Iran J Public Health, Vol. 54, No.2, Feb 2025, pp.240-251

Review Article

Assessing the Impact of Multidisciplinary Team (MDT) Care on Patients with Liver Cancer/Cirrhosis: A Systematic Review and Meta-Analysis

Qin Peng [1,#], ***Lin Li*** [1,#], ***Jing Yang*** [2], ***Kaishan Tao*** [1], ***Xian Zhao*** [1], ***Lin Wang*** [1], ****Xiaosong Jiang*** [3]

1. *Department of Hepatobiliary Pancreatic Splenic Surgery, the First Affiliated Hospital of Air Force Military Medical University, Xi'an, Shaanxi Province, China*
2. *Department of Neonatal Intensive Care Unit, the First Affiliated Hospital of Harbin Medical University, Harbin, China*
3. *Department of Oncology, the First Affiliated Hospital of Harbin Medical University, Harbin, China*

[#]These authors contributed equally to this work

***Corresponding Author:** Email: xiaosong002x@163.com

(Received 10 Sep 2024; accepted 18 Dec 2024)

Abstract

Background: Liver cancer and cirrhosis are significant public health challenges with a high global burden. Multidisciplinary Team (MDT) care has gained recognition as a promising approach to improve the management and outcomes of patients with liver cancer and cirrhosis. We aimed to evaluate the effectiveness of MDT care in improving the clinical outcomes, including survival rates, quality of life, and disease progression, in patients with liver cancer and cirrhosis.

Methods: The search was performed using the keywords of liver cancer and MDT and their combinations in international databases with a time limit for publishing articles from 2010 and 2023. The data were evaluated using a technique of meta-analysis as well as a model called random effects. The I2 test was used to examine the degree of heterogeneity between the studies. STATA was used to analyze the data.

Results: The analysis of 13 different papers with a total sample size of 8641 individuals revealed that the average scores of the MDT and liver cancer were identical to (0.64), with a confidence interval ranging from (95% 48.5-81.7).

Conclusion: MDT is effective in the length of treatment and reduction of risk and mortality rates. The negative prognostic factors of not following the MDT decision were not observed.

Keywords: Liver cancer; Multidisciplinary; Multidisciplinary team; Hepatocellular carcinoma; Cirrhosis

Introduction

Cancer/Cirrhosis, also known as hepatocellular carcinoma, is widely acknowledged as the third most frequent kind of cancer worldwide (1-4). It is also the second leading cause of cancer-related deaths, resulting in an estimated yearly mortality rate of around 830,200 persons. Liver cancer was among the top three leading causes of cancer-related mortality in 46 nations (1-3, 5-7).

DOI: 10.18502/ijph.v54i2.17896

The core tenet of Multidisciplinary Team (MDT) care is the adoption of a patient-centered approach, whereby specialists from various disciplines get together regularly to engage in deliberation and develop the most effective treatment plan for patients (8, 9). The effectiveness of MDT has been shown in the therapy of breast cancer, oral cancer, and prostate cancer (10-13). In contemporary times, MDTs have been more prominent as a prevailing strategy for diagnosing and treating Liver Cancer/Cirrhosis. Managing Liver Cancer/Cirrhosis involves the MDT of specialists from several domains, including surgery, oncology, radiology, pathology, and other pertinent disciplines (14, 15).

Prior studies have shown the possible therapeutic benefits associated with implementing MDT in the context of colorectal cancer (2, 9, 10, 12, 16-21). However, other research has shown opposing results, shedding insight on possible disadvantages or constraints linked to MDT (1-3, 22-24). Therefore, we aimed to evaluate the possible influence of MDT on the rates of overall survival (OS) and response to chemotherapy in individuals diagnosed with Liver Cancer/Cirrhosis.

Methods

Search Strategy

We conducted a comprehensive literature search in electronic databases such as PubMed, MEDLINE, Embase, Google Scholar, Scopus, Science Direct, etc., for relevant articles published from 2010 to 2023. The search terms were including keywords related to liver cancer, cirrhosis, MDT care, and relevant synonyms. Boolean operators (AND, OR) were used to combine search terms

Selection of studies and data extraction

At first, the researchers reviewed the medical literature and gathered every paper discussing liver disorders, cirrhosis, and MDT. Entry and exit criteria were used to deter-mine which research was accepted for this study. The following were the criteria for inclusion: This study included data from all previous observational research that has looked at liver disorders, cirrhosis, and MDT. Criteria for excluding studies included whether they were relevant to the issue at hand, whether they were conducted using MDT, whether they were repetitious, and whether the complete texts of the publications could be accessed. The researchers read through the abstracts of the papers to determine whether they met the inclusion and exclusion criteria. Once this was done, the researchers separated the linked elements and retrieved the articles' full texts. In addition, an email requesting the necessary information was sent to the writers of those articles whose article information was missing some of the needed components. For the purpose of information extraction, a form was used containing the variables of the first author of the study, year of article publication, sample size, and average percentage and number in both groups with MDT and without MDT, respectively. Three different researchers independently evaluated each paper, and in the event of a disagreement, the responsible author, an expert in meta-analysis, reviewed the article to settle the dispute.

