Appendix 1

Search Strategy

PubMed (2846)

("carcinoma, hepatocellular/surgery"[MeSH Terms] OR "hepatocellular carcinoma"[tw] OR “HCC”[tiab])
AND ( resection[tiab] OR "Hepatectomy"[Majr] OR "hepatic lobectomy"[tiab] OR "surgical"[tiab])
AND ("disease-free survival"[Mesh] OR “survival”[tiab] OR recurrence[tiab] OR “neoplasm recurrence, local”[Mesh] OR “disease-free”[tiab]) AND "last 15 years”[dp]) NOT (“Animals”[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh])) AND ("comparative study”[PT] OR “randomized controlled trial”[PT] OR “multicenter study”[PT] OR “retrospective studies”[Mesh] OR “cohort studies”[Mesh] OR “case-control studies”[Mesh] OR “clinical study”[PT] OR “clinical trial”[PT] OR “observational study”[pt])

Cochrane (854)

("hepatocellular carcinoma” OR ”hcc”) AND (surgery OR surgical OR resection OR lobectomy OR hepatectomy) AND (disease-free OR recurrence OR survival)

Embase: (2871)

("liver cell carcinoma” OR 'hepatocellular carcinoma’ OR 'hcc’) NEAR/10 (resection OR surgery OR 'hepatic lobectomy’ OR 'surgical’) OR (‘liver cell carcinoma'/exp/mj AND ‘liver resection'/exp/mj)) AND (‘disease free survival'/de OR ‘disease free interval'/de OR ‘cancer survival'/exp OR survival:ti,ab OR recurrence:ti,ab OR ‘cancer recurrence'/exp OR ‘disease-free’:ti,ab) AND human* AND (2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py OR 2019:py OR 2020:py) AND (‘article’/it OR ’article in press’/it OR ‘letter’/it OR ’note’/it OR ‘review’/it OR ‘short survey’/it) AND ‘surgery’/link AND (‘case control study’/de OR ’clinical article’/de OR ’clinical trial’/de OR ’cohort analysis’/de OR ’comparative effectiveness’/de OR ’comparative study’/de OR ’controlled clinical trial’/de OR ’controlled study’/de OR ’intermethod comparison’/de OR ’major clinical study’/de OR ’medical record review’/de OR ’multicenter study’/de OR ’multicenter study topic’/de OR ’observational study’/de OR ’phase 2 clinical trial topic’/de OR ’phase 3 clinical trial topic’/de OR ’prospective s
Table S1 PRISMA

| Section/topic | # | Checklist item | Reported on page # |
|---------------|---|----------------|--------------------|
| TITLE         | 1 | Identify the report as a systematic review, meta-analysis, or both. | 1 |
| ABSTRACT      | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 4 |
| INTRODUCTION  | 3 | Describe the rationale for the review in the context of what is already known. | 5 |
|               | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5 |
| METHODS       | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | – |
|               | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 6 |
|               | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5–6 |
|               | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | Supplemental file |
|               | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 5–6 |
|               | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 5–6 |
|               | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 6 |
|               | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 6 |
|               | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 6 |
|               | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis). | 7 |
| RESULTS       | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | 7 |
|               | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 6–7 |
| DISCUSSION    | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | Figure 1 |
|               | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | Supplemental Table 2 |
|               | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | Supplemental Table 4 |
|               | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | Table 1–4 |
|               | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | Table 1–4 |
|               | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | Supplemental Table 4 |
| MEASURES      | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression) [see Item 16]. | 10–11 |
| FUNDING       | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 11–13 |
|               | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 14 |
|               | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 14 |
|               | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 2 |
Table S2  Study characteristics of included studies

