Original Article

Exploring the effect of microecological agents on postoperative immune function in patients undergoing liver cancer surgery: a systematic review and meta-analysis

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Background: Precision hepatectomy for primary liver cancer has been widely used in clinical practice. As an effective nutritional supplement to prevent endotoxemia and hepatic impairment, microecological agents have been used together with traditional enteral nutritional support substances in several clinical studies.

Methods: Chinese and English databases were searched using the terms "hepatocellular carcinoma", "hepatectomy", "microecological agents", and "microecological regulators". The search terms were "hepatocellular carcinoma", "liver resection", "microecological agents", and "microecological regulators". Meta-analysis was performed using RevMan 5.3 and Stata 13 software provided by the Cochrane system.

Results: Eleven randomized controlled trials (RCTs) were included in this study. Of these, all 11 described the correct method of random assignment; 8 described in detail the concealment of the assignment scheme; and 9 used blinding methods in the research. Microecological agents significantly reduced total bilirubin (TBIL) levels [mean difference (MD)=−0.10, 95% confidence interval (CI): (−0.14, −0.06), P<0.00001] of patients after hepatectomy. The alanine transaminase (ALT) levels [MD =−3.65, 95% CI: (−14.65, 7.34), P=0.52], aspartate aminotransferase (AST) levels [MD =−0.64, 95% CI: (−6.87, 5.58), P=0.84], prothrombin level [MD=1, 95% CI: (−2.57, 4.57), P=0.58], and C-reactive protein (CRP) level [MD =−0.28, 95% CI: (−3.01, 2.45), P=0.84] among the included articles were statistically significant. However, probiotics could significantly reduce the risk of postoperative infection in patients with liver cancer (MD =0.23, 95% CI: (0.07, 0.79), P=0.02 <0.05), and did not significantly increase the risk of complications in patients with liver cancer [odds ratio (OR) =0.82, 95% CI: (0.38, 1.77), P=0.61].

Discussion: This study used meta-analysis to confirm that microecological agents can significantly improve the immune function of patients with hepatocellular carcinoma, and have alleviating effects on endotoxemia and hyperbilirubinemia.

Keywords: Microecological agents; hepatocellular carcinoma; hepatectomy; immune functionality; meta

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Introduction

Primary carcinoma of the liver (PLC), also referred to as hepatocellular carcinoma, is an epithelial malignancy that originates in the liver, of which more than 90% are hepatocellular carcinomas and the rest are cholangiocellular and mixed hepatocellular carcinomas (1). The etiology of primary hepatocellular carcinoma is not fully established, but may be related to viral hepatitis, aflatoxins, metabolic factors, genetic factors, and long-term alcohol and tobacco consumption (2). Patients with early stage liver cancer usually do not have obvious symptoms, but over time, patients may develop symptoms such as pain in the liver area, weakness, lack of appetite, and wasting (3). At present, surgery is considered to be the preferred treatment for liver cancer. The common surgical procedures for liver transplantation include hepatectomy and liver transplantation. Hepatectomy is the removal of the liver tumor and part of the surrounding liver tissue, which is suitable for those with good liver function and involves complete tumor removal during surgery (4).

Recent studies have shown that after liver resection in patients with liver cancer, a series of postoperative problems such as damage to the intestinal barrier, bacterial translocation, liver damage, and endotoxin translocation will occur in patients with liver cancer. Patients will experience varying degrees of oxidative stress after surgery, which will lead to varying degrees of damage to the intestinal mucosal barrier. If the body's stress response is excessive or dysregulated after liver resection in patients with liver cancer, endotoxins released by conditioned pathogens will cross the intestinal mucosal barrier in some way. A large amount of invasion of tissues other than the intestinal tract, which is normally sterile, will result in postoperative infection.

In patients with primary liver cancer with enema, routine enema before surgery and decreased bile secretion after surgery can cause changes in intestinal acidity and alkalinity, which can lead to imbalance of the flora in the patient's body (5). At the same time, the antibiotics used to prevent infection after the operation will kill the sensitive bacteria in the intestinal tract, making the resistant bacteria colonize in large numbers, destroying the normal distribution of the intestinal flora in the patient's body (6). Fasting after liver resection in patients will lead to a reduction in related amino acids and energy intake, which in turn induces a decrease in the permeability of the intestinal mucosa and a weakened barrier function (7). Intestinal flora imbalance and weakened intestinal barrier function have increased the incidence of complications after liver resection. Therefore, the postoperative nutritional supply of PLC patients will directly affect the postoperative recovery of patients.

In recent years, related studies on the nutritional supply of patients with PLC have confirmed that as a microecological regulator of the normal microbiota of the gastrointestinal tract, Microecological agents have a good effect in regulating the microecological balance of the intestinal flora of patients. At present, it has been used clinically in the prevention of colon cancer, acute pancreatitis, severe trauma patients and gastrointestinal fistula after rectal surgery. It has been proven that microbial preparations can significantly alleviate postoperative intestinal flora imbalance, intestinal barrier function damage, endotoxemia and hyperbilirubinemia caused by liver resection, and reduce liver damage to patients. There have been many reports on the use of Microecological agents for the prevention of endotoxemia and liver function damage after liver resection in PLC patients. It has been reported that Microecological agents can well help the resident flora in the gastrointestinal tract to compete for the adsorption sites of the intestinal epithelium, and can inhibit the colonization or reproduction of foreign microorganisms in the intestine (8,9), thereby reducing the risk of postoperative infection and complications of patients.

