Isolated Right Ventricular Metastasis in a Woman with Advanced Hepatocellular Carcinoma after Palliative Therapy

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Keywords
Advanced hepatocellular carcinoma · Cardiac metastasis · Case report

Abstract
Hepatocellular carcinoma (HCC) with cardiac metastasis represents a group of rarity and poor prognosis. Few case reports have described this patient entity, and it remains unclear regarding the optimal treatment and predicted outcome for these patients. In our case, we represented a 67-year-old female patient with presentations of dyspnea and heart murmur, which conducted to the diagnosis of advanced HCC with isolated right ventricular metastasis. Because of multiple comorbidities regarding cardiac and pulmonary systems, she received best supportive care and survived 2 months after initial diagnosis. A systemic literature review of 80 published cases (including our patient) since the 1950s was also performed from PubMed, and the data were gathered from the medical record and literature reviews. In our review, patients with advanced HCC and cardiac metastasis involved the right heart mainly with a predomi-
nance of right atrium (53%). Meanwhile the overall 3-month survival rate in our review was 70.7%. In subgroup analysis, the overall 3-month survival was highest (97%) in patients treated with surgery and other therapies, and lowest (27%) in patients with best supportive care. To our knowledge, this is the first comprehensive literature review addressing the epidemiology, optimal treatment, and prognosis for advanced-stage HCC with cardiac metastasis. We suggest that abnormal cardiac murmur in patients with history of HCC should prompt investigation for tumor involvement of the heart. We also emphasize individualized treatment as well as prognostic measurement accordingly.

Introduction

Hepatocellular carcinoma (HCC) is the second most common cause of cancer-related death worldwide (http://globocan.iarc.fr/old/FactSheets/cancers/liver-new.asp). Patients with a Child-Pugh grade of A or B, vascular invasion or extrahepatic metastasis, and cancer-related symptoms (performance status 1–2) are classified as Barcelona Clinic Liver Cancer (BCLC) stage C disease [1]. The most common locations of metastases include lung, followed by lymph nodes, bone, mesentery and/or omentum, adrenal glands, and brain, respectively [2, 3]. Cardiac metastasis is uncommon in patients with HCC, with a reported incidence of 2–4% [4] and a median survival of 1–4 months [5]. The epidemiology, optimal treatment, and prognosis in this patient population are not clear. We present a case of isolated right ventricular metastasis in a woman with advanced HCC after palliative therapy and analyzed the epidemiology, treatment, and prognosis from systemic literature review.

Case Presentation

The 67-year-old woman presented to the emergency department with insidious-onset, persistent, and moderately severe abdominal tenderness at right upper quadrant area for more than 1 month. She also mentioned exertional dyspnea, dry cough, and bilateral legs’ edema simultaneously. She had medical history of hypertension, type II diabetes mellitus, and newly diagnosed chronic obstructive pulmonary disease (Global Initiative for Chronic Obstructive Lung Disease [GOLD] stage B) and did not receive follow-up regularly. She did not travel in the recent 1 year but had continuous exposure to tobacco of 1 pack per day for more than 30 years. She was admitted to local hospital and was transferred to our hospital for survey.