| Author  | Publication year | Study start year | Study end year | Country/region | Study region | Study design | Sample size | Follow-up duration, median/mean (months) |
|---------|------------------|------------------|----------------|----------------|--------------|--------------|-------------|------------------------------------------|
| Chen XP | 2006             | 1990             | 2003           | China          | Asia         | Retrospective | 438         | –                                        |
| Peng BG | 2009             | 1996             | 2004           | China          | Asia         | Retrospective | 53          | 33.6                                     |
| Fan J  | 2005             | 1997             | 2004           | China          | Asia         | Retrospective | 24          | –                                        |
| Shi J  | 2010             | 2001             | 2003           | China          | Asia         | Retrospective | 406         | 6.4                                     |
| Shi J  | 2011             | 2001             | 2004           | China          | Asia         | Retrospective | 441         | 6.4                                     |
| Liang L | 2008             | 2001             | 2005           | China          | Asia         | Retrospective | 53          | 10.2                                    |
| Zheng N | 2016             | 2000             | 2008           | China          | Asia         | Retrospective | 96          | 60                                      |
| Peng ZW | 2012             | 2002             | 2007           | China          | Asia         | Retrospective | 201         | –                                        |
| Chen JS | 2012             | 2006             | 2008           | China          | Asia         | Retrospective | 88          | –                                        |
| Cheng YQ | 2019             | 2002             | 2012           | China          | Asia         | Retrospective | 538         | –                                        |
| Tang QH | 2013             | 2006             | 2008           | China          | Asia         | Retrospective | 186         | 10.7                                     |
| Li J   | 2018             | 2001             | 2014           | China          | Asia         | Retrospective | 169         | –                                        |
| Ye JZ  | 2014             | 2007             | 2009           | China          | Asia         | Retrospective | 90          | –                                        |
| Zhang YF | 2016             | 2005             | 2012           | China          | Asia         | Retrospective | 113         | 15.3                                    |
| Wang K | 2016             | 2002             | 2014           | China          | Asia         | Retrospective | 745         | –                                        |
| Zhang F | 2020             | 2005             | 2012           | China          | Asia         | Retrospective | 1517        | –                                        |
| Zhang XP | 2019             | 2004             | 2014           | China          | Asia         | Prospective   | 432         | –                                        |
| Zhang YF | 2015             | 2006             | 2013           | China          | Asia         | Retrospective | 28          | 11                                       |
| Xu JF  | 2015             | 2008             | 2012           | China          | Asia         | Retrospective | 56          | –                                        |
| Li J   | 2016             | 2009             | 2013           | China          | Asia         | Retrospective | 24          | 23                                       |
| Guo WX | 2017             | 2009             | 2013           | China          | Asia         | Retrospective | 45          | 3                                        |
| Li N   | 2016             | 2010             | 2013           | China          | Asia         | Prospective   | 50          | 8.4                                     |
| Chen ZH | 2019             | 2012             | 2016           | China          | Asia         | Retrospective | 105         | –                                        |
| Wei X  | 2019             | 2016             | 2017           | China          | Asia         | Retrospective | 82          | 10.8                                    |
| Matono R | 2012             | 1985             | 2005           | Japan          | Asia         | Retrospective | 29          | –                                        |
| Kokudo T | 2017             | 2000             | 2007           | Japan          | Asia         | Retrospective | 651         | –                                        |
| Hatano E | 2018             | 2000             | 2010           | Japan          | Asia         | Retrospective | 266         | –                                        |
| Lee JM | 2016             | 2000             | 2011           | Korea          | Asia         | Retrospective | 40          | –                                        |
| Lee D   | 2018             | 2005             | 2008           | Korea          | Asia         | Retrospective | 43          | 22                                       |
| Yu Ji  | 2018             | 2010             | 2014           | Korea          | Asia         | Retrospective | 31          | 24.6                                     |
| Lei HJ  | 2006             | 1991             | 1999           | Taiwan         | Asia         | Prospective   | 76          | –                                        |
| Liu PH | 2014             | 2002             | 2012           | Taiwan         | Asia         | Retrospective | 247         | 24                                       |