Therefore, relevant articles related to the use of Microecological agents in patients with PLC were selected for meta-analysis to evaluate the impacts of Microecological agents on the immune function of patients with liver cancer, aiming to provide a reference for the clinical application of microbial agents after hepatectomy. We present the following article in accordance with the PRISMA reporting checklist (available at https://dx.doi.org/10.21037/apm-21-2669).

Methods

Literature search

The China National Knowledge Internet (CNKI) (1979–2021.4), China Biomedical Literature Database (1994–2021.4), Cochrane Library (2005–2021.4), Medline (1948–2021.4), Embase (1966.1–2021.4), and other databases were electronically searched for relevant published randomized controlled trials (RCTs) on the use of microecological agents after liver surgery. Also, relevant literature in journals was hand-searched. Relevant literature was selected using a compound Boolean logical search. Chinese and English databases were searched using the following search terms: "hepatocellular carcinoma", "hepatectomy", "microecological agents", and "microecological regulators". The meta-analysis was performed using RevMan 5.3 and Stata 13 software provided by the Cochrane system.

The above search terms were freely combined, and the first screening of the initially-retrieved literature was performed by reading the titles and abstracts to exclude non-compliant articles and to identify relevant studies. A second screening was performed based on the inclusion and exclusion criteria, and the included literature was traced using a search engine. Finally, a third screening was performed to evaluate the quality of the articles by reading their full texts. The deadline for retrieval of all documents was June 10, 2021.

Literature inclusion/exclusion criteria

The inclusion criteria were as follows: (I) published RCTs of blank controls versus microecological agents for the prevention of post-hepatectomy complications; (II) research involving study subjects with a confirmed diagnosis of hepatocellular carcinoma and a child grade of A or B; and (III) studies involving microecological agents of type as probiotic dairy products or drugs, used for >7 days.

The exclusion criteria were as follows: (I) literature such as conference presentations, review articles, research reports, and lectures; (II) non-clinical RCTs; (III) JADAD score ≤2; and (IV) literature with inaccessible full text, incomplete data, or duplicate publications.

Observed indicators

The main indicators in this study were as follows: glutathione transaminase level, glutathione alanine transaminase level, interleukin-6 (IL-6) level, total bilirubin (TBIL) level, direct bilirubin (DBIL) level, and peripheral blood endotoxin level.

Data extraction

Data were extracted independently by two experts using Microsoft Excel, and consistent conclusions were obtained through discussion in cases of disagreement between the two experts. The following data was extracted from the included studies: authors, title, publication date, sample size, treatment protocol, evaluation index, duration of treatment, and efficacy. The quality of the literature was evaluated using JADAD scores based on the following criteria: (I) the study was randomized; (II) the randomization method was correct; (III) the study was double-blinded; and (IV) the description of double-blind hair. Each of the aforementioned aspects was scored 1 point; a total score ≤2 was considered a low-quality study, while a total score ≥3 was considered a high-quality study.

Risk of bias and quality assessment

The literature was independently screened by two experts according to the inclusion and exclusion criteria. The Cochrane Handbook Risk of Bias Assessment Tool for Randomized Controlled Trials was used to evaluate the risk of bias for the inclusion of RCTs. Specifically, the RCTs were evaluated based on whether the random assignment method was correct, whether the allocation protocol was concealed, whether the method was correct, selective reporting of study results, completeness of study data, as well as whether the study subjects, treatment protocols, and study results were blinded. The above entries were judged as “high risk of bias”, “low risk of bias”, and “unclear”, respectively.

Statistical analysis

Statistical analysis was performed using RevMan 5.3 software. The risk of bias assessment chart in RevMan 5.3 software was adopted to assess the risk bias of the included articles. The results of each included study were tested for heterogeneity by using the χ^2 test, in which continuous variable results were expressed as mean difference (MD) or standardized mean difference (SMD), and discontinuous variables were expressed as odds ratio (OR). All effects were expressed with a 95% confidence interval (CI). When the heterogeneity results P>0.01 and I^2<50%, it meant that the homogeneity of the results of each study was high, and the fixed-effects model was used for meta-analysis. When P<0.01 and I^2>50%, it showed that the heterogeneity of the results of each study was high, and the random effects model was used for meta-analysis. If the heterogeneity was too large, it was necessary to further carry out the sensitivity index of the index.

Results

Search results and basic information of the included literature

A total of 1,357 articles were screened in this study, of which 70 articles were repeatedly published, 81 articles

