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Analysis of Influencing Factors of Post-TACE Fever

Ting Wu[1,*] *and Guangming Xiang*[1]

[1] Guangyuan Central Hospital Affiliated to North Sichuan Medical College, Guangyuan 628000, Sichuan, China

SUMMARY: *Post-embolisation fever is relatively common after transarterial chemoembolisation (TACE) for hepatocellular carcinoma (HCC), and because it resembles postoperative infection, it is a problem to be managed in the early post-operative period. This retrospective cohort study took 182 patients with HCC who received TACE at Guangyuan Central Hospital between January 2018 and December 2023. Fever was defined as a body temperature of* $\geq 37.3\,^{\circ}C$ *during the postoperative observation period, and infection was determined based on clinical signs, laboratory results, microbiological data and imaging findings. Fever after TACE occurred in 65 people (35.71%), and there were also 14 cases of postoperative infection (7.69%). Multivariable logistic regression indicated that a tumour diameter > 5 cm, iodized oil dose > 5 mL and the use of drug-eluting microspheres increased the odds of postoperative fever, while age ≥ 60 years was associated with a reduced adjusted odds of fever. Portal vein tumour thrombus and ascites are both independently associated with postoperative infection. Among the febrile patients, the time to the first fever and peak temperature did not differentiate between infectious and non-infectious fevers, but the duration of fever was longer in infectious fever compared to non-infectious fever. Based on the above results, post-TACE fever should be evaluated in conjunction with the extent of the tumor, severity of embolization, presence of portal vein invasion, ascites, continued fever, and so on, to avoid unnecessary antibiotics for all cases.*

KEYWORDS: *hepatocellular carcinoma; transarterial chemoembolization; post-embolization fever; postoperative infection; logistic regression; drug-eluting microspheres*

1 Introduction

Hepatocellular carcinoma is still one of the severe cancers in the world. According to the 2022 GLOBOCAN update, liver cancer has become one of the top causes of death from cancer globally and is concentrated in East and Southeast Asia. Based on the above epidemiological background, most hospitals treating large numbers of unresectable or intermediate-stage HCC patients use local control strategies as the main treatment approach [1].

According to the latest recommendations by the international community, TACE is now one of the standard options for locoregional therapy in patients with good liver function who have undergone arterial chemoembolisation (ACE). Both the AASLD guidelines and the ESMO clinical practice guidelines recommend treatment based on the amount of liver reserve, tumour burden, vascular invasion, performance status and feasibility of other curative or

*15281706273@163.com
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systemic options [2, 3]. Postoperative fever is thus a problem in practice because it occurs at the interface between the expected embolic injury and clinically significant infection.

TACE creates ischaemia in the tumour by selectively catheterising the tumour-feeding arteries, delivering chemotherapeutic drugs and then blocking these arteries. Traditional TACE usually uses a chemotherapeutic emulsion containing iodized oil and an embolic agent, and drug-eluting beads or drug-loaded microspheres are employed for embolisation and sustained local drug release. The 2023 Korean Liver Cancer Association's practical recommendations list post-embolization syndrome as the most frequent adverse event following TACE, and non-infectious fever, pain, nausea and vomiting are its characteristic signs [4].

Recently, many studies have focused on the safety characteristics of drug-eluting bead TACE. A 2025 updated meta-analysis of observational studies showed that DEB-TACE had a good radiologic response and survival outcomes compared to conventional TACE, and the overall complication rates of the two approaches were relatively close [5]. The current group did not evaluate anti-cancer effect; however, it did contain procedural factors that directly affect embolization intensity, such as the amount of iodized oil and the use of drug-loaded microspheres. Fever after TACE is often due to a larger area of necrosis, an increase in inflammatory mediators and local ischemia, and the burden of treatment materials.

The diagnosis problem is that post-embolisation fever and infection have overlapping initial features. Fever in the first few days after TACE is often self-limited, but prolonged high fever, chills, abdominal pain, elevated inflammatory markers, ascites infection, or imaging findings of abscess should be excluded. Reports of complications following transarterial treatment have shown that liver abscess is a rare but serious adverse event after TACE, and, in addition, evidence summaries on post-TACE embolisation syndrome have focused on symptom monitoring and risk stratification rather than automatic intensification of treatment [6, 7].

Therefore, the two clinical problems of this study were a fever after TACE and a post-operation infection. To determine the clinical and procedural factors of fever, to identify preoperative indicators of infection, and to know whether the time at which fever occurs, its duration or the peak temperature can distinguish between infectious fevers and non-infectious post-embolisation fevers.

2 Materials and Methods

2.1 Study design and patient cohort

A single-center retrospective cohort study was carried out on the medical records of patients with HCC who received TACE at Guangyuan Central Hospital from January 1, 2018, to December 31, 2023. The sections of the patient management system were: geriatrics, infectious diseases, gastroenterology and interventional treatment. The analytical unit was the patient-level TACE admission record, and the postoperative observation window extended to day 10 after surgery or discharge, whichever came first.