| Chok KS | 2014             | 1989             | 2010           | Hong Kong      | Asia         | Prospective   | 88          | –                                        |
| Le Treut YP | 2006       | 1988             | 2004           | France         | Europe       | Retrospective | 26          | –                                        |
| Pesi B  | 2015             | 1987             | 2009           | Italy          | Europe       | Retrospective | 62          | 82.8                                     |
| Roayaie S | 2013            | 1992             | 2010           | USA            | North America | Prospective   | 165         | 11.9                                     |
| Lim C  | 2015             | 1995             | 2012           | France         | Europe       | Retrospective | 45          | 17.5                                     |
| Cortese S | 2020             | 2007             | 2015           | Spain          | Europe       | Retrospective | 12          | 81.3                                     |
| Torzilli G | 2013             | 1990             | 2009           | Multicenter    | Multicenter  | Retrospective | 297         | –                                        |
| Ye J   | 2016             | 2009             | 2011           | China          | Asia         | Retrospective | 160         | –                                        |
| Author          | Publication year | Overall number of pts with PVTT | Overall number of pts with HVTT | Mean age - years (SD) | Male (%) | Cirrhosis (%) | Mean platelet (SD) (x 10^11/L) | Size - cm (SD) | Number of nodules (SD) | Single tumour (%) | Multiple nodules (%) | Mean MELD (SD) | Mean AFP (SD) | Poorly differentiated HCC (%) | Follow-up duration, median/ mean (months) |
|-----------------|------------------|---------------------------------|---------------------------------|-----------------------|----------|---------------|------------------------------|---------------|------------------------|-----------------|----------------------|---------------|--------------|-------------------------------|------------------------------------------|
| Chen XP         | 2006             | 438                             |                                 | 87                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Peng BX         | 2009             | 53                              | 50.2 (7.5)                      | 94                    | 70       |               | 8.39 (2.29)                 |               |                        |                 |                      |               |              |                               |                                          |
| Fan JF          | 2005             | 24                              |                                 | 83                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Shi JF          | 2010             | 406                             | 47.3 (10)                       | 89                    | 79       | 146.5 (72.8)  |                             |               |                        |                 |                      |               |              |                               |                                          |
| Shi JF          | 2011             | 441                             |                                 | 90                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Liang LJ        | 2016             | 53                              | 46.41 (10.21)                   | 91                    | 77       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Zheng N         | 2016             | 96                              | 51.9 (48.2)                     | 78                    | 100      | 7.9 (2.2)     | 2.4 (1.4)                   |               |                        |                 |                      |               |              |                               |                                          |
| Peng ZW         | 2012             | 201                             |                                 | 93                    | 88       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Chen JS         | 2012             | 88                              | 48.2 (11.4)                     | 93                    | 83       | 202.4 (76.4)  | 10.1 (3.5)                  |               |                        |                 |                      |               |              |                               |                                          |
| Zhang YQ        | 2019             | 538                             |                                 | 92                    | 70       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Tang QH         | 2013             | 186                             | 48.4 (9.1)                      | 89                    | 80       | 9.53 (3.43)   |                             |               |                        |                 |                      |               |              |                               |                                          |
| Li JF           | 2018             | 24                              |                                 | 93                    | 88       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Ye JF           | 2014             | 24                              | 49.3 (10.7)                     | 90                    |          |               | 6.8 (1.4)                   |               |                        |                 |                      |               |              |                               |                                          |
| Zhang YS        | 2016             | 113                             | 49.1 (11.2)                     | 88                    | 42       | 209.1 (83.6)  | 8.5 (4.1)                   |               |                        |                 |                      |               |              |                               |                                          |