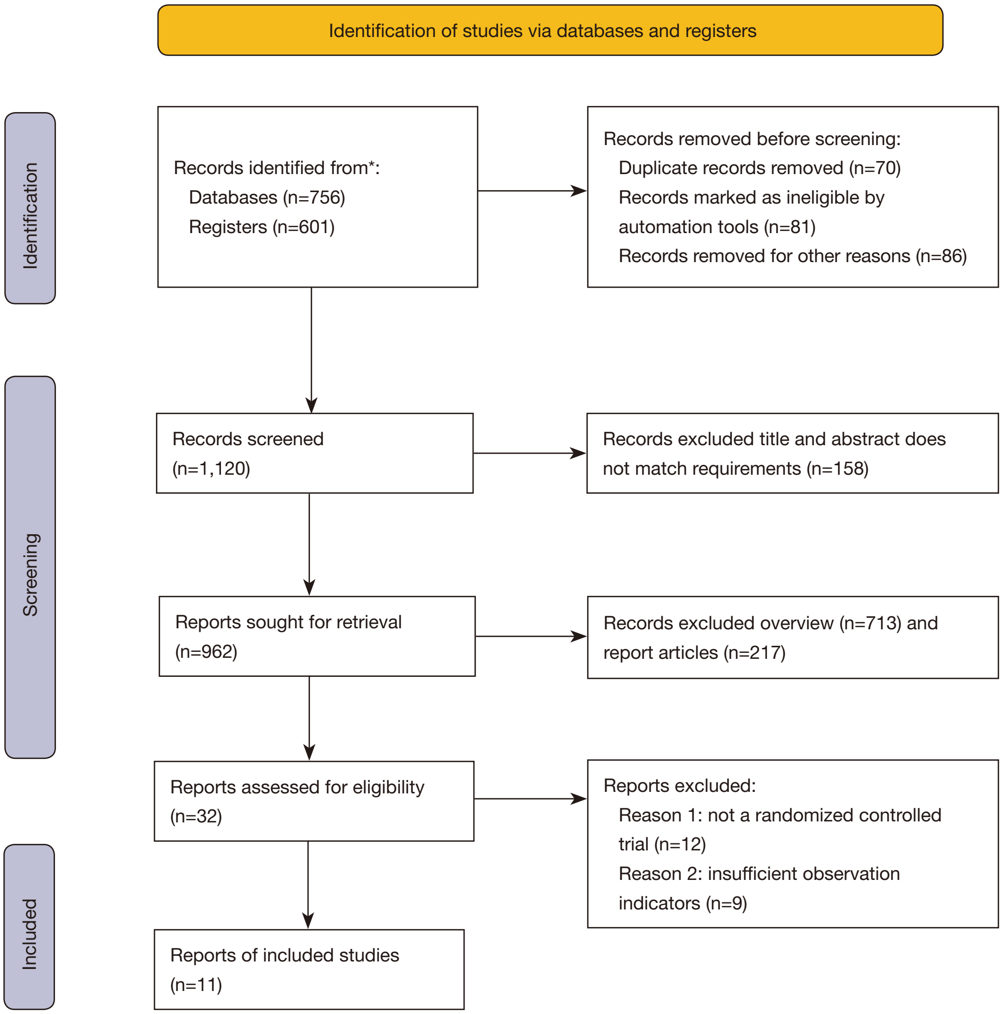

Figure 1 Literature search flowchart. *, consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

were marked as unqualified by automated tools, and 86 articles were eliminated due to other reasons. After the abstracts and titles of the articles were read, 158 articles were eliminated, leaving 962 articles. After the full texts were read, 713 review articles and 217 research reports were excluded, leaving 32 articles. After 12 articles with non-randomized controlled experiments and 9 articles with insufficient observation indicators were excluded, 11 articles were selected (*Figure 1*).

There were 11 articles (10-20) that met the inclusion criteria, and there were 788 patient cases. Among the 11 articles, they were all small-sample studies, with the sample size ranging from 9 to 68, and the age of the research subjects was all over 45 years old. The 11 articles described the sample size, experimental grouping, treatment plan, course of treatment, and JADAD score in detail. *Table 1* showed the basic characteristics of articles included.

Risk of bias evaluation results of the included studies

Figures 2,3 showed the results of multiple risk bias evaluations of included articles drawn by RevMan 5.3 software. In this study, among the 12 randomized controlled experiments, 11 described the correct random allocation method, accounting for 100%, and 8 described the hidden allocation plan in detail, accounting for 72.72%. There were 9 articles using blind method, accounting for 81.81%, and no blind method was used in the remaining articles.

Table 1 Basic characteristics of the included literature

Author	Year of publication	Number of cases		Treatment protocol		Treatment course	JADAD rating
		Microecological preparation group	Control group	Microecological preparation group	Control group		
Eguchi S (10)	2011	25	25	Synbiotics	No intervention, enteric nutrition	16	3
Grąt M (11)	2017	21	23	Probiotics	Placebo	30/90	4
Iida H (12)	2020	60	60	Clostridium butyricum and fibers	No intervention	<14, 14–70, >70	3
Kanazawa H (13)	2005	21	23	Bifidobacterium breve strain Yakult, Lactobacillus casei strain Shirota; prebiotic: galactooligo saccharides	No intervention, enteric nutrition	13	2
Liu Z (14)	2015	66	68	Lactobacillus plantarum, Lactobacillus acidophilus, Bifidobacterium longum	Placebo	16	3
Rayes N (15)	2002	31	32	Synbiotics	Placebo/inulin	13	4
Rayes N (16)	2005	33	33	Synbiotics	Placebo/fibers	13	3
Rayes N (17)	2012	9	10	Pediacoccus pentosaceus, Leuconostoc mesenteroides Lactobacillus paracasei subspecies paracasei, Lactobacillus plantarum; prebiotic: bioactive fibers: betaglucan, inulin, pectin, and resistant starch	Placebo/fibers	11	4
Rifatbegovic Z (18)	2010	60	60	Lactobacillus plantarum 2,362, L. paracasei subsp paracasei 19, Pediacoccus pentoseceus 5–33:3 and 32–77:1, L. raffinolactis and fibers	No intervention	10	2
Usami M (19)	2011	32	29	Lactobacillus casei strain Shirota, Bifidobacterium breve strain Yakult; prebiotic: galactooligosaccharides	No intervention	25	3
Zhang Y (20)	2013	34	33	Synbiotics	Enteric nutrition and fibers	7	4