Patients met the diagnostic criteria for HCC at the time of study, were between 18 and 82 years old, and had not received radiotherapy, systemic chemotherapy, immunotherapy, active extrahepatic infection, or antibiotic exposure in the prespecified preoperative period. Patients were excluded if TACE was combined with other surgical operations, if emergency embolisation of ruptured HCC was necessary, or if there was a hepatic arteriovenous fistula, iodine allergy, multiple metastases, other malignant tumours, pregnancy or lactation, or incomplete records that prevented analysis. The final group had 182 people.

The path of analysis is shown in Figure 1. The three analytic targets in the figure are a fever model, an infection model, and a comparison of fever subgroups; therefore, they use different denominators and should not be merged in interpretation.

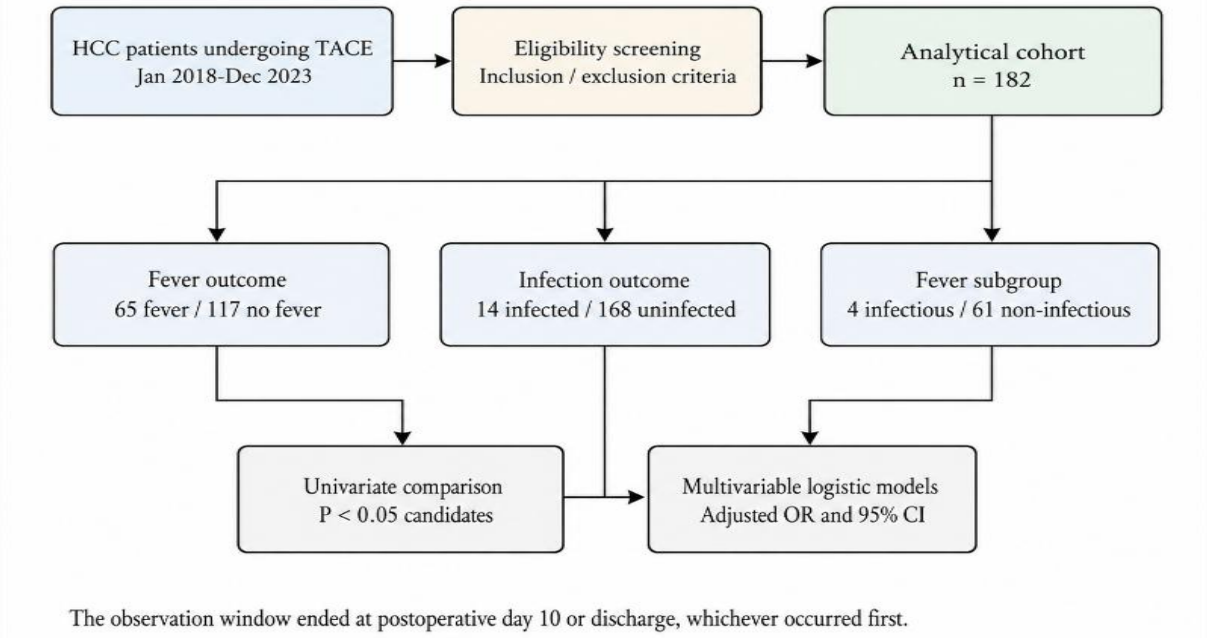

Figure 1: Retrospective Cohort and Analysis Pathway.

As shown in Figure 1, the fever comparison was based on 65 febrile and 117 non-febrile patients, and the infection comparison was based on 14 infected and 168 uninfected patients. Only the 65 febrile patients were included in the fever subgroup analysis, and among them, 4 had infectious fever and 61 did not.

2.2 Variables and outcome definitions

The four domains of the collected variables. Baseline variables include sex, age, body mass index (BMI), diabetes mellitus, gallstones, preoperative white blood cell count, albumin, alanine aminotransferase (ALT), alpha-fetoprotein (AFP), Child-Pugh grade, CNLC stage, tumor number, tumor location, tumor size, portal vein tumor thrombus (PVTT), and ascites. The variables of the procedure are how much iodised oil is used, whether drug-eluting microspheres were used, which type of gelatin sponge or gelatin particle was selected, and the operating time.

Postoperative fever was defined as a body temperature of $\geq 37.3^{\circ}\mathrm{C}$ at any time during the observation. For each febrile patient, the time of the first fever, duration of fever and maximum temperature were collected. The clinical characteristics of the illness, signs and symptoms, blood tests, C-reactive protein levels, procalcitonin values, microbiological cultures (when available), imaging results, etc., all help to diagnose it together. To enhance the international readability of the definition of infection, it has been harmonised with the CDC/NHSN approach, which requires active review of clinical, laboratory, pharmacy, radiology and admission-discharge-transfer data sources in healthcare-associated infection surveillance [8].