On physical examination at admission, her temperature was 35.6°C, heart rate 104 beats/min, respiratory rate 20 breaths/min, and blood pressure 138/68 mm Hg. On auscultation of heart, there were high-pitched, early diastolic decrescendo murmur at the left-sided third intercostal space, and high-pitched, holosystolic murmur at the left lower sternal border and with radiation to the right lower sternal border. Pulmonary examination revealed bilaterally diffuse wheezing and rales. Abdominal examination showed local tenderness at right upper quadrant area and palpable spleen contour, while palpation was without muscles guarding or rebounding pain. The rest of the physical examination was unremarkable except for pitting edema in bilateral lower legs.
Laboratory examination revealed a total leukocyte count of 9,900 cells per μL, hemoglobin concentration of 12.5 g/dL, and platelet count of 260,000 per μL. Her alanine aminotransferase was 34 U/L, aspartate aminotransferase 41 U/L, alkaline phosphate 143 U/L, serum total bilirubin 0.3 mg/dL, albumin 2.9 g/dL, creatinine 72.5 μmol/L, alpha-fetoprotein 31.9 IU/mL, internal normalized ratio 1.02, and activated partial thromboplastin time 22.4 s on initial presentation. In addition, serum markers were negative for hepatitis B surface antigen and hepatitis C antibody, while positive for IgG antibody to hepatitis B core antigen. Chest X-ray showed alveolar infiltration over left lower lobe with bilateral costophrenic angle blunting. Electrocardiogram reported sinus tachycardia. Abdominal sonography exhibited two hepatic masses at right hepatic lobe indicating hepatic malignancy. Magnetic resonance imaging of abdomen with gadolinium-based contrast displayed two HCCs at segment 6 and 7/8 interface, while the largest one was 60 mm in diameter. Owing to associated symptoms and physical examination of heart murmurs, we arranged two-dimensional transthoracic echocardiography for differential diagnosis, which manifested a cardiac mass in right ventricle (Fig. 1a, c, e) extending to right ventricular outflow track, which resulted in moderate tricuspid regurgitation (Fig. 1e, f) and pulmonary hypertension with peak systolic pressure gradient 67.5 mm Hg. In order to diagnose accurately, we arranged multiple detector computed tomography of heart with non-ionic contrast, which showed an infiltrative, multilobulated mass in the right ventricular chamber (Fig. 1b, d) with deep invasion to myocardium and size of 42 × 67 mm. Besides, one pulmonary mass at left upper lobe (Fig. 2) with multiple lymphadenopathies within mediastinum and left hilum was also noted, without any involvement to pulmonary valve, tricuspid valve, right atrium, or inferior vena cava, indicating cardiac and pulmonary metastases. According to Barcelona Clinic Liver Cancer (BCLC) classification, she was diagnosed as advanced stage of HCC with cardiac and pulmonary metastases. We consulted cardiovascular surgeons, who recommended anticoagulant with enoxaparin rather than surgical resection because of multiple comorbidities regarding cardiac and pulmonary systems and high perioperative anesthesia risk. In addition, we suggested target therapy of Nexavar for her. But she decided to receive home hospice after family meeting using framework of shared decision making, and she was discharged on the 14th day of hospitalization. Finally, she expired peacefully at home 2 months after diagnosis.

Discussion

Cardiac metastasis in advanced HCC is uncommon but challenging in clinical management, with totally 80 cases (including our patient) reported in the literature (see online suppl. File S1; www.karger.com/doi/10.1159/000504566). Mean patient age at admission was approximately 59.7 years, with a male predominance (78%) (Table 1, Table 2, Table 3). The cardiac metastases were on the right heart in 87%, left heart in 4%, and bilateral chambers in 9% of patients. Within the cardiac metastases of right heart, 78% involved right atrium, while 40% contained right ventricles, respectively. Besides, the most common site of heart involvement in advanced HCC remained the right atrium (52%), followed by right atrium and ventricle simultaneously (21%), right ventricle alone (14%), bilateral hearts (9%), and left heart alone (4%), based on our analysis. The mean maximal diameter of the cardiac tumor was 59 mm (15–150 mm).
The overall mortality rate was 67.5%, but it was lower (54.8%) in patients who received combined therapies including surgery and was higher (100%) in subjects with palliative therapy. Regarding the management, surgery alone was performed in 21% of our patients, while combined treatments with surgery, add-on therapies without surgery, and palliative therapy were performed in 39, 21, and 19% of our patients, respectively. Meanwhile, the overall 3-month survival rate in our review was 70.7% (Table 4). In subgroup analysis, the overall 3-month survival was highest (97%) in patients treated with surgery and other therapies, and lowest (27%) in patients with best supportive care. The 3-month survival rate in groups of combined therapy except surgery, and surgery alone were 76 and 57%, respectively. Among these patients, tumor progression and hepatic failure were the most common causes of death, while bleeding, thromboembolic events, heart failure, and multi-organ failure had also been reported.