Meta-analysis of the effects of microecological agents on patients' alanine aminotransferase (ALT)

Figure 4 was a forest diagram of the effects of Microecological agents on ALT in patients with liver cancer. Among the 11 articles included in the study, 4 articles described in detail the changes in the ALT levels of the Microecological agent group and the control group. The relevant data of the 4 articles were extracted to analyze the heterogeneity of the ALT levels of patients with liver cancer surgery. The results showed that chi-square test (Chi^2) =44.56, degrees of freedom (df) =3, I^2=93% >50%, and P<0.00001, indicating obvious heterogeneity. Statistical analysis using a random effects model showed that there was no significant difference between Microecological agents and placebo treatment in the control group on the ALT levels of patients with liver cancer after hepatectomy [MD

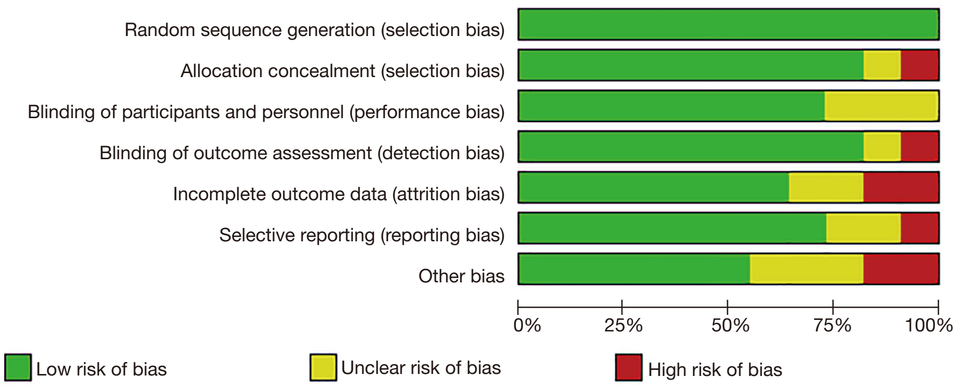

Figure 2 Results of risk bias evaluation of the included literature.

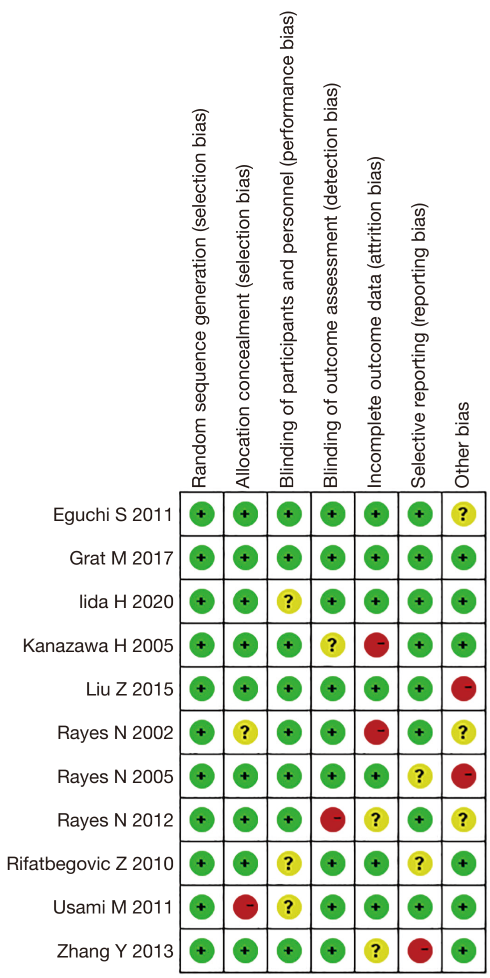

Figure 3 Results of multiple risk bias evaluations of the included studies. +, indicates low risk of bias; -, indicates high risk of bias; ?, indicates unclear.

=–3.65, 95% CI: (–14.65, 7.34), P=0.52].

Meta-analysis of the effect of microecological preparations on aspartate transaminase (AST) in patients

Figure 5 was a forest diagram of the effects of Microecological agents on AST in patients with liver cancer. Among the 11 articles included in the study, 4 articles described in detail the changes in the AST levels of the Microecological agent group and the control group. The relevant data of the 4 articles were extracted to analyze the heterogeneity of the AST levels of patients with liver cancer surgery. The results showed that Chi^2=9.03, df=3, I^2=67% >50%, and P=0.03, indicating obvious heterogeneity among the included articles. Statistical analysis using a random effects model showed that there was no significant difference between Microecological agents and placebo treatment in the control group on the AST levels of patients with liver cancer after hepatectomy [MD =–0.64, 95% CI: (–6.87, 5.58), P=0.84].

Meta-analysis of the impacts of Microecological agents on the prothrombin level of patients

Figure 6 was a forest diagram of the effects of Microecological agents on prothrombin level in patients with liver cancer. Among the 11 articles included in the study, 2 articles described in detail the changes in the prothrombin level of the Microecological agent group and the control group. The relevant data of the 2 articles were extracted to analyze the heterogeneity of the prothrombin level of patients with liver cancer surgery.

