Original Article

Camrelizumab in combination with chemotherapy and targeted therapy improves the prognosis in patients with advanced biliary tract cancer: a single-center retrospective clinical study

Yizhuo Zhang[1#], Xiaolong Liu[2#], Guixing Jiang[2], Xinyu Dong[2], Hong Jae Chon[3], Giovanni Brandi[4], Daniel Neureiter[5], Defei Hong[2]

[1]School of Medicine, Shaoxing University, Shaoxing, China; [2]Department of General Surgery, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, Hangzhou, China; [3]Department of Medical Oncology, CHA Bundang Medical Center, CHA University School of Medicine, Seongnam, Korea; [4]Department of Experimental, Diagnostic and Specialty Medicine, S. Orsola-Malpighi University Hospital, Bologna, Italy; [5]Institute of Pathology, Paracelsus Medical University/University Hospital Salzburg (SALK), Salzburg, Austria

Contributions: (I) Conception and design: Y Zhang, X Liu, D Hong; (II) Administrative support: D Hong; (III) Provision of study materials or patients: D Hong; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Defei Hong, PhD. Department of General Surgery, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University, No. 3 East Qingchun Road, Hangzhou 310058, China. Email: hongdefi@163.com.

Background: Biliary tract cancer (BTC) is an aggressive neoplasm with poor overall survival. Chemotherapy has improved the prognosis of BTC, but the outcomes still remain very unsatisfactory. Immune checkpoint inhibitor (ICI) therapy has shown promising efficacy in multiple solid tumors, including BTC. However, despite significant progress, the use of immunotherapy for the treatment of BTC is still in its early stages, and the evidence for its use is mixed, possibly due to inaccurate grouping based on the expression of programmed death ligand 1, a reliable candidate biomarker if carefully handled. Here, we reviewed the outcomes of camrelizumab, an Food and Drug Administration-approved anti-PD-1 ICI, combined with chemotherapy or targeted therapy in patients with advanced BTC.

Methods: Patients with advanced BTC treated with camrelizumab in combination with chemotherapy or targeted therapy as the first-line therapy from September 2020 to September 2023 were included in this retrospective, non-randomized and single-center design study. Treatment efficacy and treatment-related adverse events were subjected to statistical analysis.

Results: Fifteen patients were enrolled in this study. The mean age of the patients was 62 years (ranging from 25 to 75 years old), comprising 9 males and 6 females. The pathological diagnoses included 11 cases of intrahepatic cholangiocarcinoma, 1 case of extrahepatic cholangiocarcinoma, and 3 cases of gallbladder carcinoma. Among them, 5 cases diagnosed at stage IIa were deemed inoperable for surgery due to anticipated insufficient residual liver volume. Additionally, there were 5 cases classified as stage IIIb and 5 cases as stage IV. Seven patients achieved a partial response, and the study had an overall response rate of 46.7%. Seven patients had stable disease, with a disease control rate of 93.3%. At the cut-off date of September 30, 2023, the median follow-up time was 15.7 months (range, 1.7–33 months). The patients had a median progression-free survival time of 18 months (95% confidence interval: 12.4–not reached). Of the patients, nine (60.0%) were deemed eligible for surgery. Six patients (40%) developed grade III neutropenia, one (6.7%) developed grade IV neutropenia, and one (6.7%) developed grade III thrombocytopenia.

Conclusions: The application of camrelizumab as neoadjuvant therapy in the treatment of patients with advanced BTC showed encouraging efficacy and safety.

Keywords: Advanced biliary tract cancer (advanced BTC); immunotherapy; chemotherapy; biomarker

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Introduction

Biliary tract cancer (BTC) is an aggressive neoplasm that is prone to resistance to chemotherapy and has poor overall survival (OS). Its incidence continues to increase annually, especially for intrahepatic form (1). Surgical resection has long been considered the only curative treatment for BTC. However, as the symptoms of the disease tend to be non-specific, most patients are diagnosed at a late stage. Only less than one-third of patients have the opportunity to undergo curative surgery, resulting in an all-stage 5-year OS rate of no more than 20% (1-4). For patients with advanced BTC, the median OS has been reported to be as short as 3.3–4.5 months (1).