Inclusion Criteria

- Studies reporting the impact of MDT care on patients with liver cancer and cirrhosis.
- Studies published in English.
- Studies with full-text availability.

Exclusion Criteria

- Studies without relevant outcomes or data.
- Studies with a high risk of bias.
- Studies not published in English.

Statistical analysis

Considering that the index investigated in this study was liver diseases, cirrhosis, and MDT, its variance was calculated through normal distribution, and the 95% confidence interval was also calculated. Also, Cochran's Q test and I2 index were used to determine the degree of heterogeneity of the data. According to the I2 index, the heterogeneities were divided into three categories: less than 25% (low heterogeneity), 25% to 75% (moderate heterogeneity), and more than 75% (high heterogeneity) (25). Cirrhosis and MDT, due to the significance of the heterogenei-

ty indices Q=231.68, P<0.001, and I2=97.8%, the random effects model was used to investigate the relationship between the average scores of MDT on liver cancer and cirrhosis with the year of conducting the studies and the sample size of the studies were used from meta-regression and to check the score based on gender and treatment group, subgroup analysis was used. Data analysis was done with STATA version 12 software and the metan command. The level of significance in the tests was 0.05.

MDT

Various models exist for implementing a multidisciplinary team, including a range of approaches such as the establishment of a multidisciplinary board, the implementation of a fluid referral system facilitating collaboration between various disciplines, and the creation of a co-located clinic (26, 27). The concept of multidisciplinary care originated with the establishment of tumor boards, when healthcare personnel would present patients to a diverse group of doctors for their expert opinions and recommendations (28). Historically, tumor board presentations were conducted retrospectively after evaluating patients. On the other hand, prospective treatment planning is becoming increasingly common (20, 29-31). 15% of all patients must be presented before tumor boards per a directive from the Commission on Cancer. At least eighty percent of the patients who are presented have to be done so in a prospective way. It is common practice to employ tumor boards for the initial diagnosis of a patient's condition; however, there is also a rising trend of using their services throughout the transition between treatment choices (32, 33). A liver tumor board, which is interdisciplinary in nature, comprises a group of specialists from several fields that work together to assess and develop therapy and management strategies for individuals diagnosed with cancer. The fundamental specialties often found on a tumor board generally include transplant hepatology and surgery, hepatobiliary surgery, interventional radiology, and medical oncology (34-36). The integration of pathologists and translational researchers into multidisciplinary teams is becoming more prevalent due to the growing awareness of cancer subtypes, including mixed hepatocellular cholangiocarcinoma (19, 26).While it is not common practice to include disciplines such as dermatology, endocrinology, and rheumatology in cancer multidisciplinary teams, establishing strong connections with these fields might be beneficial in effectively managing problems arising from immune checkpoint inhibitors. The composition of tumor boards extends beyond medical specializations, including several disciplines such as nursing, nurse navigators, social workers, and case managers (23, 28). These non-medical professionals contribute significantly to the development and execution of individualized and effective treatment strategies for patients. The participation of these specialized fields is of significant importance in fostering patient involvement, enhancing treatment adherence, and incorporating concerns related to quality of life and other survivorship factors into treatment choices. The presence of strong leadership within the multidisciplinary tumor board is of utmost importance in fostering positive relationships and facilitating efficient communication among its members (34). Research has shown that successful leadership in tumor boards is associated with possessing two crucial attributes: non-technical abilities, namely communication and clinical experience. Leadership plays a crucial role in ensuring the inclusion of all disciplines in treatment decisions, preventing the dominance of a single specialty, and promoting consistency in clinical decision-making over time. Moreover, effective leadership allows for the incorporation of patient-specific factors in decision-making processes and facilitates the provision of patient-centered care. Multidisciplinary tumor boards have been widely adopted as the prevailing standard of treatment for several types of malignancies throughout extensive healthcare systems (12, 13).

The provision of multidisciplinary care makes it possible and facilitates decisions that put the patient's interests first. This occurs as a result of greater participation on the part of a variety of team members who have had personal experi-

ence working directly with the patient (31). Consequently, an approach to decision-making that is more all-encompassing is used, one that considers the preferences and values held by the patient. Decisions that take into account the comorbidities, performance level, and preferences of the patient are often considered to be more clinically appropriate and are typically more well-accepted by patients (35). To foster an approach focused on the patient, the multidisciplinary team may incorporate patient values by using open-ended inquiries related to treatment preferences and participating in conversations regarding treatment possibilities connected to the patients' expressed desired outcomes. This might be done to create a patient-centered approach. It has been shown that the inclusion of clinical nurses and navigators as essential members of the multidisciplinary team has the capacity to improve the inclusion of the patient perspective and to make it easier to make decisions that are focused on the patient (22, 31).