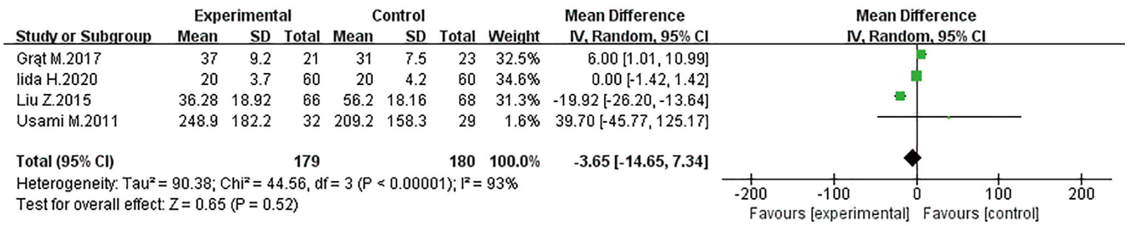

Figure 4 Forest plot of the effect of microecological agents on alanine aminotransferase in patients.

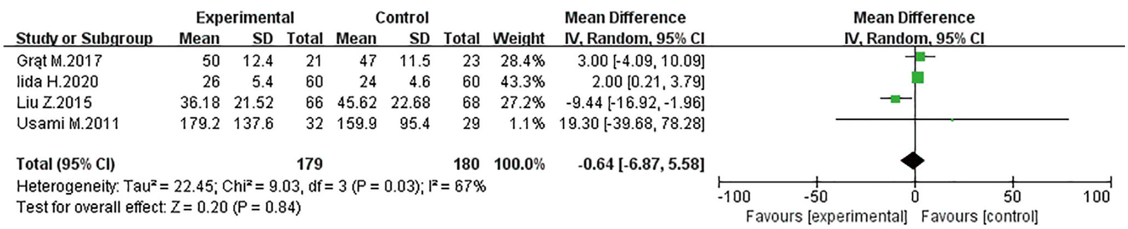

Figure 5 Forest plot of the effect of microecological agents on aspartate aminotransferase levels in patients.

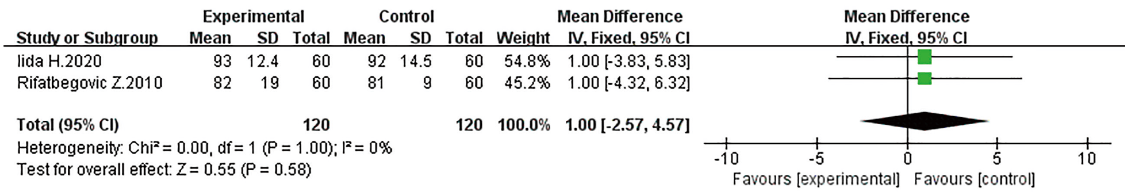

Figure 6 Forest plot of the impacts of microecological agents on the prothrombin level of patients.

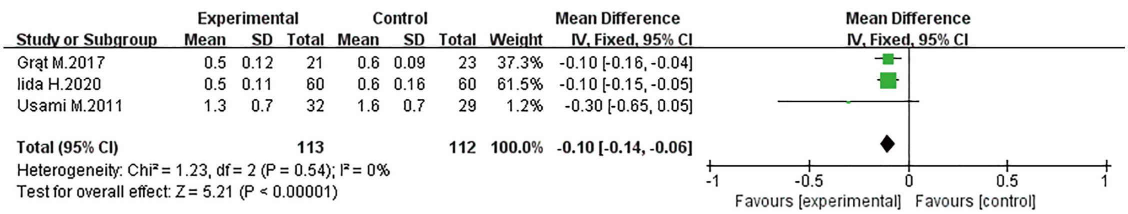

Figure 7 Forest plot of the impacts of microecological agents on patients' total bilirubin.

The results showed that Chi^2=0, df=7, I^2=0% <50%, and P=1, indicating good homogeneity among the included articles. Statistical analysis using a random effects model showed that there was no significant difference between Microecological agents and placebo treatment in the control group on the prothrombin level of patients with liver cancer after hepatectomy [MD =1, 95% CI: (−2.57, 4.57), P=0.58].

Meta-analysis of the impacts of Microecological agents on total bilirubin (TBIL) levels

Figure 7 was a forest diagram of the effects of Microecological agents on TBIL level in patients with liver cancer. Among the 11 articles included in the study, 3 articles described in detail the changes in the TBIL level of the Microecological agent group and the control group.

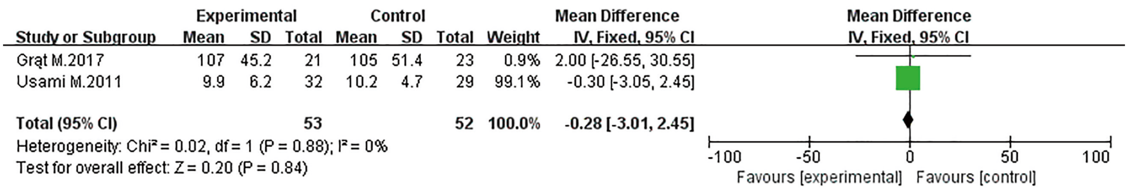

Figure 8 Forest plot of the impacts of microecological agents on C-reactive protein levels of patients.

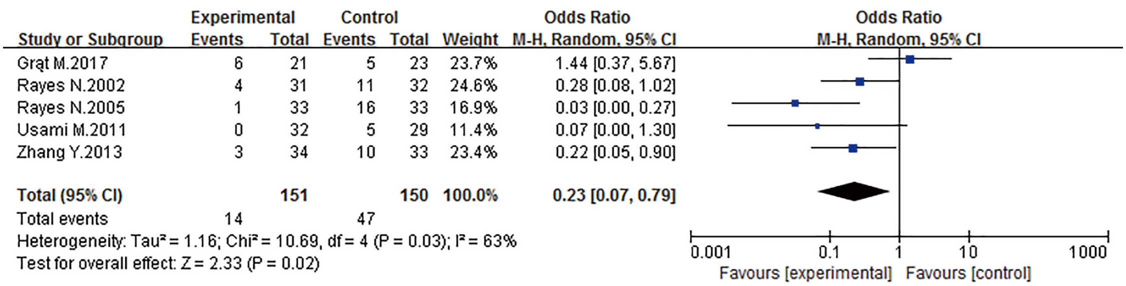

Figure 9 Forest plot of the impacts of microecological agents on incidence of postoperative infections of patients.