Regression model: YF=1 means that the patient had a fever after surgery, and YF=0 means that they did not. The outcome of infection was coded as YI=1 for postoperative infection and YI=0 for no postoperative infection. Continuous variables were included in the

group comparison, and clinically meaningful thresholds for multivariable models were set for age, tumor diameter, iodized oil dose, and operation time.

2.3 Statistical analysis and formulas

SPSS 26.0 was employed for statistical analysis. Distributional Form of Quantitative Variables Normally distributed data are presented as mean ± standard deviation, and an independent-samples t-test is performed. Non-normally distributed variables were expressed as medians and interquartile ranges, and a Mann-Whitney U test was used for comparison. Categorical variables were presented as cases and percentages, and either a chi-square test or an exact test was used based on the size of the cell count.

Variables with P<0.05 in univariate comparison, together with clinically necessary candidates, were entered into multivariable logistic regression models. The general model was expressed as Equation (1), where Y_i indicates fever or infection status, $X_{i,k}$ indicates the kth clinical or procedural predictor, and beta k is the corresponding regression coefficient.

$$logit[P(Y_i = 1)] = \ln\left(\frac{P(Y_i=1)}{1-P(Y_i=1)}\right) = \beta_0 + \beta_1 X_{i,1} + \beta_2 X_{i,2} + \cdots + \beta_k X_{i,k} \quad (1)$$

Adjusted odds ratios and confidence intervals were calculated from the regression coefficient and its standard error as shown in Equation (2).

$$\mathrm{OR}_k = exp(\beta_k), \qquad 95\%\ \mathrm{CI} = exp(\beta_k \pm 1.96 \times \mathrm{SE}(\beta_k)) \quad (2)$$

For non-normally distributed fever-pattern variables, rank-based comparison was conducted using the Mann-Whitney framework in Equation (3), where R_1 is the sum of ranks in group 1, n1 and n2 are group sizes, and N is the total sample size.

$$Z = \frac{R_1 - \frac{n_1(N+1)}{2}}{\sqrt{\frac{n_1 n_2 (N+1)}{12}}} \quad (3)$$

All the tests were two-sided, and P<0.05 was considered statistically significant. Since the number of infected individuals was small, more attention was paid to the effect size, confidence interval width and biological plausibility of the infection model.

3 Results

3.1 Incidence of postoperative fever and infection

Among the 182 eligible patients, 65 developed a post-operative fever and thus had an incidence of 35.71%. There were 14 cases of postoperative infection, and the rate was 7.69 per hundred. Among the febrile patients, 4 were classified as infectious fever and 61 as non-infectious fever. Fever and infection occur at different times; therefore, most of the fever episodes after TACE in this study were not caused by infection.

3.2 Baseline and procedural factors associated with postoperative fever

Table 1 shows that patients with and without a fever after TACE have different clinical and procedural characteristics. The group comparison was kept because it shows which variables were included in the clinical screening before multivariable modelling. The descriptive row for tumour size was used as a coded tumour-size grade in the available table, and the

regression model employed the clinically interpretable threshold of tumour diameter >5 cm.

Table 1: Comparison of Clinical and Procedural Characteristics in the Fever Group and Non-Fever Group.

Clinical characteristic	No fever (n=117)	Fever (n=65)	Statistic	P value
Sex (male/female)	99/18	61/4	3.350	0.067
Age (years)	57 (52.00, 64.75)	54 (48.00, 58.00)	-2.206	0.027
BMI (kg/m2)	22.69 (20.66, 24.34)	22.65 (21.21, 24.02)	-0.549	0.583
Diabetes mellitus (yes/no)	7/110	1/64	1.964	0.161
White blood cell (×10^9/L)	4.47 (3.54, 5.96)	4.27 (3.40, 5.82)	-0.772	0.440
Albumin (g/L)	38.55 (35.25, 41.60)	38.80 (33.90, 42.30)	-0.354	0.723
ALT (U/L)	36.00 (23.00, 54.00)	36.00 (23.00, 55.00)	-0.166	0.868
AFP (ng/mL)	53.95 (3.29, 1035.20)	133.76 (9.90, 1965.00)	-1.915	0.056
Tumor-size grade	1.00 (1.00, 2.00)	2.00 (1.00, 2.00)	-3.684	<0.001
Child-Pugh grade (A/B)	110/7	57/8	2.210	0.137
Number of tumors (1/>1)	56/61	36/29	0.946	0.331
Tumor location (left/right/bilateral)	14/78/25	12/42/11	1.654	0.437
Portal vein tumor thrombus (yes/no)	12/105	21/44	13.688	<0.001
CNLC stage (Ia-IIa/IIb-IIIa)	95/22	53/12	0.003	0.955
Ascites (yes/no)	20/97	8/57	0.735	0.391
Gallstones (yes/no)	6/111	4/61	0.085	0.771
Iodized oil dose (mL)	5.00 (5.00, 8.00)	8.00 (6.00, 10.00)	-4.732	<0.001
Drug-eluting microspheres (yes/no)	39/78	43/22	18.182	<0.001
Gelatin particles (yes/no)	17/100	11/54	0.184	0.668
Operation time (min)	80.00 (60.00, 100.00)	90.00 (79.00, 120.00)	-2.645	0.008