HCC is recognized as one of the most chemoresistant tumors [6], and approximately one third of the patients are at advanced stage of HCC, with an average survival period of 6–12 months [7]. Transcatheter arterial chemoembolization is an effective local-regional treatment to prevent intrahepatic tumor progression not only for intermediate-stage HCC [8] but also for advanced-stage HCC [9, 10]. For patients with vascular invasions and/or extrahepatic metastasis, systemic therapies were recommended as standard treatments worldwide [6, 11]. Sorafenib and lenvatinib has been shown to be effective in first-line therapy, while regorafenib is effective in second line in patients with radiological progression after sorafenib. Cabozantinib has been demonstrated to be superior to placebo in second or third line as well as nivolumab, which has been approved in second line by FDA. However, for advanced-stage HCC, surgical intervention is not considered as a standard therapeutic choice and has been seldomly performed in daily practice. From the perspective of surgeons, vascular invasion with tumor thrombus could be classified into three types based on its anatomic location relative to the heart [12], and alternative surgical strategies including standard radical hepatectomy, total hepatic vascular exclusion, or hepatectomy plus thrombectomy under cardiopulmonary bypass could be performed according to each subtype. In our review, most of these patients receiving surgery had isolated cardiac metastasis (77.1%), and the percentage in group of surgery alone (82.4%) was higher than that in group of combined modalities (74.2%). The overall survival rate of patients who received surgery either alone or combined with other treatments appeared to be superior to those without surgery. Therefore, surgical intervention in selected patients with cardiac involvement might be beneficial not only in palliation of symptoms but also in survival benefit after individualized and comprehensive evaluation.

Although the baseline characteristics of patients were not standardized in our review, such as performance status, disease acuteness, and extent of tumor involvement, we offered descriptive information of patients in advanced-stage HCC with cardiac metastasis and prognostic measurement according to different therapeutic modalities in our review. To our knowledge, this is the first comprehensive literature review relative to advanced-stage HCC with cardiac metastasis discussing the epidemiology, optimal treatment, and prognosis. It emphasizes the need for thorough evaluation and individualized treatment to achieve a beneficial clinical outcome in patients with advanced-stage HCC with cardiac metastasis via multidisciplinary teamwork.
Acknowledgements

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Statement of Ethics

Written informed consent was obtained from the patient and his family for publication of this case report and any accompanying images.

Disclosure Statement

The authors have no conflict of interest.

Author Contributions

C.-T. Fan and S.-I. Shiu designed the study. C.-T. Fan and S.-I. Shiu screened studies and extracted data. C.-T. Fan and S.-I. Shiu did the statistical analyses. C.-T. Fan, W.-W. Lin, and S.-I. Shiu prepared figures. C.-T. Fan, W.-W. Lin, M.-J. Chen, and S.-I. Shiu reviewed the results, interpreted data, and wrote the manuscript. All authors approved the final version of the manuscript.

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Fig. 1. Cardiac mass (arrow) measuring 42 × 67 mm was detected from apical four-chamber view in trans-thoracic echocardiography (a) and multi-detector computed tomography (b) with deep invasion to myocardium. Metastatic tumor extent from right ventricular to right ventricular outflow track and featured with pulmonary outflow tract obstruction (c, d), which led to moderate tricuspid regurgitation (e) and pulmonary hypertension with peak systolic pressure gradient 67.5 mm Hg (f). RA, right atrium; RV, right ventricle; RVOT, right ventricular outflow track; LA, left atrium; LV, left ventricle.
Fig. 2. Multi-detector computed tomography showed a pulmonary mass (asterisk) seen at left upper lobe with segmental lung collapse (arrowhead).
### Table 1. The demographic data of patients with advanced hepatoma (TNM IVB) and cardiac metastasis in literature review (for full references, see online suppl. material)