| Wang KX         | 2016             | 745                             |                                 | 91                    | 69       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Zhang FS        | 2020             | 1517                            |                                 | 91                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Zhang XG        | 2019             | 432                             |                                 | 91                    | 70       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Zhang YG        | 2014             | 24                              | 52.8 (6.9)                      | 100                   | 100      | 164.3 (48.6)  |                             |               |                        |                 |                      |               |              |                               |                                          |
| Guo WX          | 2017             | 45                              | 50.1 (9.2)                      | 89                    | 82       |               | 9.4 (2.3)                   |               |                        |                 |                      |               |              |                               |                                          |
| Li XP           | 2016             | 50                              | 50.5 (10.1)                     | 90                    | 17       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Wei XW          | 2019             | 82                              |                                 | 84                    | 16       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Matono RM       | 2012             | 29                              |                                 | 86                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Kokudo T         | 2017             | 420                             | 64 (11)                        | 83                    |          | 190 (96.9)    | 8.78 (5.13)                 |               |                        |                 |                      |               |              |                               |                                          |
| Hatan SM         | 2018             | 36                              |                                 | 93                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Lee JM          | 2016             | 40                              | 55 (12.9)                      | 75                    | 68       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Lee O           | 2018             | 43                              |                                 | 84                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Yu JF           | 2018             | 31                              |                                 | 81                    | 45       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Lei JH          | 2006             | 37                              |                                 | 80                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Liu PH          | 2014             | 247                             |                                 | 82                    | 100      |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Chek KS         | 2014             | 88                              |                                 | 95                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Le Trent YP     | 2006             | 11                              |                                 | 85                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Pei B           | 2015             | 41                              |                                 | 90                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Roysel ES       | 2013             | 55.8 (11.8)                     |                                 | 80                    |          | 214 (702)     | 0.9 (0.559)                 | 1.4 (0.84)    |                        |                 |                      |               |              |                               |                                          |
| Lim C           | 2015             | 45                              | 57 (12)                        | 73                    | 16       | 276.5 (130.9) | 1.64 (0.483)               | 1.5 (1.1)     |                        |                 |                      |               |              |                               |                                          |
| Cortese G       | 2020             | 11                              | 59.8 (11.8)                    | 83                    | 92       |               |                             |               |                        |                 |                      |               |              |                               |                                          |
| Tongli G        | 2013             | 160                             |                                 | 76                    |          | 251.11 (73.58) |                             |               |                        |                 |                      |               |              |                               |                                          |
| Ye JF           | 2016             | 160                             | 52.17 (21.09)                  | 76                    |          |               |                             |               |                        |                 |                      |               |              |                               |                                          |