Note: Values are presented as the median (interquartile range), mean ± standard deviation, or number of cases, depending on the type and distribution of the variable. $P<0.05$ is taken as the threshold.

The fever group was younger, had a higher grade of tumor size, more frequent PVTT, a higher dose of iodized oil, more frequent use of drug-eluting microspheres, and a longer operation time. The number of white blood cells and albumin in the two groups were not statistically different according to the available table, and therefore, they were not considered to be independent predictors in the analysis.

3.3 Multivariable model for postoperative fever

Table 2 shows the adjusted associations of the multivariable fever model. Age ≥60 years had a lower adjusted odds of fever. Tumor diameter > 5 cm, iodized oil dose > 5 mL, and drug-eluting microsphere use were all still associated with fever. PVTT and operation time were

not significantly different after adjustment.

Table 2: Multivariable logistic regression analysis of postoperative fever after TACE.

Influencing factor	OR	95% CI	P value
Age ≥60 years	0.372	0.159-0.870	0.023
Tumor diameter >5 cm	2.233	1.019-4.890	0.045
Portal vein tumor thrombus	2.375	0.957-5.893	0.062
Iodized oil dose >5 mL	2.758	1.166-6.525	0.021
Drug-eluting microspheres	2.675	1.159-6.175	0.021
Operation time ≥120 min	1.300	0.849-1.991	0.227

The modified model and the infection model are shown in Figure 2. Both models were plotted on the same odds-ratio axis, and it was shown that fever and infection had partially different risk profiles.

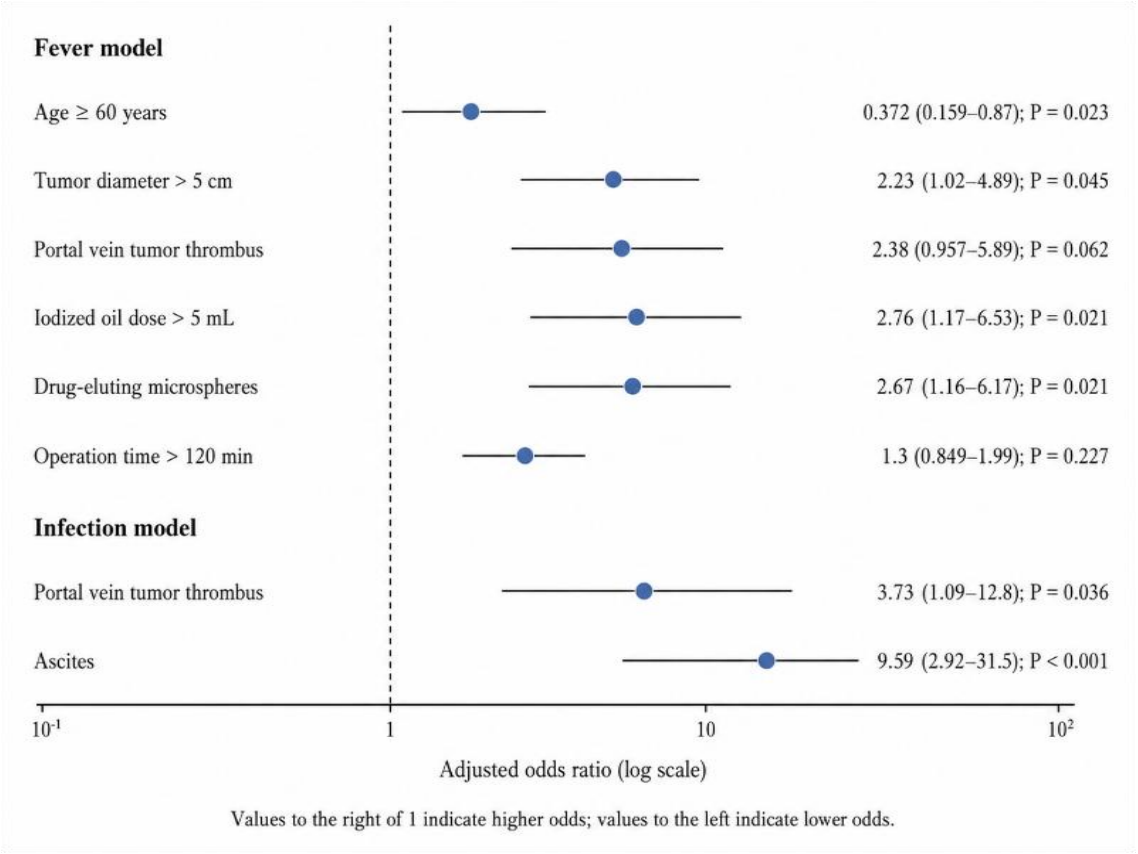

Figure 2: Adjusted odds ratios for postoperative fever and postoperative infection.