Liver Cancer/Cirrhosis

Liver cancer poses a significant worldwide burden. Based on estimations for the year 2022, liver cancer ranks as the sixth most often diagnosed form of cancer and stands as the third leading cause of mortality attributed to cancer (3, 7). Liver cancer is furthermore classified as the second most prevalent contributor to early mortality resulting from cancer (2, 37). The occurrence and fatality rates of liver cancer have seen a decline in several Eastern Asian nations, including Japan, China, and the Republic of Korea. Conversely, other countries with historically low incidence rates, such as the United States, Australia, and various European nations, have experienced a rise in these rates (38, 39). According to Fig. 1, it is clear that the incidence of liver cancer in Western Asia and China is higher than in other regions.

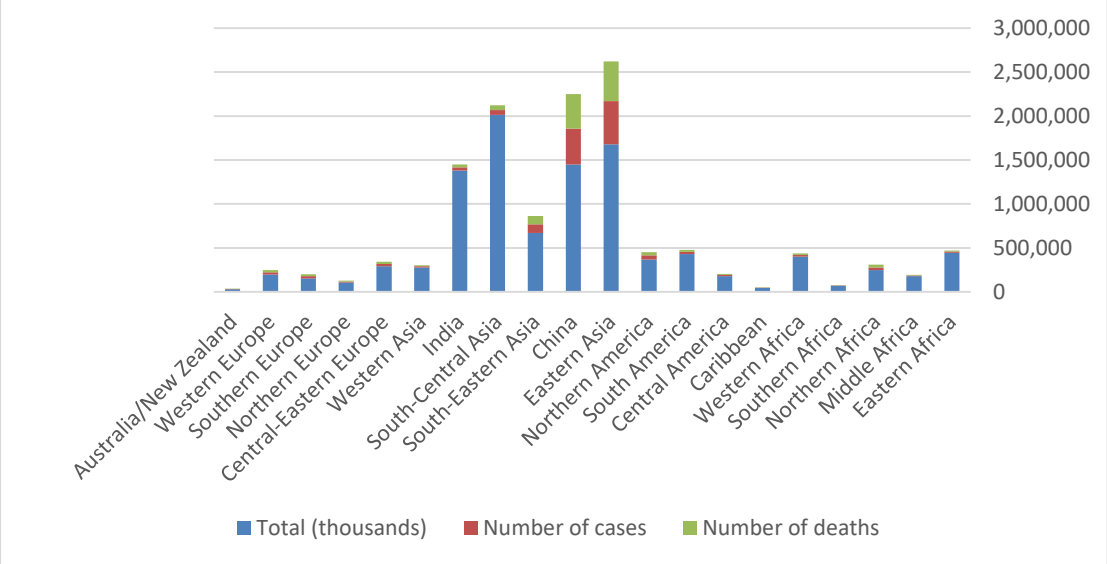

Fig. 1: Incidence of liver cancer by region (39-41)

Results

All the observational studies that investigated MDT liver cancer were examined from 2010 to 2023 and entered into a systematic review and meta-analysis based on PRISMA guidelines. In this study, 13 articles were analyzed. The sample size was 8641 people, with an average of 664 people in each study (Fig. 2 and Table 1).

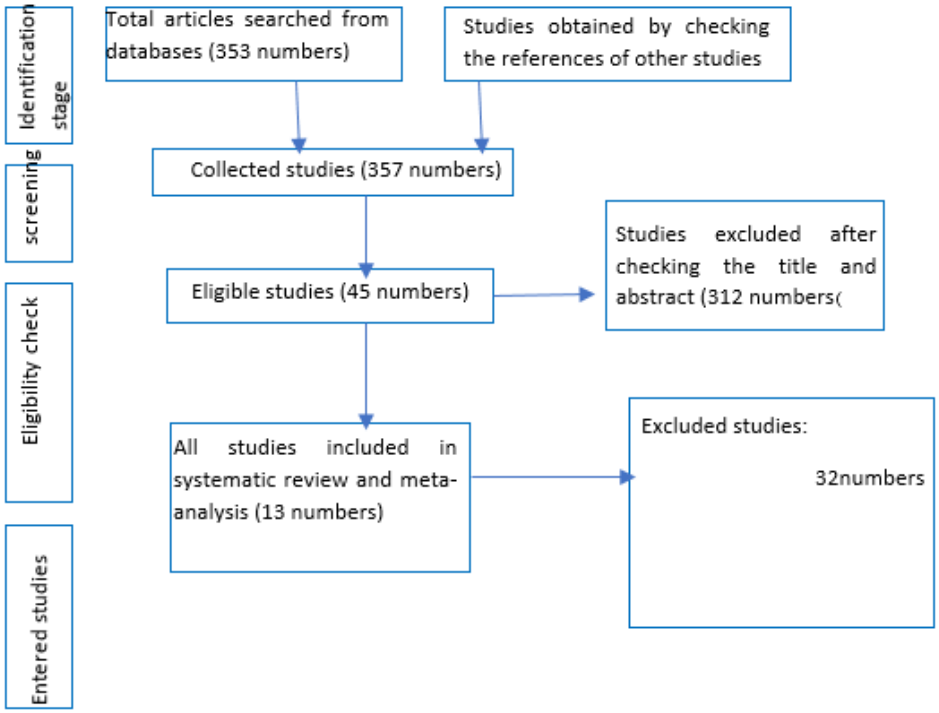

Fig. 2: Diagram of the process of selecting articles based on Prisma instructions