Conversion surgery after neoadjuvant chemotherapy can improve the median OS of patients with advanced BTC, but the outcomes remain unsatisfactory, and may include severe and potentially fatal adverse events (AEs) (5-9). Further, there is no standard second-line therapy for BTC. In the ABC-06 clinical trial, which was one of the first prospective randomized clinical trials, the OS time was only 1 month longer in patients who received the FOLFOX6 regimen (folinic acid, fluorouracil, and oxaliplatin) than those who received placebo (2).

Recent molecular insights into BTC have paved the way for the development of targeted therapies, significantly improving treatment outcomes, with immune checkpoint inhibitors (ICIs) potentially serving as additional supporters (10).

In recent years, ICIs have been recognized as an effective treatment for many solid tumors, overall. In the first-line treatment of BTC, the strategy of combining chemotherapy with immunotherapy has shown promising prospects. For example, in the TOPAZ-1 study, the addition of durvalumab to the cisplatin and gemcitabine (GC) regimen as first-line treatment for unresectable, locally advanced, or metastatic BTC significantly improved progression-free survival (PFS) and OS in patients (11). This finding provides important evidence for the application of immunotherapy in BTC. Additionally, in the KEYNOTE-966 study, the addition of pembrolizumab to the GC regimen also demonstrated similar efficacy, further confirming the potential of chemotherapy combined with immunotherapy in the first-line treatment of BTC (12). However, despite these positive results, the use of immunotherapy for the treatment of BTC is still in its early stages, the question of combinatory treatment strategy with chemo- and targeted therapy is still unanswered and its outcomes have been controversial (13). In this study, we evaluated the efficacy and safety of camrelizumab, a Food and Drug Administration approved anti-PD-1 ICI, combined with chemotherapy or targeted therapy in patients with advanced BTC. We present this article in accordance with the STROBE reporting checklist (available at https://jgo.amegroups.com/article/view/10.21037/jgo-2025-184/rc).

Highlight box

Key findings

- In this study, 15 patients had a median progression-free survival time of 18.0 months, while the median survival time was not reached. The overall response rate reached 46.7%.

What is known, and what is new?

- Biliary tract cancer (BTC) is an aggressive malignancy with poor overall survival until now despite comprehensive insight into the molecular mechanism of carcinogenesis.
- The new perspective is combinatory immunotherapy might help improve the prognosis of advanced BTC.

What is the implication, and what should change now?

- Camrelizumab combined with chemotherapy shows potential efficacy for this population. And we should revise the previous notion that the prognosis of biliary tract malignancies can only rely on surgical intervention or chemotherapy.

Methods

Patient selection

This retrospective, non-randomized, single-center design study included advanced BTC patients identified from Department of General Surgery, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University who had received camrelizumab as immunotherapy combined with chemotherapy between September 2020 and September 2023. To be eligible for inclusion in this study, the patients had to meet the following inclusion criteria: (I) have a histologic or cytologic diagnosis of BTC (intrahepatic cholangiocarcinoma, extrahepatic cholangiocarcinoma, or

Table 1 Demographic and clinical data of the study population

Characteristics	Values (n=15)	P value†
Age (years)	62 [25–75]	n.a.
Sex		0.61
Male	9 (60.0)	
Female	6 (40.0)	
BMI (kg/m^2)	22.4±3.1	n.a.
TNM		0.002
IIa	5 (33.3)	
IIIb	5 (33.3)	
IVa	1 (6.7)	
IVb	1 (6.7)	
IV	3 (20.0)	
Targeted therapy		>0.99
Yes	7 (46.7)	
No	8 (53.3)	
Surgery		0.61
Yes	9 (60.0)	
No	6 (40.0)	
Chemotherapy		0.007
GEMOX	5 (33.3)	
GAP	8 (53.3)	
None	2 (13.3)	
Type		0.02
Intrahepatic cholangiocarcinoma	11 (73.3)	
Gallbladder carcinoma	3 (20.0)	
Extrahepatic cholangiocarcinoma	1 (6.7)	