The relevant data of the 2 articles were extracted to analyze the heterogeneity of the TBIL level of patients with liver cancer surgery. The results showed that Chi^2=1.23, df=2, I^2=0% <50%, and P=0.54, indicating good homogeneity among the included articles. Statistical analysis using a random effects model showed that Microecological agents could greatly lower the TBIL contents of patients with liver cancer after hepatectomy [MD =−0.10, 95% CI: (−0.14, −0.06), P<0.00001].

Meta-analysis of the impacts of Microecological agents on patients' CRP

Figure 8 was a forest diagram of the effects of Microecological agents on CRP level in patients with liver cancer. Among the 11 articles included in the study, 2 articles described in detail the changes in the CRP level of the Microecological agent group and the control group. The relevant data of the 2 articles were extracted to analyze the heterogeneity of the CRP level of patients with liver cancer surgery. The results showed that Chi^2=0.02, df=1, I^2=0% <50%, and P=0.88, indicating obvious heterogeneity among the included articles in term of CRP level. Statistical analysis using a random effects model showed that Microecological agents could greatly lower the CRP contents of patients with liver cancer after hepatectomy [MD =−0.28, 95% CI: (−3.01, 2.45), P=0.84].

Meta-analysis of impacts of microecological agents on the incidence of postoperative infections in patients

Figure 9 was a forest diagram of the effects of Microecological agents on incidence of postoperative infections in patients with liver cancer. Among the 11 articles included in the study, 5 articles described in detail the changes in the incidence of postoperative infections of the Microecological agent group and the control group. The relevant data of the 5 articles were extracted to analyze the heterogeneity of the incidence of postoperative infections of patients with liver cancer surgery. The results showed that Chi^2=10.69, df=4, I^2=63% >50%, and P=0.03, indicating obvious heterogeneity among the included articles in term of incidence of postoperative infections. Statistical analysis using a random effects model showed that Microecological agents could greatly lower the incidence of postoperative infections of patients with liver cancer after hepatectomy [MD =0.23, 95% CI: (0.07, 0.79), P=0.02 <0.05].

Meta-analysis of the impacts of microecological agents on the incidence of postoperative complications in patients

Figure 10 was a forest diagram of the effects of

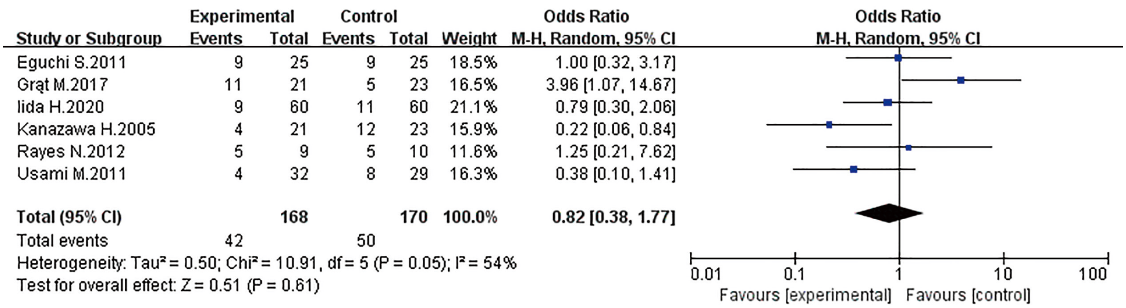

Figure 10 Forest plot of the impacts of microecological agents on incidence of postoperative complications of patients.

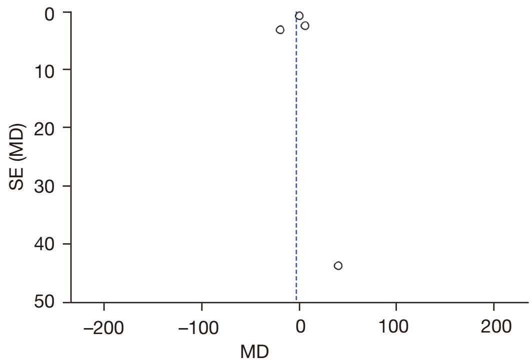

Figure 11 Funnel plot of postoperative alanine transaminase level excursions. SE, standard error; MD, mean difference.

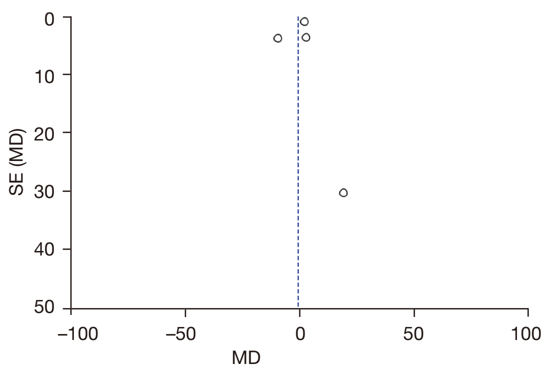

Figure 12 Funnel plot of postoperative aspartate aminotransferase level excursions. SE, standard error; MD, mean difference.