Table 1: literature characteristic

References	Year published	Sample size		Gender				Follow-up duration		Post-operative morbidity (%)		Response to chemotherapy (%)	
		MDT	Non-MDT	Male		Female		MDT	Non-MDT	MDT	Non-MDT	MDT	Non-MDT
				MDT	Non-MDT	MDT	Non-MDT						
(42)	2020	229	294	142	171	87	123	240	300	6.2	21.5	81.7	60.7
(20)	2019	230	389					210	240	6.2	19.2	75.8	70.7
(19)	2017	235	37					171	191	23	22.3	48.5	61.1
(11)	2012	298	297	166	180	132	117	420	330	30	30.3	79.1	62.4
(33)	2019	738	5881	611	4676	127	1205	41	328			71.2	49.4
(35)	2016	120	131	97	112	23	19	239	102	34	32	64	50
(14)	2014	65	30					98	98	15.4	15	81.8	88.5
(31)	2023	76	74	64	66	12	8	180	180	17.9	33.3	71.6	75
(28)	2020	490	209					28	56			87.30	63.60
(16)	2021	228	79					210	150	11	25	79.80	33.30
(1)	2022	597	250	340	174	257	76			17	29.50	71	61.50
(26)	2020	44	33							17	25	75	59
(42)	2014	65	35					90	110	23	21	74	56

The findings showed that the highest prevalence is for the study (33) with 738 MDT patients. Age-wise, the data reveals another noteworthy difference. The median age of patients in the MDT cohort is considerably lower at 45.08 years, in contrast to the Non-MDT cohort, where the median age is notably higher at 54.91 years. This age contrast is also statistically significant ($P < 0.001$), signifying a significant age gap between the two cohorts. Furthermore, follow-up duration demonstrates that 47.48% of MDT cohort patients had a follow-up, whereas 52.53% of Non-MDT cohort patients had a follow-up. Although numerically minor, this difference is statistically significant ($P< 0.001$). Additionally, the MDT cohort exhibits a higher mean post-operative morbidity of 29% (95% CI: 6.2%-34%) compared to 23.5% (95% CI: 15%-32%) in the Non-MDT cohort, with a *P*-value of less than 0.001, indicating a significant distinction in post-operative outcomes between the cohorts. Lastly, the response to chemotherapy in the MDT cohort is notably better, with a mean of 64% (95% CI: 48.5%-81.7%) compared to 57.5% (95% CI: 49.4%-88.5%) in the Non-MDT cohort, a statistically significant difference with a *P*-value of less than 0.001. These findings emphasize the critical role of the multi-disciplinary approach in enhancing patient response to chemotherapy and highlight the demographic and clinical differences between the two cohorts (Table 2). The average score of the effect of MDT on liver cancer is based on the name of the first author and the year of conducting the research. The middle point of each line segment shows the average effect score in each study, and the diamond shape shows the average MDT score on liver cancer for all studies (Fig. 3).

Also, according to Fig. 3, the percentage of deaths compared to infection in North America with a rate of 74.67% and the region of Australia and New Zealand with a percentage of 75.75% were the lowest, and this shows that the percentage of recovery and treatment is higher in the countries of these regions (38, 39).