As shown in Figure 2, the most severe fever-related procedural variables were iodized oil dose >5mL and the use of drug-eluting microspheres; the most serious infection-related factor was ascites. The non-significant PVTT row in the fever model is still clinically relevant because PVTT was significant in the infection model.

3.4 Factors associated with postoperative infection

Table 3 shows the infected and uninfected groups. Infection was not frequent, but between the two groups, PVTT and ascites showed the most significant associations with postoperative

infection. Tumor diameter and iodized oil dose had higher median values in the infected group, but their P values did not reach the preset significance level.

Table 3: Comparison of Clinical and Procedural Features in Infected vs. Uninfected Patients.

Clinical characteristic	Uninfected (n=168)	Infected (n=14)	Statistic	P value
Sex (male/female)	148/20	12/2	1.245	0.793
Age (years)	56 (51.00, 64.00)	53 (48.00, 56.00)	-0.991	0.322
BMI (kg/m2)	22.66 (20.76, 24.23)	22.86 (21.34, 22.86)	-0.549	0.583
Diabetes mellitus (yes/no)	161/7	13/1	0.272	0.602
WBC (×10^9/L)	4.43 (3.43, 5.96)	3.63 (2.92, 5.88)	-1.273	0.203
Albumin (g/L)	38.40 ± 4.95	37.14 ± 46.72	0.923	0.357
ALT (U/L)	34.50 (23.00, 53.00)	43.00 (32.00, 68.00)	-0.441	0.659
AFP (ng/mL)	62.70 (5.05, 1385.40)	319.60 (5.10, 1089.90)	-0.441	0.659
Tumor diameter (cm)	4.50 (2.30, 8.00)	6.80 (4.60, 10.20)	-1.741	0.087
Child-Pugh grade (A/B)	154/14	13/1	0.024	0.876
Number of tumors (1/>1)	84/84	8/6	0.264	0.608
Tumor location (left/right/bilateral)	24/110/34	2/10/2	0.314	0.860
Portal vein tumor thrombus (yes/no)	27/141	6/8	6.246	0.012
CNLC stage (Ia-IIa/IIb-IIIa)	135/33	13/1	1.329	0.249
Ascites (yes/no)	20/148	8/6	20.316	<0.001
Gallstones (yes/no)	9/159	1/13	0.079	0.778
Iodized oil dose (mL)	6.00 (5.00, 8.00)	10.00 (5.00, 10.00)	-1.737	0.082
Drug-eluting microspheres (yes/no)	73/95	9/5	2.226	0.132
Gelatin particles (yes/no)	24/144	4/10	2.026	0.155
Operation time (min)	90.00 (60.00, 110.00)	85.00 (80.00, 90.00)	-0.227	0.820

WBC: White blood cell count; ALT: Alanine aminotransferase; AFP: Alpha-fetoprotein; CNLC: China liver cancer staging.

The infected group had a higher proportion of PVTT and ascites. The two indicators are poor portal perfusion and a decompensated intra-abdominal fluid status; they are directly associated with infection vulnerability and may be affected by fever.

Table 4 is the multivariable infection model. PVTT increased the adjusted odds of infection by 3.729 times, and ascites increased them by 9.591 times. The wide confidence intervals are due to a small number of infected patients, but they do not indicate that the associations have no direction or clinical significance.

Table 4: Multivariate Logistic Regression Analysis of Postoperative Infection After TACE.

Influencing factor	OR	95% CI	P value
Portal vein tumor thrombus	3.729	1.086-12.804	0.036
Ascites	9.591	2.922-31.479	<0.001

According to the infection model, postoperative infection is likely in patients with preoperative PVTT and ascites, even if there is no early fever. This is necessary because the infection risk cannot be explained by the same variables that predicted non-infectious post-embolization fever.

3.5 Relationship between fever characteristics and postoperative infection

Among the 65 febrile patients, infectious and non-infectious fevers were classified based on the time to the first fever, duration of fever and peak temperature. Table 5 shows that only the duration of the fever was statistically different among the groups for this factor.

Table 5: Comparison of Fever Patterns in Infectious and Non-infectious Fever.