| Patient (reference) | Age  | Gender | Etiology               | Metastases* | Cardiac tumor (size/infiltration depth) | Cirrhosis Intervention* | Outcomes/observation period | Cause of death                      |
|---------------------|------|--------|------------------------|-------------|-----------------------------------------|-------------------------|-----------------------------|------------------------------------|
| 2018 Kim et al.     | 46   | M      | HBV                    | L/Har       | NA                                      | Y (6)                   | Alive/2.5 Ys                |                                    |
| 2018 Dokmak et al.  | 59   | M      | Metabolism             | Har         | NA                                      | N                       | Alive/6 M                   |                                    |
| 2018 Ninomiya et al.| 77   | M      | Har                    | NA          | N                                       | S                       | Alive/6 M                   |                                    |
| 2018 Gray et al.    | 65   | F      | Hvis                   | 30×40 mm/NA | NA                                      | S                       | Alive/2 Ys                  |                                    |
| 2018 Otaru et al.   | 71   | M      | NA                     | L/Har       | NA                                      | S+N/L                   | Dead/3 Ys                   | Brain metastasis                 |
| 2017 Sahti et al.   | 67   | M      | HCV                    | Har         | NA                                      | Y (7)                   | Alive/6 M                   |                                    |
| 2017 Kornberger et al.| 69   | M      | Hvr/Hvl/Hvis           | 72×45×56 mm/myocardium | NA                        | S                       | Dead/5.5 M                  | NA                                 |
| 2017 Komaros et al. | 59   | NA     | HCV                    | Har         | NA                                      | S+N/L                   | Alive/6 D                   |                                    |
| 2017 Takaya et al.  | 74   | M      | HCV                    | Har         | NA                                      | S                       | Dead/3 Ys                   | Brain stem hemorrhage            |
| 2017 Abdelhady et al.| 73   | F      | Har                    | NA          | S                                       | N                       | Dead/1 M                    | Hepatorenal syndrome             |
| 2017 Boritmonte et al.| 56   | M      | HBV                    | Hvr/muscle  | Y (5)                                   | S+N                     | Alive/1 Y 7 M                |                                    |
| 2016 Fujita et al.  | 67   | F      | HCV                    | Har         | Y (NA)                                  | S/L                     | Alive/24 D                  |                                    |
| 2016 Pectasides et al.| 53   | M      | HCV/alkoholism         | L/Ln/Har    | NA                                      | Y (NA)                  | Dead/1 Y 10 M                | Right heart failure with hepatic de-compensation |
| 2015 Lou et al.     | 35   | M      | HBV                    | Har         | NA                                      | Y (NA)                  | Dead/6 M                    | Hepatic failure                 |
| 2015 Monzie et al.  | 54   | M      | HBV                    | Hvr         | 37×23 mm/NA                             | Y (NA)                  | Alive/9 M                   |                                    |
| 2014 Hiyuga et al.  | 74   | M      | NA                     | Har         | NA                                      | S+N/L                   | Alive/2 Ys 11 M             |
| 2014 Hayashida et al.| 72   | M      | Har                    | NA          | S/L                                     | Dead/6 M                | Tumor progression            |
| 2014 Li et al.      | 66   | M      | HBV                    | Har         | NA                                      | S/L                     | Dead/6 M                    | Tumor recurrence                |
| 2014 Tameda et al.  | 74   | M      | Alkoholism             | L/Hvr       | 50 mm/myocardium                        | Y (NA)                  | Dead/9 M                    | NA                                 |
| 2013 Philipsen et al.| 44   | F      | NA                     | L/Br/Hvl/spleen/kidney/thyroid | NA/endocardium          | P                       | Dead/1 D                    | Multiple cerebellar infarctions     |
| 2012 Barbero et al. | 70   | M      | HCV                    | Har/Hvr     | 95×42 mm/NA                             | NA                      | Alive/1 Y 7 M                |                                    |
| 2012 Tastekin et al.| 24   | M      | NA                     | L/Hvl       | 40 mm/myocardium                        | N                       | Dead/6 M                    | Multiple organ failure           |
| 2012 Ulus et al.    | 61   | M      | NA                     | Har         | 56×52 mm/NA                             | NA                      | Dead/8 D                    | Acute kidney failure             |
| 2011 Kakal et al.   | 70   | M      | HCV                    | Har         | 53×61 mm/NA                             | NA                      | Dead/2 M                    | NA                                 |
| 2011 Vijay et al.   | 50   | M      | NA                     | Har/Hvr     | NA                                      | Y (NA)                  | Dead/1 D                    | NA                                 |
| 2011 Dedelinas et al.| 40   | M      | HBV                    | Har/Hvr     | NA                                      | Y (NA)                  | Alive/2 M                   |                                    |
| 2011 House et al.   | 67   | M      | NA                     | Har         | 30×22 mm/NA                             | NA                      | Alive/2 Ys 3 M              |
| 2010 Sakamoto et al.| 80   | M      | NA                     | L/M/A/Hal   | NA                                      | NA                      | Dead/2 M                    | Cerebral infarction              |
| 2010 Liu et al.     | 46   | F      | NA                     | Hvr/Hvis    | NA/myocardium                           | S+C (thaldomid)         | Dead/4 M                    | Tumor recurrence                  |
| 2010 Jong et al.    | 48   | M      | NA                     | L/Har       | >60 mm/NA                               | Y (NA)                  | Alive/6 M                   |                                    |
| 2009 Balius et al.  | 82   | NA     | NA                     | Har/Hvr     | 6×3×24 mm/NA                            | NA                      | Dead/6 M                    | NA                                 |
| 2008 Sung et al.    | 71   | M      | NA                     | L/Har/Hvr   | 50×36×25 mm/NA                          | NA                      | Alive/6 M                   |                                    |
| 2007 Kan et al.     | 74   | F      | HCV                    | Hvr/Har     | NA                                      | S+N+C                   | Dead/4 M                    | Tumor progression                |