Data are presented as median [range], n (%) or mean ± SD. †, using the one-sample binomial test or sequence test. BMI, body mass index; GAP, nab-paclitaxel + gemcitabine + cisplatin; GEMOX, gemcitabine + oxaliplatin; n.a., not applicable; SD, standard deviation; TNM, Tumor-Node-Metastasis.

gallbladder carcinoma); (II) have not previously received immunotherapy or systemic treatment; (III) have at least one measurable lesion as defined by the Response Evaluation Criteria in Solid Tumors (RECIST; version 1.1); and (IV) have an Eastern Cooperative Oncology Group performance status score of 0–2. The basic information of patients is shown in *Table 1*. Written informed consent to participate in the immunotherapy study was obtained from all patients before the combination therapy began. Patient-identifying information was accessed during and after data collection. The study was approved by the Ethics Committee of Sir Run Run Shaw Hospital (approval No. 2024-0072), and conducted in accordance with the principles set forth in the Declaration of Helsinki and its subsequent amendments.

Treatment

During the study period, camrelizumab (200 mg) was administered every 3 weeks in combination with gemcitabine + oxaliplatin (GEMOX) chemotherapy and targeted therapy (anlotinib), targeted therapy only (anlotinib), or nab-paclitaxel + gemcitabine + cisplatin (GAP) chemotherapy. A modified GEMOX regimen was used, which consisted of 1,000 mg/m^2 of gemcitabine on days 1 and 8 and 85 mg/m^2 of oxaliplatin on day 1 of a 3-week cycle. The GAP regimen consisted of 800 mg/m^2 of gemcitabine, 25 mg/m^2 of cisplatin, and 125 mg/m^2 of nab-paclitaxel on days 1 and 8 of a 3-week cycle. For the patients treated with GAP who experienced severe AEs, gemcitabine was continued at a dosage of 800 mg/m^2 on days 1 and 8 while the dosage of cisplatin was reduced to 20 mg/m^2 on days 1 and 8 and that of nab-paclitaxel was reduced to 100 mg/m^2 on days 1 and 8. Anlotinib was administered daily at a dose of 12 mg. Treatment was continued until disease progression, intolerable toxicity, or death. The chemotherapy dosage was adjusted further according to tolerability as necessary.

Endpoints and safety assessments

The primary endpoints of the study were the surgical rate after conversion therapy, the secondary endpoints include the OS time, the disease control rate (DCR), and the proportion of patients who had a complete response (CR), partial response (PR), or stable disease (SD) as per the RECIST (version 1.1) and the rate and severity of treatment-related AEs. OS was defined as the period from the date of diagnosis to the date of the most recent follow-up or death. AEs were assessed using the Common Terminology Criteria for Adverse Events (version 4.0) (https://pubmed.ncbi.nlm.nih.gov/22502948/) and the clinical practice guidelines for the management of toxicities from immunotherapy published by the European Society for Medical Oncology (www.esmo.org/).

Statistical analysis

Baseline characteristics, laboratory data, imaging findings,

and the grade and frequency of AEs were examined using descriptive statistics. Continuous variables were compared using the Student's *t*-test, and categorical variables were compared using the Chi-squared test or Fisher's exact test. The intravariable heterogeneity was tested by one-sample binomial or sequential test and one-sample Kolmogorov-Smirnov-Poisson test, too. Survival times and rates were estimated using the Kaplan-Meier method with the log-rank test. Estimated medians with 95% confidence intervals (CIs) were determined. A Cox proportional hazards model was used for the subgroup analysis to estimate the hazard ratios for OS and PFS. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA), SAS (version 9.4; SAS Institute Inc., Cary, NC, USA), and R (version 3.3.0; The R Foundation for Statistical Computing, Vienna, Austria). Statistical results were considered significant at $P<0.05$.