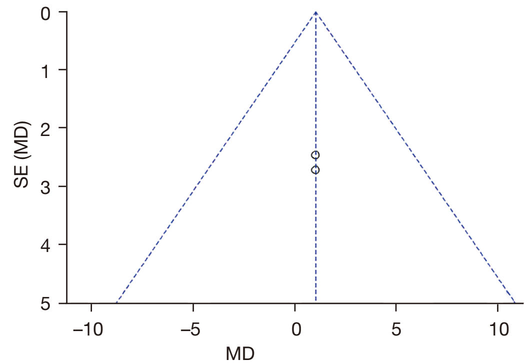

Figure 13 Funnel diagram of prothrombin level shift in patients with liver cancer after surgery. SE, standard error; MD, mean difference.

Microecological agents on incidence of postoperative complications in patients with liver cancer. Among the 11 articles included in the study, 6 articles described in detail the changes in the incidence of postoperative complications of the Microecological agent group and the control group. The relevant data of the 6 articles were extracted to analyze the heterogeneity of the incidence of postoperative complications of patients with liver cancer surgery. The results showed that Chi^2=10.91, df=5, I^2=54% >50%, and P=0.05, indicating obvious heterogeneity among the included articles in term of incidence of postoperative complications. Statistical analysis using a random effects model showed that the incidence of postoperative complications patients with liver cancer in the experimental group and control group was not statically obvious after hepatectomy [OR =0.82, 95% CI: (0.38, 1.77), P=0.61].

Publication bias results

Figures 11-17 showed the funnel charts of publication bias of the included articles. Among them, *Figures 11-17* were funnel charts based on the data of AST, ALT, prothrombin, bilirubin, CRP, postoperative infection, and postoperative complications, respectively. Some of the circles included in the study were basically concentrated on the midline and are basically symmetrical to the midline, indicating that there

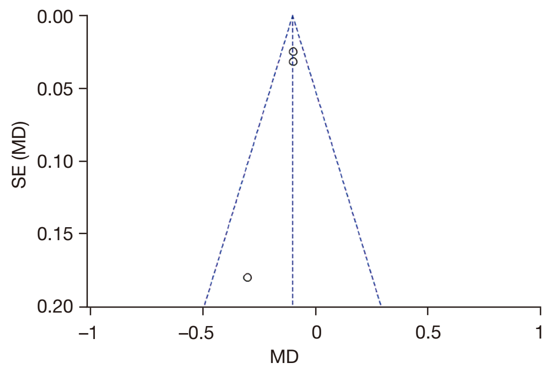

Figure 14 Funnel diagram of total bilirubin level shift in patients with liver cancer after surgery. SE, standard error; MD, mean difference.

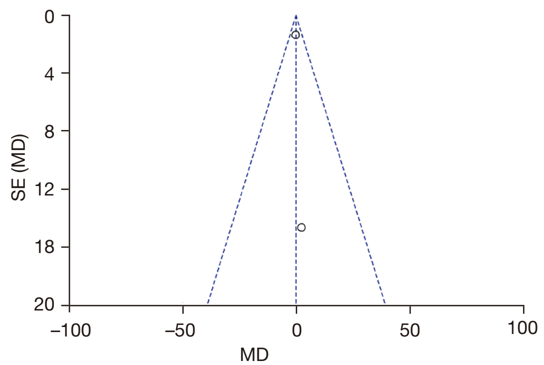

Figure 15 Funnel diagram of C-reactive protein level shift in patients with liver cancer after surgery. SE, standard error; MD, mean difference.

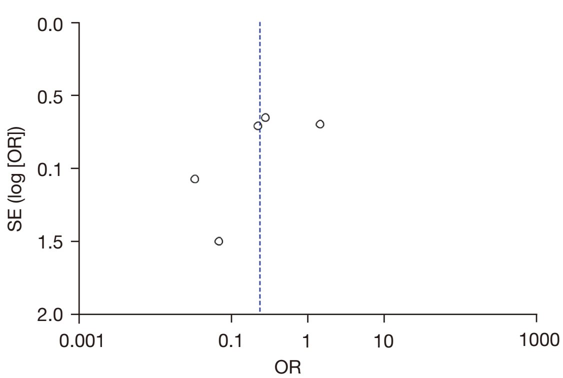

Figure 16 Funnel diagram of postoperative infection shift in patients with liver cancer after surgery. SE, standard error; OR, odds ratio.

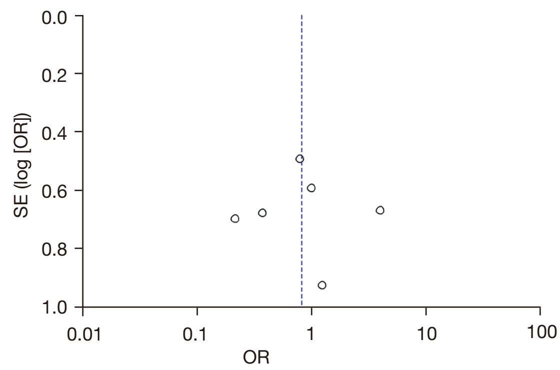

Figure 17 Funnel diagram of postoperative complications shift in patients with liver cancer after surgery. SE, standard error; OR, odds ratio.

was no publication bias in the included articles. Therefore, the conclusions drawn were relatively reliable.

