GP, Mullen JL, Matthews DC, Prognostic nutritional index in gastrointestinal surgery. Am J Surg. 1980;139:160-7.
13. Onodera T, Goseki N, Kosaki G. Prognostic nutritional index in gastrointestinal surgery of malnourished cancer patients. Nihon Geka Gakkai Zasshi. 1984;85:1001-5.
14. Sun K, Chen S, Xu J, et al. The prognostic significance of the prognostic nutritional index in cancer: a systematic review and meta-analysis. J Cancer Res Clin Oncol. 2014;140:1537-49.
15. Xue Y, Zhou X, Xue L, et al. The role of pretreatment prognostic nutritional index in esophageal cancer: A meta analysis. J Cell Physiol. 2019;234:19655-62.
16. Proctor M, McMillan D, Morrison D, et al. A derived neutrophil to lymphocyte ratio predicts survival in patients with cancer. British J Cancer. 2012;107:695-9.
17. Group WIW. International classification of ultrasound images in cystic echinococcosis for application

International Journal of Echinococcoses 2022;1(2):38-45
DOI: 10.5455/IJE.2022.01.01

in clinical and field epidemiological settings. Acta tropica. 2003;85:253-61.

18. Öztürk G, Yildirgan MI, Atamanalp SS, et al. An algorithm for the treatment of the biliary complications of hepatic hydatid disease. Turkis J Med Sci. 2009;39:671-85.
19. El-Gendi AM, El-Shafei M, Bedewy E. The role of prophylactic endoscopic sphincterotomy for prevention of postoperative bile leak in hydatid liver disease: a randomized controlled study. J Laparoendosc Adv Surg Tech A. 2018;28:990-6.
20. Deo KB, Kumar R, Tiwari G, Surgical management of hepatic hydatid cysts–conservative versus radical surgery. HPB. 2020;22:1457-62.
21. Galati G, Sterpetti AV, Caputo M, et al. Endoscopic retrograde cholangiography for intrabiliary rupture of hydatid cyst. Am J Surg. 2006;191:206-10.
22. Kayaalp C, Aydin C, Olmez A, et al. Leakage tests reduce the frequency of biliary fistulas following hydatid liver cyst surgery. Clinics. 2011;66:421-4.
23. Projahn D, Koenen RR. Platelets: key players in vascular inflammation. J Leukocyte Biol. 2012;92:1167-75.
24. Ozcan Cetin EH, Cetin MS, Aras D, et al. Platelet to lymphocyte ratio as a prognostic marker of in-hospital and long-term major adverse cardiovascular events in ST-segment elevation myocardial infarction. Angiology. 2016;67:336-45.
25. Toprak C, Tabakci MM, Simsek Z, et al. Platelet/lymphocyte ratio was associated with impaired myocardial perfusion and both in-hospital and long-term adverse outcome in patients with ST-segment elevation acute myocardial infarction undergoing primary coronary intervention. Postępy w Kardiologii Interwencyjnej= Advances in Interventional Cardiology. 2015;11:288.
26. Inaoka K, Kanda M, Uda H, et al. Clinical utility of the platelet-lymphocyte ratio as a predictor of postoperative complications after radical gastrectomy for clinical T2-4 gastric cancer. World J Gastroenterol. 2017;23:2519.
27. Xia W-K, Liu Z-L, Shen D, et al. Prognostic performance of pre-treatment NLR and PLR in patients suffering from osteosarcoma. World J Surg Oncol. 2016;14:1-8.