Results

Patents characteristics

In total, 18 patients were initially diagnosed with advanced BTC during the study period. Of these patients, three refused any treatment, and 15 received camrelizumab as immunotherapy in combination with chemotherapy and/or targeted therapy. The mean age of the patients was 62 years (ranging from 25 to 75 years old), comprising 9 males and 6 females. The pathological diagnoses included 11 cases of intrahepatic cholangiocarcinoma, 1 case of extrahepatic cholangiocarcinoma, and 3 cases of gallbladder carcinoma. Among them, 5 cases diagnosed at stage IIa were deemed inoperable for surgery due to anticipated insufficient residual liver volume. Additionally, there were 5 cases classified as stage IIIb and 5 cases as stage IV. All patients received camrelizumab (200 mg) at 3-week intervals. Of the patients, five received camrelizumab with GEMOX and anlotinib for two to six cycles.

Survival outcomes

All of the patients were deemed eligible for surgery, and while none of the patients were down-staged after the initial treatment, four patients achieved R0 resection, and only one patient had a positive vascular margin. Two patients continued to receive two cycles of GEMOX treatment and survived to the end of this study. One patient received one cycle of GEMOX and died 6 months after diagnosis due to viral pneumonia. One patient received Chinese traditional medicine and survived till the end of this study. One patient refused any further treatment and died from viral pneumonia with an OS time of 27 months. Moreover, among these five patients, one female patient was initially diagnosed with gallbladder cancer with brain metastasis. After neurosurgery, she was transferred to the Chemotherapy Department, and achieved partial remission. Radical resection of the gallbladder carcinoma was performed after a multidisciplinary team discussion. Some 18 months later, she was found to have isolated para-aortic metastasis and underwent further surgery after another multidisciplinary team discussion. To date, she has not relapsed.

Two patients refused to undergo any chemotherapy, and only received camrelizumab with anlotinib. Of these two patients, the female patient had previously received 39 cycles of treatment and was alive at the end of this study, while the male patient had received ten cycles of immune plus targeted therapy, followed by radiotherapy for one cycle at a local hospital, and died 3 days after radiotherapy from an unknown cause. The remaining eight patients received camrelizumab with GAP. Of these eight patients, one was diagnosed with stage IIa with multiple liver metastases, one was diagnosed with stage IIa with middle hepatic vein invasion, four were diagnosed with stage IIIb accompanied by adjacent organ invasion or distant lymph node metastasis, and two were diagnosed with stage IV with distant metastasis. Of these patients, four received modified doses of cisplatin and nab-paclitaxel after the initial three cycles treatment, and all of them achieved partial remission, while only two achieved downstaging. The other four patients underwent radical surgery, and three achieved R0 resection. Of the patients, three continued the modified GAP regimen for two to four cycles, but the others refused any further treatment.

Taken together, seven patients achieved a PR, and had an overall response rate (ORR) of 46.7%; seven patients achieved SD, and the DCR was 93.3%; one patient had progressive disease and had an OS time of 5 months. At the cut-off date of September 30, 2023, the median follow-up time was 15.7 months (range, 1.7–33 months), 11 patients were still alive, the median survival time had not been reached, and the median PFS time was 18.0 months (95% CI: 12.4–not reached) (*Figure 1*). In total, nine patients (60.0%) were deemed eligible for surgery.