* L, lung; Ln, lymph nodes; Bo, bone; M, mesentery or omentum; A, adrenal glands; Br, brain; Har, right atrium; Hvr, right ventricle; Hal, left atrium; Hvl, left ventricle; Hvis, interventricular septum. *I, immunotherapy; N, Nexavar; T, TACE; R, radiation therapy; S, surgery; A, antiplatelets; W, warfarin; C, chemotherapy; P, palliative care; L, combined regional therapy. F, female; M, male; NA, not available; Y, yes; N, no; B, days; M, months; Ys, years; ALC, alcoholism.
### Table 2. Continuation of Table 1

| Patient (reference) | Age | Gender | Etiology | Metastases | Cardiac tumor (size/infiltration depth) | Cirrhosis Intervention* | Outcomes/observation period | Cause of death |
|---------------------|-----|--------|----------|------------|----------------------------------------|------------------------|-------------------------------|----------------|
| 2007 Murakami et al. | 58  | M      | NA       | Har        | NA                                     | NA                     | Dead/1 Y 1 M                  | Tumor progression |
| 2007 Sekine et al.  | 63  | F      | NA       | Har/Hvr    | 30×15 mm/NA                             | Y (NA) S              | Alive/7 D                    |                            |
| 2007 Kiolcz et al.  | 65  | F      | HBV/HCV  | Har/Hvr    | 62×37 mm/NA                             | Y (NA) S+A (enoxaparin) | Dead/2 D                      | NA                      |
| 2007 Mansour et al. | 65  | NA     | Alcoholism| Har        | 60 mm/NA                                | Y (NA) S              | Alive/3 Ys                   |                            |
| 2006 Hasuike et al. | 66  | M      | NA       | L/Har      | NA                                     | NA                    | Dead/5 M                      | Pneumonia               |
| 2006 Hasuike et al. | 79  | M      | NA       | L/Har/Hvr  | NA                                     | NA                    | Alive/1 Y 7 M                 |                            |
| 2006 Jikel et al.   | 48  | M      | Alcoholism | Hvr        | NA/endocardium                          | Y (NA) P             | Dead/16 D                     |                            |
| 2005 Cheng et al.   | 65  | F      | NA       | L/Hvr      | NA                                     | NA                    | Dead/2 D                      | NA                      |
| 2004 Longo et al.   | 43  | M      | NA       | L/Hvr      | NA/myocardium                           | NA                    | Dead/20 D                     | Acute heart failure       |
| 2004 Novotny et al. | 67  | M      | HBV/    | Har        | NA/myocardium                           | Y (NA) A             | Dead/3 M                      | Haptic failure           |
|                    |     |        | Alcoholism|           |                                        |                       |                               |                            |
| 2004 Masci et al.   | 43  | M      | HBV/    | L/Hvr/Hvs  | 60×60×30 mm/myocardium                  | Y (NA) S+C (cisplatin+doxorubicin) | Dead/6 M                      | Haptic failure           |
|                    |     |        | Alcoholism|           |                                        |                       |                               |                            |
| 2004 Díaz et al.    | 71  | M      | HCV      | Har/Hvr    | 60×30 mm/NA                             | IA thrombolysis       | Dead/1 D                      | Pulmonary embolism        |
| 2004 Lin et al.     | 45  | M      | HBV      | L/Hvr      | 91×56 mm/NA                             | NA                    | Alive/3 M                     |                            |
| 2004 Kassotis et al.| 75  | F      | NA       | Har/Hal    | 60×45 mm/myocardium                     | NA                    | Dead/1 D                      | Idiopathic PEA            |