Discussion

This systematic review study included 11 articles, which were designed to evaluate the effects of Microecological agents on postoperative immune function of patients with hepatocellular carcinoma. All 11 articles described the correct random allocation method, 8 detailed the concealment of the allocation plan, and 9 articles used the blind method. The reason may be the unclear random allocation method of the study or the subjective bias of doctors (21).

The analysis of the heterogeneity of postoperative ALT levels of patients undergoing liver cancer surgery in this study showed that there was a certain heterogeneity among the postoperative ALT levels of liver cancer patients included in the study. The statistical analysis of random effects model showed that there was no significant difference between the postoperative ALT levels of liver cancer patients treated with microbial agents and placebo [MD =–3.65, 95% CI: (–14.65, 7.34), P=0.52]. There was also no significant difference in AST levels between the two groups of patients included in these 4 articles [MD =–0.64, 95% CI: (–6.87, 5.58), P=0.84]. Such results were different from the conclusions of many similar studies that microbial preparations can significantly reduce postoperative ALT and AST levels in patients with liver cancer compared with placebo treatment (22). This can be due to the fact that the number of related studies involving Microecological agents used for the postoperative treatment of liver cancer patients included in this study was too small, and there was a certain difference between the postoperative ALT level and AST level data of the included liver cancer patients.

In addition, the analysis of the heterogeneity of the levels of prothrombin, bilirubin, and CRP in patients with liver cancer showed that the differences in the levels of prothrombin between the Microecological agent group and the control group were not statistically significant [MD =1, 95% CI: (−2.57, 4.57), P=0.58]. There was no significant difference in CRP content between the experimental group and the control group in patients with liver cancer after liver cancer surgery, and it was not statistically significant [MD =−0.28, 95% CI: (−3.01, 2.45), P=0.84]. The comparison of TBIL levels in patients with liver cancer after surgery showed that microbial agents significantly reduced the TBIL levels in patients after hepatectomy [MD =−0.10, 95% CI: (−0.14, −0.06), P<0.00001]. This shows that the use of microbial agents can significantly reduce liver damage after hepatectomy for primary hepatocellular carcinoma, repair the intestinal barrier damage, relieve the symptoms of intestinal flora imbalance, and reduce the occurrence of postoperative hyperbilirubinemia (23). Current research shows that Microecological agents can reduce the probability of postoperative complications in patients undergoing liver resection because they can antagonize non-native bacteria, stimulate intestinal mucosal proliferation, promote the absorption of nutrients in the intestine, and increase the vitality of the patient's immune system (24). Among them, the impact of Microecological agents on the immune system is mainly reflected in the promotion of normal intestinal flora to stimulate the host's immune system through the bacteria itself or through cell wall components, activate immune cells, and exert their effects on the surface through the production of antibodies, interferons, interleukins, etc. (25).

In addition, comparison on the results of meta-analysis involving postoperative infection and complication rates of liver cancer patients included in the articles revealed that compared with placebo treatment, treatment with Microecological agents can significantly reduce the risk of postoperative infection in patients with liver cancer [MD =0.23, 95% CI: (0.07, 0.79), P=0.02<0.05]. The meta-analysis results of the incidence of postoperative complications of liver cancer patients included in articles showed that the difference between the incidence of postoperative complications of liver cancer patients in the experimental group and the control group was not statistically significant [OR =0.82, 95% CI: (0.38, 1.77), P=0.61]. Summary on similar studies reveals that the possible mechanisms for microbial agents to reduce the probability of infection and complications after liver resection include the following aspects. Firstly, the antagonistic effect of resident bacteria in the body on non-native bacteria. Secondly, microbial preparations can stimulate glycolysis. Thirdly, microbial preparations can stimulate the proliferation of intestinal mucosal cells. Fourthly, microbial preparations activate immune cells, produce corresponding immune active factors (antibodies, interferons, interleukins, etc.), and improve the vitality of the immune system (26). Fifthly, it could increase intestinal absorption of vitamin nutrients (B vitamins, vitamin K, vitamin C, niacin, biotin, folic acid, etc.). Finally, some components in microbial preparations have anti-tumor effects, for example, bifidobacteria can reduce the pH of the intestinal lumen, inhibit the formation of carcinogens, or activate macrophages to play an anti-tumor effect (27,28). The above-mentioned various reasons may lead to the effect of Microecological agents to reduce the risk of postoperative infection in patients with liver cancer and enhance the immunity of patients.

For a meta-analysis of the effects of Microecological agents on the immune function of patients after liver cancer surgery, the funnel chart showed that the published articles included in this study were not biased. Therefore, the conclusions obtained were credible, and risk bias was not the main factor affecting the conclusions.

Conclusions

This study included 11 articles on the use of Microecological agents to provide postoperative nutrition for patients undergoing liver cancer surgery. It was confirmed by meta-analysis that Microecological agents can significantly reduce the bilirubin level of patients after hepatectomy. It also significantly reduces the risk of postoperative infection in patients with liver cancer, and significantly improves the immune function of patients with liver cancer. The limitations of this study were as follows. Firstly, the articles lack some important biochemical indicators. Secondly, there are information biases in the data collection process. Thirdly, changing the inclusion criteria and excluding low-quality studies can't significantly reduce heterogeneity. There was a certain degree of heterogeneity in the included articles, which may have a certain impact on the results. At the same time, the Ben study did not fully evaluate the safety of the Microecological agents in the articles. Therefore, further research was needed in the future. In short, this study provided some scientific references for postoperative recovery treatment of liver cancer patients.

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Footnote

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