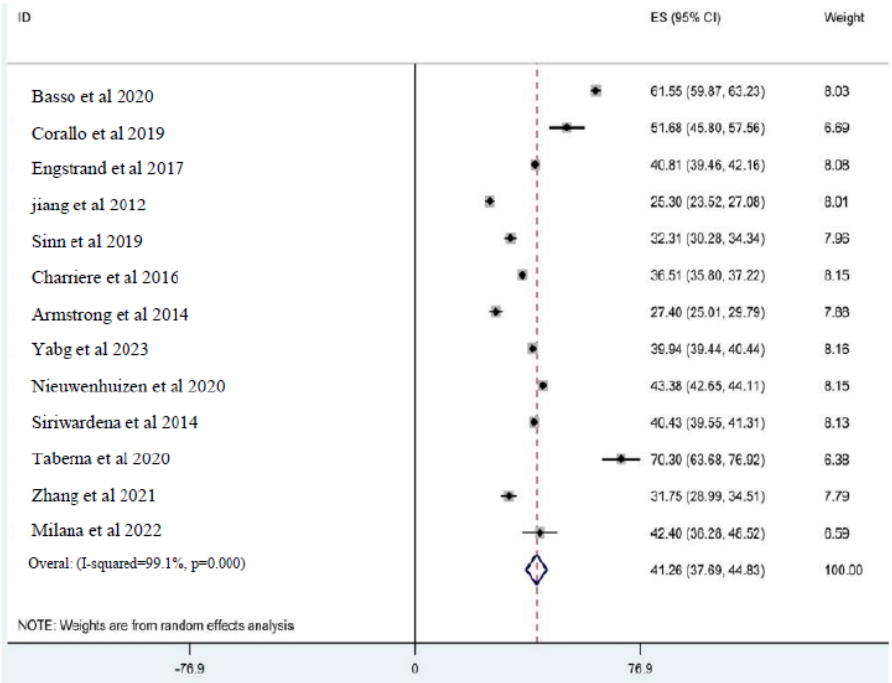

Fig. 3: The average score of the effect of MDT on liver cancer based on research

Begg's regression test was used to check the diffusion bias (Fig. 4). In this research, the possibility of bias in the publication of results was investigated by funnel plot based on Begg's test, and the result showed no publication bias.

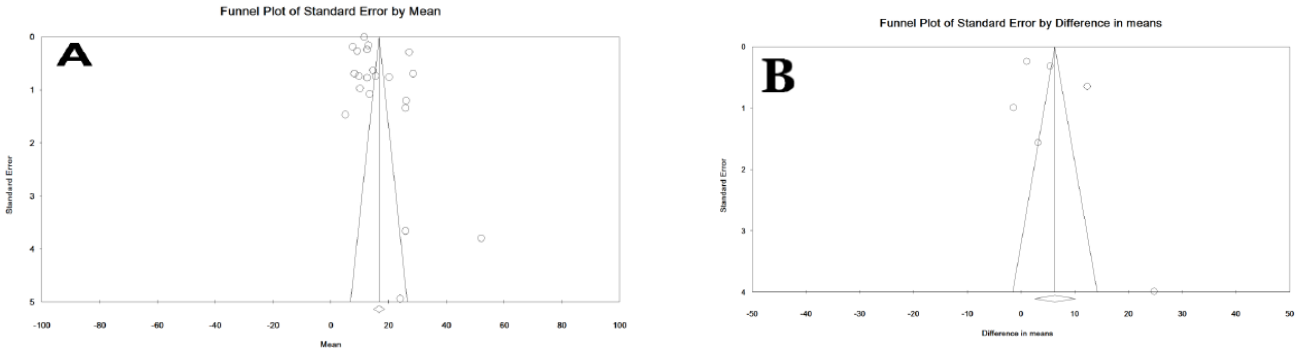

Fig. 4: Begg's regression test to check the diffusion bias for patients in the MDT and Non-MDT group

Table 2: Research results to measure the effect of MDT on liver cancer

Characteristics	MDT cohort, N (%)	Non-MDT cohort, N (%)	*P*-value
Gender			
Male	1080 (13.27)	5205 (63.95)	< 0.001
Female	381 (4.6)	1472 (18.08)	< 0.001
Age			
Median years	45.08	54.91	< 0.001
Follow-up			
Duration	1599 (47.48)	1769 (52.53)	< 0.001
Mean	199/875	221/125	< 0.001
Post-operative morbidity			
Mean (95% CI)	29% (6.2%-34%)	23.5% (15%-32%)	< 0.001
Response to chemotherapy			
Mean (95% CI)	64% (48.5%-81.7%)	57.5% (49.4%-88.5%)	< 0.001

Discussion

The results of some studies show the effective role of MDT in diagnosis, treatment, or treatment time in liver cancer, for example, in 5 The involvement of a multidisciplinary team is of utmost importance in expeditiously reaffirming the diagnosis, determining the stage of hepatocellular carcinoma (HCC), and devising a personalized treatment strategy(1). It is probable that the process of screening potential recipients of a liver transplant and coordinating bridging and downsizing therapeutic methods, such as radio frequency ablation and transarterial chemoembolization, will take a significant amount of time. In a nutshell, utilizing a multidisciplinary team approach provides a prompt and individualized treatment strategy (30, 36). This treatment strategy may include curative surgical interventions for patients who have been diagnosed with early-

stage HCC, palliative or hospice care for patients who have metastatic HCC, or a combination of these two types of care for patients who have both types of HCC. Establishing a liver tumor board composed of experts from various fields has gained widespread acceptance across most tertiary care centers in the United States. For individuals who have been identified as having HCC, this method is regarded as the gold standard in terms of medical treatment and forms an essential part of the best practice regimen.

In addition, MDT increased the diagnostic accuracy and overall survival of patients diagnosed with colorectal cancer in a study (11). The work done by the MDT encouraged communication and cooperation across disciplinary lines, ensuring a high-quality diagnosis, decision-making based on evidence, and the most effective treatment planning.

On the other hand, the findings of certain other studies contradict the conclusions drawn from this one. For example, studies (42) do not demonstrate the survival advantages of MDT therapy but suggest that it enables patients with more advanced illnesses to undergo surgery. The evaluation of MDT reduces the problems of chemotherapy and postoperative care throughout the medium term. The MDT therapy of patients with liver-limited colorectal metastases did not result in a statistically significant improvement in survival rates (20). Therefore, the evidence does not support the idea that MDT examination may enhance the prognosis of patients with colorectal metastases restricted to the liver.