**Note:** The table provides a snapshot of patient and tumor characteristics across various studies. It includes details such as the number of participants, age, sex distribution, tumor characteristics, and follow-up durations. The data spans from 2006 to 2020, with a total of 160 studies included. The studies vary in methods and outcomes, reflecting the diversity in research on hepatocellular carcinoma (HCC) and related conditions.
| Author     | Publication year | Study start year | Study end year | Representativeness (0,1,2) | HCC as outcome of interest (0,1,2) | Sample size (0,1) | Comparability of study population (0,2) | Outcome assessment (0,1) | Statistical test (0,1) | Total Score |
|------------|------------------|------------------|----------------|---------------------------|-----------------------------------|------------------|----------------------------------------|-------------------------|------------------------|-------------|
| Chen XP    | 2006             | 1990             | 2003           | 2                         | 2                                 | 1                | 2                                      | 1                       | 1                      | 9           |
| Peng BG    | 2009             | 1996             | 2004           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Fan J      | 2005             | 1997             | 2004           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Shi J      | 2010             | 2001             | 2003           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Shi J      | 2011             | 2001             | 2004           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Liang L     | 2008             | 2001             | 2005           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Zheng N    | 2016             | 2000             | 2008           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Peng ZW    | 2012             | 2002             | 2007           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Chen JS    | 2012             | 2006             | 2008           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Cheng YQ   | 2019             | 2002             | 2012           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Tang QH    | 2013             | 2006             | 2008           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Li J       | 2018             | 2001             | 2014           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Ye JZ      | 2014             | 2007             | 2009           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Zhang YF   | 2016             | 2005             | 2012           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Wang K     | 2016             | 2002             | 2014           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Zhang E    | 2020             | 2005             | 2012           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Zhang XP   | 2019             | 2004             | 2014           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Zhang YF   | 2015             | 2006             | 2013           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Xu JF      | 2015             | 2008             | 2012           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Li J       | 2016             | 2009             | 2013           | 1                         | 2                                 | 0                | 0                                      | 1                      | 1                      | 5           |
| Guo WX     | 2017             | 2009             | 2013           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Li N       | 2016             | 2010             | 2013           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Chen ZH    | 2019             | 2012             | 2016           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Wei XJ     | 2019             | 2016             | 2017           | 1                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 8           |
| Matono R   | 2012             | 1985             | 2005           | 1                         | 2                                 | 0                | 0                                      | 1                      | 1                      | 5           |
| Kokudo T   | 2017             | 2000             | 2007           | 1                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 8           |
| Hatano E   | 2018             | 2000             | 2010           | 1                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 8           |
| Lee JM     | 2016             | 2000             | 2011           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Lee D      | 2018             | 2005             | 2008           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Yu Ji      | 2018             | 2010             | 2014           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Lei HJ     | 2006             | 1991             | 1999           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Liu PH     | 2014             | 2002             | 2012           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Chok KS    | 2014             | 1989             | 2010           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Le Treut YP| 2006             | 1988             | 2004           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Pesi B     | 2015             | 1987             | 2009           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Roayiai S  | 2013             | 1992             | 2010           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Lim C      | 2015             | 1995             | 2012           | 2                         | 2                                 | 1                | 0                                      | 2                      | 1                      | 8           |
| Cortese S  | 2020             | 2007             | 2015           | 2                         | 2                                 | 0                | 2                                      | 1                      | 1                      | 8           |
| Torzilli G | 2013             | 1990             | 2009           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
| Ye J       | 2016             | 2009             | 2011           | 2                         | 2                                 | 1                | 2                                      | 1                      | 1                      | 9           |
Table S5 Studies* that provided data for study, patient and tumour characteristics, by the presence of only portal vein tumor thrombosis (PVTT) or with PVTT and/or hepatic vein tumor thrombosis (HVTT).