Safety

The major treatment-related AEs are summarized in

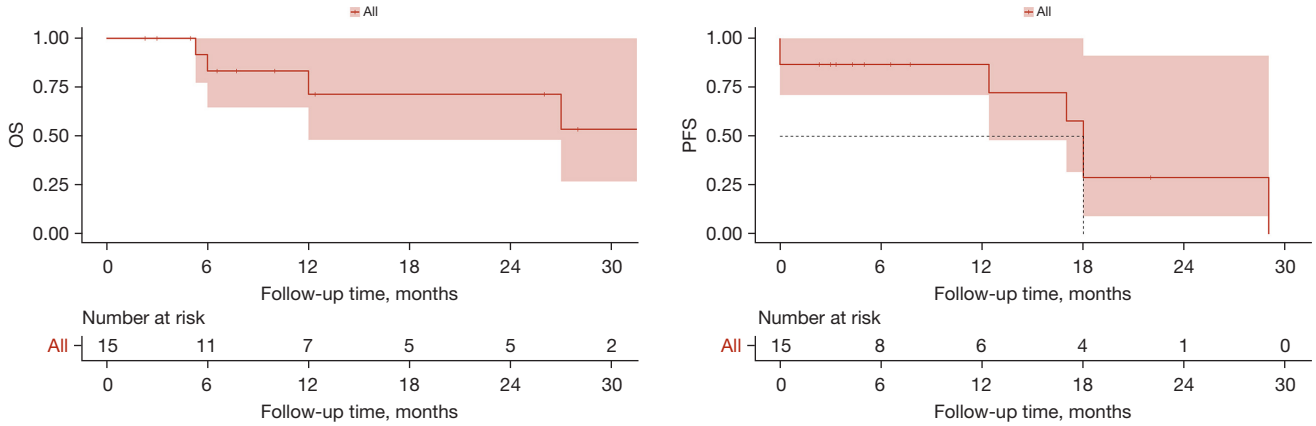

Figure 1 Overall survival and progression-free survival. OS, overall survival; PFS, progression-free survival.

Table 2. The most common AEs of any grade were neutropenia (n=12, 80%), thrombocytopenia (n=8, 53.3%), liver dysfunction (n=8, 53.3%). Immune-related AEs were observed in a subset of patients, with reactive cutaneous capillary endothelial proliferation (RCCEP) occurring in 4 patients (26.7%). Targeted therapy-related AEs were also noted in some patients, with hypertension reported in 2 patients (13.3%).

A subset of patients experienced grade III or higher severe AEs. Specifically, six (40%) developed grade III neutropenia, one (6.7%) developed grade IV neutropenia, and one (6.7%) developed grade III thrombocytopenia. No grade III or higher immune-related AEs or targeted therapy-related AEs were observed.

Subgroup analyses

Inflammatory status, tumor stage, the surgical strategy used, and the use of targeted therapy were not found to be associated with survival.

Discussion

BTC is one of the most malignant tumors, for which the best curative treatment continues to be surgery (14). Most BTC patients are diagnosed at a late stage, and have a 5-year OS rate of less than 20% (1-4). Adjuvant chemotherapy is an important treatment that improves the prognosis of BTC patients (15). Since the ABC-02 study showed that gemcitabine combined with cisplatin has better efficacy than gemcitabine alone, several combination regimens that include gemcitabine had been established, including GEMOX, gemcitabine + S1 (GS), and gemcitabine + nab-paclitaxel (GA), all of which have significantly improved the OS of patients with BTC (5-7,16). The recently established GAP regimen, which includes gemcitabine, nab-paclitaxel, and cisplatin, has been shown to have better efficacy than the traditional treatment, with a PFS time of up to 11.8 months and an OS time of up to 19.2 months. However, severe AEs are common during chemotherapy, and the improvement in OS remains unsatisfactory. The SWOG1815 study found that the GAP regimen did not result in any significant improvements in OS compared to GC (17).

Currently, there are no standard second-line regimens for advanced BTC. ABC-06 was the first prospective randomized clinical trial and was conducted in the UK (2). In that trial, the OS time improved from 5.3 months in the group that received active symptom control (ASC) alone to 6.2 months in the group that received ASC + FOLFOX (P=0.03). Further, the ASC group had 6- and 12-month OS rates of only 35.5% and 11.4%, respectively, while those of the ASC + FOLFOX group reached 50.6% and 25.9%, respectively.

Immunotherapy has shown promising results in the treatment of various types of solid tumors, including gastrointestinal cancer (18-21), but controversy about the outcomes continues (22-24). First, the results of ICI as monotherapy have been unsatisfactory. In the KEYNOTE-158 study, pembrolizumab monotherapy had mild clinical activity in patients with unresectable or metastatic BTC, and an ORR of 5.8%, a median OS time of 7.4 months (95% CI: 5.5–9.6), and a median PFS time of 2.0 months (95% CI: 1.9–2.1) (24). In KEYNOTE-028,