There is a growing amount of research that supports the many benefits of adopting a multidisciplinary strategy for the delivery of healthcare, and this evidence comes from a variety of sources (40, 43). These advantages include an increased possibility of obtaining any treatment, an improved likelihood of receiving curative therapies, and improved overall survival rates. In addition, there is a greater likelihood of receiving any form of therapy (38-40). Early research to evaluate the impact of multidisciplinary therapy on outcomes associated with HCC was carried out at the San Francisco Veterans Affairs (VA) Medical Center (27, 44). The researchers discovered that the establishment of a seamless referral system among healthcare providers led to an improvement in the administration of both palliative and curative treatments, which in turn resulted in improved overall survival rates experienced with a public healthcare system that produced outcomes that were comparable to those found in the previous studies (30, 36). A multidisciplinary tumor board was established as part of the project, which also involved the establishment of a co-located clinic that included many medical disciplines. This intervention was shown to improve the outcomes associated with HCC. Patients who were cared for in the multidisciplinary clinic, as opposed to patients who got treatment in the past, displayed greater rates of obtaining curative treatment, had shortened time intervals between treatment commencement, and demonstrated better survival rates at each stage of their disease. Patients who received treatment in the past exhibited these characteristics at lower rates. Notably, the studies carried out by (15) demonstrated that subsequent to the installation of the multidisciplinary programs, there has been an increase in the occurrence of cancers discovered at an earlier stage. The information included in the user's text does not need to be rewritten in any way. The migration that has been seen up to this point may have been caused by many different variables. The increased knowledge of healthcare professionals about HCC, which has resulted in more surveillance and earlier identification, is one cause that may be considered. One such possibility is that improvements in radiologic knowledge have increased the diagnostic precision available for detecting small HCC tumors. The observed movement may also be influenced by improved accessibility to medical clinics and shorter wait times for appointment scheduling. A complete analysis was done on a cohort of 3,988 patients who underwent therapy for HCC across 128 VA hospitals in the United States as part of a multicenter study that was under-taken (8). According to the findings of another study (20), individuals who were treated at a VA hospital affiliated with an academic institution and had a multispecialty

evaluation had a greater chance of receiving HCC treatment. Similarly, the provision of expert medical therapy by professionals such as hepatologists, medical oncologists, or surgeons within a 30-day period following diagnosis, coupled with the examination of cases by a multidisciplinary tumor board, demonstrated a link with lower mortality rates. In this example, the multidisciplinary tumor board evaluated the cases of patients who had received specialized medical treatment during the first 30 days after diagnosis. Over the course of eight years, a single facility in Seoul, Korea, undertook research that included the examination of 6,619 individuals who had been diagnosed with HCC (21, 27).

According to the findings of the research, patients who were treated by a multidisciplinary team had a greater five-year survival rate in comparison to patients who were treated with alternative treatment options. This conclusion held true even after a propensity-matched analysis was performed; the 5-year survival rate for patients handled by a multidisciplinary team was 71.4%, but 58.7% for those managed in any other way. Multidisciplinary therapy showed a significant survival benefit for patients with impaired liver function, high AFP levels, or advanced tumor burden. Because of the greater variety of treatment techniques that are being seen, deciding on therapy for these subgroups might be difficult (34, 45).

On the other side, not adhering to the advice of multidisciplinary tumor boards may be associated with less favorable outcomes. On the other hand, besides patients and healthcare professionals, several other elements might explain why something like this happens in real-world clinical settings. The input from the user does not include any in-formation that has to be rewritten (36). A total of 419 talks at tumor boards involving 137 patients diagnosed with HCC were evaluated as part of a study conducted in a single site. According to the data, 90 patients did not adhere to the advice made by the medical professionals, making the total number of incidents of nonadherence 145. The user did not provide any text for the system to modify.

Various patient-related reasons led to the problem, such as missed appointments, clinical worsening, and choices made by the patients themselves (38). These were only some things that caused the problem. On the other hand, factors related to healthcare providers, such as doctors' preferences and their perception that the recommended therapy was not suitable for the patient, also influenced the study's outcome (38). Although the findings above highlight the probable inevitability of non-adherence in certain scenarios, such as those involving clinical deterioration, they show that nonadherence may be frequent and should be prevented whenever possible. For example, in clinical deterioration situations (2).

Conclusion

The MDT approach has a significant and positive impact on managing liver cancer. The data clearly indicates that the MDT cohort exhibits several advantages over the Non-MDT cohort. First, the MDT approach results in a more balanced gender distribution, which can be important in tailoring treatment strategies to the specific needs of both male and female patients. Moreover, the MDT cohort is associated with a notably younger patient population, suggesting the potential for early diagnosis and intervention. Additionally, patients in the MDT cohort have a better response to chemotherapy, demonstrating the effectiveness of the collaborative approach in optimizing treatment outcomes.