Fever category	Cases	Time to first fever (days)	Fever duration (days)	Peak temperature (°C)
Infectious fever	4	1 (1.00, 1.75)	7 (5.50, 11.50)	38.20 (38.13, 39.40)
Non-infectious fever	61	2 (1.00, 3.00)	2 (1.00, 3.50)	38.50 (38.20, 38.80)
Z value	-	-1.096	-3.100	-0.535
P value	-	0.273	0.002	0.593

Figure 3 is the same as the comparison shown in an interval plot. Avoid over-emphasising the peak temperature; as the medians of the peak temperatures for both groups are similar, the duration difference will be clearer.

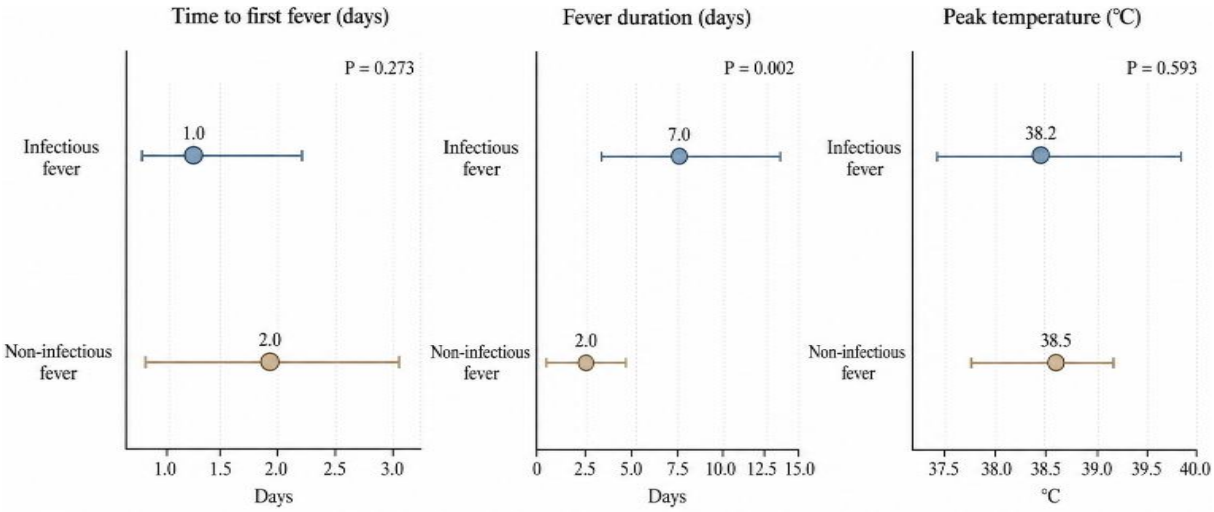

Figure 3: Median and Interquartile Range of Fever Pattern Indicators in Infectious and Non-Infectious Fevers.

The medians of the lengths of fever were 7 days for infectious fever and 2 days for non-infectious fever. The Time to first fever and peak temperature were not statistically different. Therefore, a prolonged fever is more indicative of the illness in this group than a sudden high temperature or a brief high temperature.

4 Discussion

This paper reduced the original large question of fever after TACE into two more focused ones: factors predicting post-treatment fever and factors predicting post-treatment infection. A

fever after TACE is relatively common, and infections are less likely and have a different management strategy. The proportion of the group with a fever was 35.71%, and the proportion with a postoperative infection was only 7.69%. The fever was within the range of wide postembolisation syndrome reported in the literature, and although the frequency of infection was lower than that of fever, most of the early fever episodes after TACE were not infectious.

White blood cell counts were not significantly different between the fever group and the non-fever group in the available data. Therefore, the fever model indicates that fever was more closely associated with the extent of tumour burden and embolization intensity than with the initial leukocyte level in this group.

Tumour diameter >5 cm: Increased odds of fever after adjustment. The above results are in line with the mechanism of post-embolisation fever. Generally speaking, a large tumour needs to be covered by a larger area for embolisation, will have a larger area of necrosis after arterial occlusion, and may cause more severe inflammation. Previous research on post-embolisation fever after TACE has also correlated fever with tumor burden, embolisation dose and drug-eluting bead treatment [9, 10]. The current group has been added as a local dataset, and tumor diameter was still independently associated with the outcomes after correcting for procedural factors.

Iodized oil dose >5 mL was also relatively large. Iodized oil can be used to deliver drugs and induce embolisation; a high volume is likely to be associated with a large or highly vascularised lesion and may lead to ischaemic injury of the surrounding liver tissue. Therefore, the results can be regarded as a joint index of treatment burden and embolization intensity. A low dose is not necessarily suitable; depending on how large the tumour is, whether it is vascularised, and how well the liver is functioning in a person, a higher dose may be required.