Table 2 Treatment-related adverse events

Characteristics	Values (n=15)	P value†
Granulocytopenia		<0.001
None	3 (20.0)	
Grade I	1 (6.7)	
Grade II	4 (26.7)	
Grade III	6 (40.0)	
Grade IV	1 (6.7)	
Thrombocytopenia		0.03
None	7 (46.7)	
Grade I	5 (33.3)	
Grade II	2 (13.3)	
Grade III	1 (6.7)	
Liver dysfunction		0.03
None	7 (46.7)	
Grade I	6 (40.0)	
Grade II	2 (13.3)	
Kidney dysfunction		0.03
None	14 (93.3)	
I grade	1 (6.7)	
Immune-related adverse events		0.03
None	11 (73.3)	
RCCEP grade I	4 (26.7)	
Targeted therapy-related adverse events		0.03
None	13 (86.7)	
Hypertension	2 (13.3)	

Data are presented as n (%). †, using the one-sample Kolmogorov-Smirnov-Poisson test. RCCEP, reactive cutaneous capillary endothelial proliferation.

which is a large ongoing phase II, single-arm, open-label cohort study of pembrolizumab in BTC, pembrolizumab monotherapy had an ORR of only 13.0%, a median OS time of 5.7 months (95% CI: 3.1–9.8), and a median PFS time of 1.8 months (95% CI: 1.4–3.1) (25). Camrelizumab monotherapy failed to improve the OS or PFS of patients with advanced BTC, who showed almost no response to the treatment (20).

However, immunotherapy combined with chemotherapy or targeted therapy might be an option for the treatment of advanced BTC (26-28). The TOPAZ-1 and KEYNOTE-966 trials assessed the use of GC with or without ICI in the treatment of advanced BTC, and confirmed the role of immunotherapy combined with chemotherapy as a management strategy for advanced BTC (29). In a real-world retrospective study, immunotherapy combined with chemotherapy had a better OS time (11 months) than chemotherapy alone (8 months) (30). In a retrospective non-randomized study, a combination of camrelizumab plus apatinib as second-line therapy for previously treated advanced BTC had a median OS time of 13.1 months, and a PR rate of 19% and a DCR of 71.4% (18). In a single-arm prospective pilot study by Yu *et al.*, camrelizumab combined with chemotherapy had an ORR of 14.3%, and a DCR of 64.3% (23). Sun *et al.* reported that a combination of a programmed death-1 (PD-1) inhibitor plus chemotherapy had a median OS time of 14.9 months, which was significantly longer than the median OS time of 4.1 months achieved by monotherapy using a PD-1 inhibitor (31). A recently published Chinese study reported that nivolumab combined with chemotherapy had an ORR of 33.3% and an OS time of 15.4 months, which were considerably better than the ORR of 3.3% and the median OS time of 5.2 months achieved by nivolumab monotherapy (14). Thus, ICI may improve the efficacy of BTC treatment when combined with other regimens, such as chemotherapy or targeted therapy.

In this study, we reviewed the outcomes of camrelizumab combined with chemotherapy or targeted therapy in patients with advanced BTC at our center, Sir Run Run Shaw Hospital, School of Medicine, Zhejiang University. As mentioned above, five patients received camrelizumab as immunotherapy, GEMOX as chemotherapy, and anlotinib as targeted therapy; two patients received camrelizumab and anlotinib; and eight patients received camrelizumab and GAP as chemotherapy. At the data cut-off time, 11 patients were still alive, the median survival time had not been reached, and the median PFS was 18.0 months (95% CI: 12.4–not reached) (*Figure 1*). In total, nine patients (60.0%) were able to proceed to surgery. The median operation time was 245.0±50.7 min (range, 185–340 min) and the median blood loss was 222.2±213.6 mL (50–700 mL). Of the patients, three had a small amount of postoperative pleural effusion, one had secondary atelectasis, one had secondary pulmonary infection, and two had secondary branch pulmonary infarction. The symptoms of all patients demonstrated marked improvement subsequent to the administration of symptomatic treatment.