Furthermore, the MDT approach, despite experiencing slightly higher post-operative morbidity, showcases the potential for enhanced post-surgical care and management. The statistical significance of these differences underscores the clinical relevance of the MDT approach in liver cancer management. In conclusion, the data strongly supports the effectiveness of the MDT approach in liver cancer. It improves demographic balance and enhances patient outcomes, making it a valuable and essential strategy in the fight against this disease.

Funding

The research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Milana F, Famularo S, Luberto A, et al (2022). Multidisciplinary tumor board in the management of patients with colorectal liver metastases: a single-center review of 847 patients. *Cancers (Basel),* 14(16):3952.
2. Mammas CS, Mamma AS (2022). E-multidisciplinary oncology conference for liver cancer as a technology and method to optimize personalization and outcomes in the peripheries. *Stud Health Technol Inform*, 289:313-316.
3. Cao JJ, Kwon DH, Ghaziani TT, et al (2023). Accuracy of information provided by ChatGPT regarding liver cancer surveillance and diagnosis. *AJR Am J Roentgenol*, 221(4):556-9.
4. Bahardoust M, Dehkharghani MZ, Ebrahimi P, et al (2023). Effect of ABO blood group on postoperative overall survival and recurrence-free survival rate in patients with hepatocellular carcinoma after hepatectomy: a multi-center retrospective cohort study. *BMC Surg*, 23(1):324.
5. Mintz KJ, Leblanc RM (2021). The use of nanotechnology to combat liver cancer: Progress and perspectives. *Biochim Biophys Acta Rev Cancer*, 1876(2):188621.
6. Chan L-K, Tsui Y-M, Ho DW-H, et al (2022). Cellular heterogeneity and plasticity in liver cancer. *Semin Cancer Biol*, 82:134-149.
7. Huang L, Sun H, Sun L, et al (2023). Rapid, label-free histopathological diagnosis of liver cancer based on Raman spectroscopy and deep learning. *Nat Commun*, 14(1):48.
8. Bakhshi M, Karkehabadi A, Razavian SB, editors. Revolutionizing Medical Diagnosis with Novel Teaching-Learning-Based Optimization. 2024 International Conference on Emerging Smart Computing and Informatics (ESCI).
9. Juez I, Rubio C, Figueras J (2011). Multidisciplinary approach of colorectal liver metastases. *Clin Transl Oncol*, 13(10):721-7.
10. Gish RG, Lencioni R, Di Bisceglie AM, et al (2012). Role of the multidisciplinary team in the diagnosis and treatment of hepatocellular carcinoma. *Expert Rev Gastroenterol Hepatol*, 6(2):173-85.
11. Ye Y-J, Shen Z-L, Sun X-t, et al (2012). Impact of multidisciplinary team working on the management of colorectal cancer. *Chin Med J,* 125(2):172-7.
12. Miguet M, Adam J, Blanc J, et al (2019). Multidisciplinary meetings specific to hepatocellular carcinoma: How to proceed? *J Visc Surg*, 156(3):217-27.
13. Cutolo C, Dell'Aversana F, Fusco R, et al (2022). Combined hepatocellular-cholangiocarcinoma: What the multidisciplinary team should know. *Diagnostics (Basel),* 12(4):890.
14. Dyson J, Jaques B, Chattopadyhay D, et al (2014). Hepatocellular cancer: the impact of obesity, type 2 diabetes and a multidisciplinary team. *J Hepatol*, 60(1):110-7.
15. Adam R, De Gramont A, Figueras J, et al (2012). The oncosurgery approach to managing liver metastases from colorectal cancer: a multidisciplinary international consensus. *Oncologist*, 17(10):1225-39.
16. Zhang Y-R, Wang H, Zhou N, et al (2021). A multidisciplinary team approach to the treatment of liver cirrhosis. J Inflamm Res, 14:5443-5450.
17. Naugler WE, Alsina AE, Frenette CT, et al (2015). Building the multidisciplinary team for management of patients with hepatocellular carcinoma. *Clin Gastroenterol Hepatol*, 13(5):827-35.
18. Adam R, de Gramont A, Figueras J, et al (2015). Managing synchronous liver metastases from colorectal cancer: a multidisciplinary international consensus. *Cancer Treat Rev*, 41(9):729-41.
19. Engstrand J, Kartalis N, Strömberg C, et al (2017). The impact of a hepatobiliary multidisciplinary team assessment in patients with colorectal cancer liver metastases: a