| 2003 Syed et al.    | 76  | M      | NA       | Har        | 50×40 mm/NA                             | NA                    | Dead/10 M                      | NA                      |
| 2003 Vlasseros et al.| 66  | M      | Idiopathic| Har        | 600 mm²/NA                              | Y (NA) C             | Dead/4 M                      | NA                      |
| 2001 Chu et al.     | 71  | M      | Alcoholism| M/Har      | 50×50 mm/NA                             | Y (NA) S             | Alive/1.5 M                   |                            |
| 2000 Yogita et al.  | 61  | M      | HCV      | Har        | NA                                     | Y (NA) S/L           | Dead/4 Ys 8 M                 | Pulmonary metastasis      |
| 2000 Murakawa et al.| 49  | F      | NA       | Hvr        | NA/myocardium                           | NA                    | Dead/1 Y 9 M                   | Tumor progression         |
| 2000 Wu et al.      | 42  | M      | NA       | Har        | 150 mm/NA                              | Y (NA) S/L           | Dead/1 Y 2 M                   | Tumor progression         |
| 2000 Marsteller et al.| 61  | NA     | NA       | Har        | NA                                     | NA                    | Dead/3 M                      | NA                      |
| 2000 Kotani et al.  | 67  | F      | HCV      | L/Hvr      | 4×37 mm/myocardium                      | Y (NA) C             | Alive/3 M                     |                            |
| 1999 Kashima et al. | 66  | M      | HCV      | Har        | NA                                     | Y (NA) L             | Alive/5 Ys 11 M               |                            |
| 1998 Yoshitomi et al.| 65  | F      | HCV      | Har        | NA                                     | C (carboplatin)/L    | Dead/2 M                      | Hepatic encephalopathy    |
| 1998 Yoshitomi et al.| 70  | M      | HCV      | Har        | NA                                     | NA                    | Alive/1 Y                     |                            |
| 1996 Giacalone et al.| 67  | M      | HCV      | Har        | 70 mm/NA                               | Y (NA) S             | Dead/5 D                      | NA                      |
| 1995 Baba et al.    | 81  | M      | NA       | Har        | NA                                     | Y (NA) S             | Dead/21 D                     | Hepatorenal syndrome      |
| 1994 Shibata et al. | 65  | M      | NA       | Har        | NA                                     | C (oral UFT)/L       | Alive/10 M                    |                            |
| 1994 Sohn et al.    | 61  | M      | NA       | Har        | 25×35 mm/NA                             | C (5-FU+adriamycin+mitomycin) | Dead/6 M                      | Hepatic failure           |
| 1994 Van et al.     | 52  | F      | HCV      | Har        | NA                                     | Y (NA) P             | Dead/7 D                      | Hepatic encephalopathy, hepatorenal syndrome |
| 1994 Noguchi et al. | 66  | M      | Schistosomiasis | Har        | 15 mm/NA                               | Y (NA) P             | Dead/1 M                      | Rupture of esophageal varices |
| 1994 Masaki et al.  | 47  | M      | HBV      | Har/Hvr    | NA                                     | NA                    | Dead/8 M                      | Tumor progression         |

* L, lung; Ln, lymph nodes; Bo, bone; M, mesentery or omentum; A, adrenal glands; Br, brain; Har, right atrium; Hvr, right ventricle; Hal, left atrium; Hvl, left ventricle; Hivs, interventricular septum. *I, immunotherapy; N, Nexavar; T, TACE; R, radiation therapy; S, surgery; A, antiplatelets; W, warfarin; C, chemotherapy; P, palliative care; L, combined regional therapy. F, female; M, male; NA, not available; Y, yes; N, no; D, days; M, months; Ys, years; ALC, alcoholism.
### Table 3. Continuation of Tables 1 and 2