Given the high rate of non-responsible events, reliable biomarkers need to be identified to predict the immunotherapy response. Mismatch repair deficiency (dMMR), the tumor mutational burden (TMB), and

microsatellite instability (MSI) have been suggested as candidate biomarkers (19,20,32,33). In BTC, patients with dMMR/high MSI had an ORR of up to 71% when treated with pembrolizumab (34); however, only 3–10% had the dMMR phenotype or a high TMB (19,31). Further, data from a clinical study confirmed the responsible efficacy of the treatment in patients with microsatellite-SD (32). All the responders in the KEYNOTE-158 study were microsatellite-stable, and only one case had high MSI in the KEYNOTE-028 study.

Programmed death ligand 1 (PD-L1) protein expression is considered a potential marker in many solid cancers (32). In BTC, up to 72.2% of the PD-L1 expressed is wild-type, which suggests that PD-L1 holds promise as a biomarker (21). However, PD-L1 is greatly influenced by the staining assays used (35), and could not predict prognosis in the KEYNOTE-158 or KEYNOTE-028 studies (20,25). In one recent study, PD-L1 failed to demonstrate efficacy as a predictive marker in BTC (14). In other studies, PD-L1 expression in tumor cells acted as a predictor to indicate the potential prognosis of antitumor immunotherapy, and its expression in tumor-infiltrating cells may predict an unfavorable prognosis (36-39). Notably, different PD-L1 cut-off values may have different value in predicting the immunotherapy response in BTC (21,25). PD-L1 expression has still not been validated as a biomarker of the response to ICI therapy in patients with gastrointestinal malignancies, with the exception of esophagogastric cancers (40). Therefore, we did not evaluate these biomarkers in our patients. According to our results, there appears to be no need to find biomarkers for immunotherapy in BTC.

Recently, the proportion of inflammatory cells in peripheral blood has been shown to be a potential biomarker in patients with solid tumors. Low lactate dehydrogenase (LDH) and the neutrophil-to-lymphocyte ratio (NLR) have been reported to be biomarkers for immunotherapy in the treatment of advanced pancreatic cancer (41). In a retrospective study (42), a low NLR (<5) and a low LDH level (<240 IU/L) were found to be associated with better survival in patients with non-small cell lung cancer. Further, a monocyte-to-lymphocyte ratio >0.31, a NLR >5, and a platelet-to-lymphocyte ratio of >135 were found to be poor prognostic predictors in patients with advanced gastric or colorectal cancer receiving anti-PD-1 therapy (43). However, the proportion of inflammatory cells in peripheral blood did not have any predictive value in immunotherapy (*Figure 2*). This might be due to the small number of cases and unique pathology of BTC.

This study had several limitations. First, this is a retrospective study, the sample size is small and is insufficient for a stratified analysis, and no control group was present, which resulted in a statistical bias. Second, the study sample comprised heterogenous subtypes of BTCs with three cases of gallbladder cancer, 11 cases of intrahepatic cholangiocarcinoma, and one case of extrahepatic cholangiocarcinoma. The biological characteristics of these tumors are distinct and heterogenous. Third, the treatment regimens in this study were not uniform, and the tumor stages were also varied, resulting in disparities in the tumor treatment efficacy. The primary objective of this study is to assess the safety and efficacy of camrelizumab in patients with biliary malignancies. Due to the retrospective nature of the study, the combination therapy regimen was not strictly standardized during its design phase. The choice between the GEMOX or GAP regimens was primarily determined based on the patients' physical condition and treatment compliance. While this approach may introduce potential biases into the data analysis, it does not undermine the feasibility of conducting a preliminary investigation into the efficacy of camrelizumab in treating biliary malignancies. Therefore, this study provided preliminary findings on the application of camrelizumab in initially unresectable BTC tumors, but more large-sample sized and randomized controlled trials need to be conducted in the future.

In conclusion, BTC is an aggressive malignancy with short OS. Traditional chemotherapies have not achieved satisfactory outcomes in the treatment of advanced BTC. Immunotherapy can improve the prognosis of BTC patients but should be combined with chemotherapy or other therapies. It appears further validation of biomarkers is needed in BTC.

Conclusions

The application of camrelizumab as neoadjuvant therapy in patients with advanced BTC showed encouraging efficacy and safety. Combination therapy involving targeted therapy or chemotherapy is recommended, as it is likely to enhance treatment efficacy.