population-based study. *Oncologist*, 22(9):1067-74.
20. Corallo S, Calegari MA, Zurlo IV, et al (2019). The impact of multidisciplinary team (MDT) management on outcome of hepatic resection in liver-limited colorectal metastases. American Society of Clinical Oncology.
21. Hellingman T, de Swart M, Joosten J, et al (2020). The value of a dedicated multidisciplinary expert panel to assess treatment strategy in patients suffering from colorectal cancer liver metastases. *Surg Oncol*, 35:412-7.
22. Lhewa D, Green EW, Naugler WE (2020). Multidisciplinary Team Management of Hepatocellular Carcinoma Is Standard of Care. *Clin Liver Dis,* 24(4):771-87.
23. Karkehabadi A, Homayoun H, Sasan A, editors. SMOOT: Saliency guided mask optimized online training. 2024 IEEE 17th Dallas Circuits and Systems Conference (DCAS); 2024: IEEE.
24. Byrd K, Alqahtani S, Yopp AC, et al(2021). Role of multidisciplinary care in the management of hepatocellular carcinoma. *Semin Liver Dis*, 41(1):1-8.
25. Bahardoust M, Mousavi S, Dehkharghani MZ, et al (2024). Association of Tramadol Versus Codeine Prescriptions with all-cause mortality and cardiovascular diseases among patients with osteoarthritis: a systematic review and meta-analysis of propensity score-matched population-based cohort studies. *Adv Rheumatol*, 64(1):80.
26. Nieuwenhuizen S, Puijk RS, van den Bemd B, et al (2020). Resectability and ablatability criteria for the treatment of liver only colorectal metastases: multidisciplinary consensus document from the COLLISION trial group. *Cancers (Basel),* 12(7):1779.
27. Li X, Chen Q, Bi X, et al (2020). Effects of multidisciplinary team on the outcomes of colorectal cancer patients with liver metastases. *Ann Palliat Med*, 9(5):2741-2748.
28. Taberna M, Gil Moncayo F, Jané-Salas E, et al (2020). The multidisciplinary team (MDT) approach and quality of care. *Front Oncol*, 10:85.
29. Chow FC-L, Chok KS-H (2019). Colorectal liver metastases: An update on multidisciplinary approach. *World J Hepatol*, 11(2):150-172.
30. Adam R, Kitano Y (2019). Multidisciplinary approach of liver metastases from colorectal cancer. *Ann Gastroenterol Surg*, 3(1):50-6.
31. Duininck G, Lopez-Aguiar AG, Lee RM, et al (2019). Optimizing cancer care for hepatocellular carcinoma at a safety-net hospital: The value of a multidisciplinary disease management team. *J Surg Oncol*, 120(8):1365-70.
32. Flores A, Ho CK, Asrani SK (2018). Innovative care models in liver disease: the role of multidisciplinary teams. *Curr Hepatol Rep,* 17:193-9.
33. Sinn DH, Choi G-S, Park HC, et al (2019). Multidisciplinary approach is associated with improved survival of hepatocellular carcinoma patients. *PLoS One*, 14(1):e0210730.
34. Munro A, Brown M, Niblock P, et al (2015). Do Multidisciplinary Team (MDT) processes influence survival in patients with colorectal cancer? A population-based experience. *BMC Cancer*, 15: 686.
35. Charriere B, Muscari F, Maulat C, et al (2017). Outcomes of patients with hepatocellular carcinoma are determined in multidisciplinary team meetings. *J Surg Oncol*, 115(3):330-336.
36. Fiorentini G, Sarti D, Aliberti C, et al (2017). Multidisciplinary approach of colorectal cancer liver metastases. *World J Clin Oncol*, 8(3):190-202.
37. Foda ZH, Annapragada AV, Boyapati K, et al (2023). Detecting liver cancer using cell-free DNA fragmentomes. *Cancer Discov*, 13(3):616-31.
38. An L, Zeng H, Zheng R, et al (2019). [Liver cancer epidemiology in China, 2015]. *Zhonghua Zhong Liu Za Zhi*, 41(10):721-727.
39. Calderaro J, Ziol M, Paradis V, et al (2019). Molecular and histological correlations in liver cancer. *J Hepatol,* 71(3):616-30.
40. Saitta C, Pollicino T, Raimondo G (2019). Obesity and liver cancer. *Ann Hepatol*, 18(6):810-5.
41. Wang C, Vegna S, Jin H, et al (2019). Inducing and exploiting vulnerabilities for the treatment of liver cancer. *Nature*, 574(7777):268-72.
42. Basso M, Corallo S, Calegari MA, et al (2020). The impact of multidisciplinary team management on outcome of hepatic resection

in liver-limited colorectal metastases. *Scientific Reports*, 10(1):10871.
43. De Greef K, Rolfo C, Russo A, et al (2016). Multisciplinary management of patients with liver metastasis from colorectal cancer. *World J Gastroenterol*, 22(32):7215-25.
44. Anwanwan D, Singh SK, Singh S, et al (2020). Challenges in liver cancer and possible treatment approaches. *Biochim Biophys Acta Rev Cancer,* 1873(1):188314.
45. Pillay B, Wootten AC, Crowe H, et al(2016). The impact of multidisciplinary team meetings on patient assessment, management and outcomes in oncology settings: a systematic review of the literature. *Cancer Treat Rev*, 42:56-72.