| Patient (reference) | Age | Gender | Etiology | Metastases* | Cardiac tumor (size/infiltration depth) | Cirrhosis Intervention* | Outcomes/observation period | Cause of death |
|---------------------|-----|--------|----------|-------------|-----------------------------------------|-------------------------|-----------------------------|----------------|
| 1989 Dazai et al.   | 42  | M      | HBV      | Har         | NA                                      | NA                      | L                           | Dead/7 M | Respiratory and hepatic failure |
| 1989 Chua et al.    | 60  | M      | HBV      | Har/Hvr     | NA                                      | NA                      | S/L                         | Dead/8 M | NA |
| 1989 Chua et al.    | 59  | F      | HBV      | Har/Hvr     | NA                                      | NA                      | S                           | Dead/2 Y 1 M | NA |
| 1989 Imamoglu et al.| 14  | M      | HBV      | Har         | NA                                      | NA                      | S                           | Dead/6 D | Multorgan failure |
| 1987 Miller et al.  | 60  | M      | HBV      | Har/Hvr     | 50×60 mm/NA                             | NA                      | S+IA+L                      | Alive/6 M | |
| 1986 Goto et al.    | 36  | F      | NA       | Har/Hvr     | 55×52×40 mm/NA                         | NA                      | S/L                         | Dead/7 M | Chronic liver failure |
| 1986 Chua et al.    | 53  | M      | HBV      | Har/Hvr     | NA                                      | NA                      | C (cisplatin+5-FU)          | Dead/10 D | NA |
| 1986 Chua et al.    | 60  | M      | HBV      | L/Har/Hvr   | NA                                      | Y (NA)                  | C (5-FU)                    | Dead/2 D | NA |
| 1985 Nakamura et al.| 52  | M      | Alcoholism | L/Har/Br   | NA                                      | Y (NA)                  | P                           | Dead/11 M | NA |
| 1984 Tsujimoto et al.| 62 | M      | Alcoholism | L/Bo/Har/Hvr/ Hvl/kidney/skin/ pleura/intestinal tract | NA/myocardium | Y (NA) | P                           | Dead/1 M | Renal failure |
| 1984 Horike et al.  | 57  | M      | HBV      | Har         | 60×45×30 mm/NA                          | NA                      | C                           | Dead/3 M | Respiratory failure |
| 1984 Horike et al.  | 54  | M      | Alcoholism | Har        | NA                                      | NA                      | C                           | Dead/9 M | GI bleeding, hepatic failure |
| 1975 Ehrich et al.  | 62  | M      | NA       | Bo/Har/Hvr  | 80×60×100 mm/NA                        | Y (NA)                  | S/L                         | Alive/1 Y | |
| 2019 Our patient    | 67  | F      | Idiopathic | L/Na/Hvr   | 42×67 mm/myocardium                   | Y (6)                   | P                           | Dead/2 M | |

| Mean (Tables 1–3)  | 58.7 78% M 22% F | 16 HBV 17 HCV 9 ALC 4 others 34 NA | Max. diameter 59 mm [15–150] | 32 Y 2 N 46 NA | 21% surgery alone 19% palliation 60% combined 39% combined S (+) 21% combined S (−) | 32.5% alive 67.5% dead |

* L, lung; Ln, lymph nodes; Bo, bone; M, mesentery or omentum; A, adrenal glands; Br, brain; Har, right atrium; Hvr, right ventricle; Hal, left atrium; Hvl, left ventricle; Hivs, interventricular septum. *I, immunotherapy; N, Nexavar; TACE, TACE; R, radiation therapy; S, surgery; A, antithromlet s; W, warfarin; C, chemotherapy; P, palliative care; L, combined regional therapy. F, female; M, male; NA, not available; Y, yes; N, no; D, days; M, months; Ys, years; ALC, alcoholism.
### Table 4. Survival rate of patients with advanced hepatoma and cardiac metastasis divided by metastatic locations and intervention modalities

| Parameter, n | 3-month survival, % | Overall survival, % |
|--------------|---------------------|---------------------|
| Overall (n = 80) | 70.7% | 32.5% |
| **Metastatic location** | | |
| Right heart (n = 70) | 72.0% | 34.3% |
| RA (n = 42) | 79.0% | 33.3% |
| RV (n = 11) | 70.0% | 45.5% |
| RA + RV (n = 17) | 53.0% | 29.4% |
| Left heart (n = 3) | 33.0% | 0.00% |
| Both (n = 7) | 71.0% | 28.6% |
| **Intervention modality** | | |
| Surgery alone (n = 17) | 57.0% | 41.2% |
| Surgery combined with other therapy (n = 31) | 97.0% | 45.2% |
| Combined therapy except surgery (n = 17) | 76.0% | 29.4% |
| Palliative therapy (n = 15) | 27.0% | 0.00% |