Drug-eluting microspheres alone increased the odds of fever in this group. Microspheres can cause mechanical embolism and prolonged local drug concentration, so they are biologically feasible. Previous studies have shown that the safety characteristics of DEB-TACE differ depending on the particle size, embolization selectivity, tumor load and liver function, and the significance of fever after chemoembolization has not been the same in all studies [11]. At present, the use of drug-eluting microspheres in this dataset should be considered a special case requiring closer observation of symptoms rather than being labelled as against indications.

Age ≥ 60 years had an attenuated adjusted odds of fever. This result needs to be saved precisely; otherwise, the amount of inflammation and the way the tumour is located will vary in different grades, along with other factors of admission. Cytokines, immune senescence markers and the exact time of perioperative medication administration were not measured. It can be assumed that the younger patients in this group were more likely to have an objective increase in temperature after TACE, but it does not mean that older patients are more prone to all sorts of complications.

The infection model was not a fever model. PVTT and ascites were independent risk factors for infection; high doses of iodized oil and drug-eluting microspheres mainly predicted fever. PVTT reduces portal perfusion reserve and may harm hepatic tolerance to arterial embolisation. Ascites is the result of a reduced hepatic reserve and modified peritonitis-immune microenvironment that raises the risk of bacterial translocation or spontaneous infection. Reviewing the complications of transarterial treatment, the following are considered risk factors for serious infectious or hepatobiliary complications: PVTT, hypoalbuminemia, biliary risk factors, diabetes, and drug-eluting beads [12].

Based on recent retrospective studies of the risks of D-TACE infection, these infection results are in agreement. A 2025 study on postoperative infection after drug-eluting

transarterial chemoembolisation found that liver function status, operation time and preoperative albumin were all associated with the risk of infection [13]. The current group did not exhibit the same independent risk factors, but it was also found that infection after TACE is more closely associated with impaired hepatic reserve and procedure intolerance than with fever alone.

Among the variables discriminating infectious from non-infectious fever in this study, only persistent fever met this criterion. The first day of fever was the same in both groups, and the peak temperatures did not differ between infection and post-embolisation inflammation. Therefore, it is necessary to avoid starting antibiotics based solely on a fever and high temperature in the early stages. Based on the data, a relatively high monitoring threshold has been set; persistent fever, especially when accompanied by PVTT, ascites, increased inflammatory markers, abdominal symptoms, or suspicious imaging findings, requires active infection investigation.

Liver abscess and intra-abdominal infection are still rare but serious after TACE. A Frontiers in Oncology study on liver abscess after TACE reported that patients with abscess may have delayed drainage-tube removal and poorer outcomes, and listed diabetes, biliary abnormalities, large tumour size and portal vein occlusion as risk factors [14]. Although the current group did not focus only on abscess, it still shows that imaging and culture tests need to be carried out for prolonged fever after embolization.

Therefore, the clinical management will be risk-stratified. Patients with large tumours, high doses of iodized oil and drug-eluting microspheres, need to be closely monitored for fever, pain, nausea and inflammation in the following days. Patients with PVTT or ascites have a lower threshold for infection workup, including repeated blood counts, C-reactive protein, procalcitonin, culture (when indicated), ascites assessment (when clinically feasible), and contrast-enhanced imaging (if fever persists or abdominal signs develop). Evidence summaries of post-TACE embolisation syndrome also support personalised perioperative care rather than a generalised uniform escalation [15].

A perioperative monitoring pathway can be established according to the above results without needing to expand the scope of this study. Before TACE, patients with PVTT or ascites should be regarded as infection-vulnerable. Record the volume of iodized oil and microsphere use during the procedure as structured exposure variables, rather than just as operative notes. TACE: Note the start day, how long it lasts, highest temperature, other symptoms and inflammation marker changes of the fever. Thus, this path will lead to accumulated fevers. A single temperature measurement shortly after embolization is not very informative; a combination of persistent fever, ascites status, portal vein occlusion and other objective signs of inflammation should be used instead.

The regression results also show that the treatment-intensity variables and the host-vulnerability variables are not the same. Tumour size, volume of iodinated oil, and use of microspheres are all related to the extent of embolic injury and necrosis. PVTT and ascites are related to hepatic perfusion reserve, the abdominal immune environment and infection susceptibility. When the two types of variables are combined in analysis, fever may be wrongly identified as an infection, and infection may be missed in the expected post-embolisation syndrome. Therefore, the analysis considers fever as a result that needs symptom control and infection as a result that requires diagnostic confirmation and specific antimicrobial treatment.

The language is the same as in the corresponding foreign studies. TACE, ascites, drug-eluting microspheres and portal vein tumor thrombus were all used in this paper. Uniformly name these so they can be compared with data from outside the study and avoid misinterpretation of end points.

The End result is restricted by the available choices. Fever prediction, infection prediction and fever-pattern discrimination were studied; therapeutic response, long-term survival and abscess-specific prognosis were not included in the dataset. Data support for risk-based surveillance: Fever predictors guide symptom monitoring; infection predictors guide diagnostic workup; and prolonged fever links the two paths.