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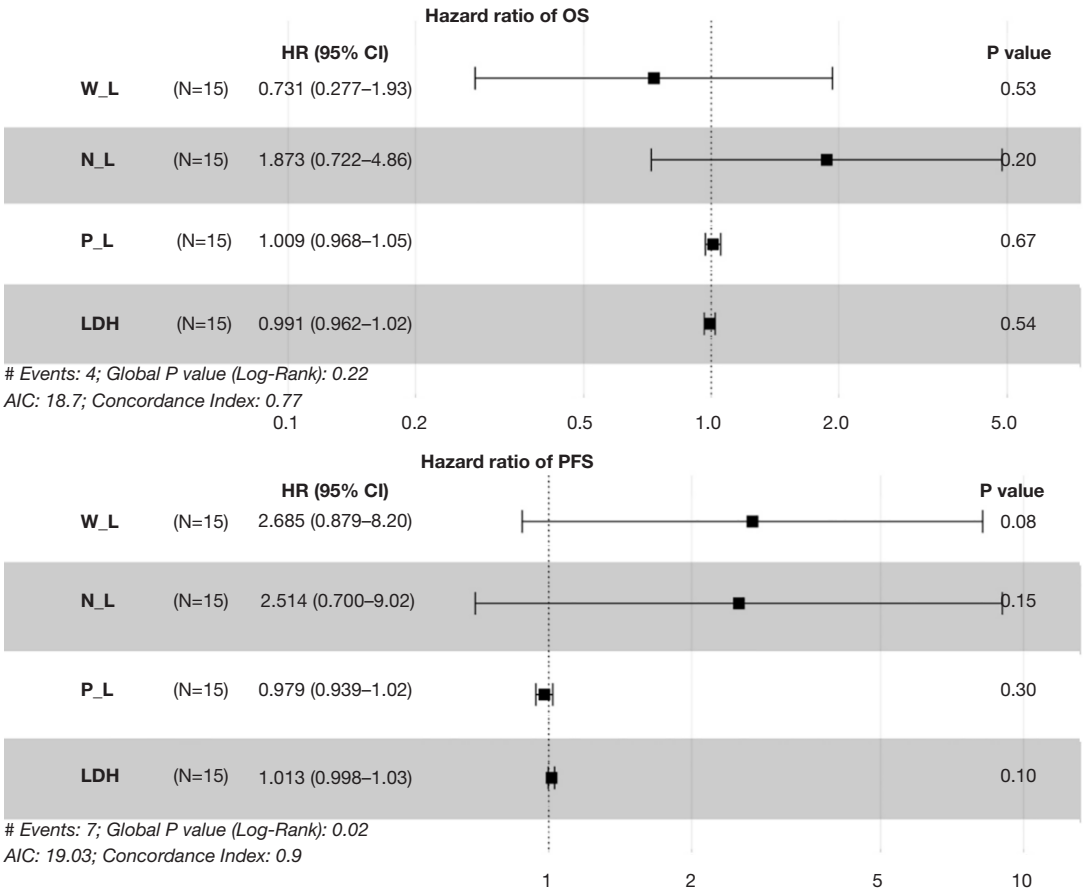

Figure 2 Multivariate Cox regression model of OS (upper panels) and PFS (lower panels) events in patients taking camrelizumab. Adjusted variables include W/L, N/L, P/L, and LDH level. AIC, Akaike Information Criterion; CI, confidence interval; HR, hazard ratio; LDH, lactate dehydrogenase; L, lymphocytes; N, neutrophils; OS, overall survival; P, platelets; PFS, progression-free survival; W, white blood cells.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jgo.amegroups.com/article/view/10.21037/jgo-2025-184/rc

Data Sharing Statement: Available at https://jgo.amegroups.com/article/view/10.21037/jgo-2025-184/dss

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Written informed consent to participate in the immunotherapy study was obtained from all patients before the combination therapy began. The study was approved by the Ethics Committee of Sir Run Run Shaw Hospital (approval No. 2024-0072), and conducted in accordance with the principles set forth in the Declaration of Helsinki and its subsequent amendments.

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