A small number of cases needs to be described conservatively. The OR for ascites was relatively large and the confidence interval was above 1, but it was based on only 14 infected patients. It is not out of the question; rather, it is less precise. For EI-oriented reporting, a more justifiable way is to state that ascites was strongly associated with infection in this cohort and should be used as a monitoring flag, and external validation is needed before it can be converted into an official prediction score. PVTT is the same as the above. It was statistically significant and clinically reasonable in light of the perfusion mechanism, but the current sample size is too small for in-depth stratification of PVTT extent.

The length of the fever can be used clinically because it does not require additional costs. The middle size of the time lag for infectious and non-infectious fever was 5 days. A relatively quick-resolving fever after TACE can usually be managed with support if no other signs of infection are present. If the fever does not subside, if it reappears after a period without fever, or if there is an increase in abdominal pain, then re-examination will be carried out. The present study does not specify a general length limit, but it shows that the duration has more information in the available data than peak temperature.

The three figures are corresponding to the three layers of evidence. Figure 1 is the denominator logic, Figure 2 shows the comparison of adjusted effect sizes for fever and infection models, and Figure 3 explains why fever duration has a larger discriminatory value than fever onset or peak temperature. The above arrangement helps to separate cohort construction, predictor estimation and bedside interpretation.

The three centres of organisation for the post-operative path are as follows. The first checkpoint is the procedural risk immediately following TACE; that is, the diameter of the tumour, dose of iodinated oil and microspheres used, and other indicators of inflammatory symptoms are known. The second is host vulnerability; PVTT and ascites help identify patients who need closer infection monitoring even if a fever is consistent with post-embolization syndrome. The third checkpoint is continued fever; in this case, blood tests, C-reactive protein, procalcitonin, cultures, ascites status and imaging results need to be repeated.

This three-checkpoint path is suitable for antibiotic stewardship. Fever does not need to be treated with antibiotics, as most of the fever cases in this group were not due to infection. The reduction in fever is not a necessary and sufficient condition for this group of patients with PVTT and ascites; other risk factors for infection are also present. Based on the changes in fever and other risks before the operation, make clinical decisions.

The research also presents the P values and adjusted effect sizes of the reports. Some factors were statistically significant in the univariate analysis but not after accounting for others; others were independent predictors. Forest plots are used to avoid overemphasising P values and can show the size, direction and confidence intervals of each association. The infectious disease model had a large effect size but also a wide confidence interval due to a small proportion of infected individuals.

In light of the above research results, it is proposed as follows: TACE is still one of the many locoregional strategies for HCC, and systematic reviews of transarterial embolization approaches show that patient selection, tumor burden, treatment method and liver function all affect outcomes [16]. The BCLC treatment system has also put forward issues of stage progression and adaptation of treatment when it does not fit the patient's needs under the

general rules [17]. Fever and infection evaluation after TACE should therefore be included in the same individualised decision process.

The defects of this study. It was retrospective and single-center, and the number of infected patients was only 14. As a result, the confidence intervals of the infection model were relatively large. The above analysis did not include specifics such as chemotherapy drug dose, microsphere size, embolization aim, location of superselective catheter, timing of antipyretic administration or antibiotic application. The diagnostic label for infection was based on clinical records, laboratory tests, images and cultures that were available at the time; thus, subclinical or partially treated infections may have gone undetected. Future research will use a prospective registry and prespecified infection criteria, detail the procedural variables, and follow up after discharge.

This Design will also be comparable to external HCC cohorts.

Add new fields prospectively with fixed definitions to reduce chart-review ambiguity and missingness.

For future multicenter studies, the same variable structure will be used, and the following fields will be added: embolization endpoint, microsphere size, chemotherapy agent and dose, prophylactic medication, catheter selectivity, and post-discharge infection events. These variables can be used to build an empirically supported predictive model, and it will be determined whether the current associations hold true across different hospitals, operators and TACE methods.

Despite the above deficiencies, the study offers some targeted empirical evidence. Separate fever risk and infection risk, avoid unwarranted inference based on a normal baseline leukocyte count, and link cohort design, regression results and fever pattern interpretation. The results are more suitable for the postoperative monitoring plan of HCC patients after TACE.

5 Conclusion

Post-TACE fever and postoperative infection had different predictor patterns in this retrospective HCC cohort. Fever was mainly linked to a tumour diameter of >5cm, an iodized oil dose of >5ml and drug-eluting microsphere use, and infection was associated with PVTT and ascites. Fever duration, rather than the time to the first fever or the maximum temperature, was used to distinguish infectious from non-infectious fevers in the febrile group. Therefore, in the postoperative management of patients with portal vein involvement, ascites and persistent fever, procedure-related fever risk monitoring and infection-related observation should be implemented.

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