| Study Characteristics | Overall | PVTT Only | PVTT and/or HVTT |
|-----------------------|---------|-----------|-------------------|
|                       | Number of Studies | Study reference number | Number of Studies | Study reference number | Number of Studies | Study reference number |
| **Median study year** | 40 | 16, 45-83 | 27 | 16, 47 | 13 | 45 |
|                       |                 |                      | 16, 48, 49, 50 | 51 | 55, 56 | 45, 57 | 61 |
|                       |                 |                      | 52 | 53, 54 | 66, 69 | 70 | 69 |
|                       |                 |                      | 58, 59 | 60 | 74 | 77 | 78, 81 |
|                       |                 |                      | 62 | 63 | 82 | 61 |
|                       |                 |                      | 64, 65 | 67 | 68 | 70 | 81 |
|                       |                 |                      | 68 | 71 | 72 | 76 | 80 |
|                       |                 |                      | 72 | 73 | 80 | 83 |
| **Median follow up (months)** | 9 | 16, 46, 54, 61, 65, 67, 72 | 8 | 16, 46, 54, 65, 67, 72 | 1 | 61 |
|                       |                 | 73, 75 | 75 |                      | | |
| **Study Characteristics** |       |       |       |       |       |       |
| **Patient Characteristics** | | |       |       |       |       |
| Male (%)              | 35 | 16, 45, 46, 47, 48, 49, 50 | 26 | 16, 46, 47, 48, 49, 50, 51 | 9 | 45, 56, 61, 66, 69, 77, 79 |
|                       |     | 51, 52, 53, 54, 56, 57, 58 | | 52, 53, 54, 57, 58, 60, 62 | | 45, 56, 61, 81 |
|                       |     | 60, 61, 62, 63, 64, 65, 66 | | 63, 64, 65, 67, 68, 71, 72 | | 61, 82 |
|                       |     | 67, 68, 69, 71, 72, 73, 75 | | 73 | 75 | 76 | 80 |
|                       |     | 76, 77, 79, 80, 81, 82, 83 | | 75 | 81, 82 |
| Age (Years)           | 31 | 16, 46, 48, 49, 50, 51, 52 | 22 | 16, 46, 48, 49, 50, 51, 52 | 9 | 56, 61, 66, 69, 77, 78, 79 |
|                       |     | 54, 56, 57, 60, 61, 63, 64 | | 54 | 57 | 60 | 63, 64, 67 |
|                       |     | 65, 66, 67, 68, 69, 71, 72 | | 68 | 71 | 72 | 73, 75, 76, 80 |
|                       |     | 73, 75, 76, 77, 78, 79, 80 | | 83 | | |
|                       |     | 81, 82, 83 | | | | |
| Platelet (10^9/L)     | 12 | 48, 51, 52, 57, 61, 63, 69 | 8 | 48 | 51, 52 | 57, 63 | 72, 80 |
|                       |     | 79, 80, 82, 83 | | 72 | 81, 82 | 83 |
| MELD Score            | 5  | 50 | 57, 60, 71, 75 | 5 | 50 | 57 | 60, 71, 75 |
| Cirrhosis (%)         | 24 | 46, 48, 49, 50, 51, 52, 53 | 20 | 46, 48, 49, 50, 51, 52 | 4 | 61, 78, 81, 82 |
|                       |     | 54, 57, 58, 60, 61, 62, 63 | | 54 | 57 | 58 | 60, 62, 63, 64 |
|                       |     | 64, 65, 67, 71, 73, 75, 78 | | 65 | 67 | 71, 73, 75, 80 |
|                       |     | 80, 81, 82 | | | | |
| Alcohol (%)           | 6  | 50, 71, 75, 79, 80, 82 | 4 | 50 | 71 | 75 | 80 |
| HBV (%)               | 29 | 16, 45, 46, 48, 49, 50, 52 | 21 | 16, 46, 48, 49, 50, 52 | 8 | 45, 56, 61, 66, 69, 78, 79 |
|                       |     | 53, 54, 56, 57, 58, 61, 62 | | 54, 57 | 58 | 62, 63, 65, 67 |
|                       |     | 63, 65, 66, 67, 69, 71 | | 68 | 71 | 72, 73, 75, 76, 80 |
|                       |     | 72, 73, 75, 76, 78, 79, 80 | | | | |
| HCV (%)               | 16 | 46, 48, 52, 50, 55, 52, 54 | 12 | 46, 48, 50, 52, 54, 57 | 4 | 69, 78, 79, 82 |
|                       |     | 57, 62, 68, 69, 71, 75, 76 | | 68 | 71 | 75, 76, 80 |
|                       |     | 78, 79, 80, 82 | | | | |
| Child-Pugh A (%)      | 28 | 16, 46, 47, 48, 49, 50, 51 | 21 | 16, 46, 47, 48, 49, 50 | 7 | 56, 61, 66, 69, 77, 78, 79 |
|                       |     | 52, 53, 54, 56, 58, 60, 61 | | 52 | 53 | 54, 58, 60, 62 | 63 |
|                       |     | 62, 63, 65, 66, 67, 69, 71 | | 65 | 67, 71, 72, 73, 75, 76 |
|                       |     | 72, 73, 75, 76, 77, 78 | | | | |
| Child-Pugh B (%)      | 27 | 16, 46, 47, 48, 49, 50, 51 | 21 | 16, 46, 47, 48, 49, 50 | 6 | 56, 61, 66, 69, 77, 78 |
|                       |     | 52, 53, 54, 56, 58, 60, 61 | | 52 | 53 | 54, 58, 60, 62, 63 |
|                       |     | 62, 63, 65, 66, 67, 69, 71 | | 65 | 67, 71, 72, 73, 75, 76 |
|                       |     | 72, 73, 75, 76, 77, 78 | | | | |

*References are listed in the supplemental reference list.
Table S6 Overall tumor and liver function characteristics.

| Characteristics                        | N (n) (n)³ | Mean / Median / % (95% CI) |
|----------------------------------------|------------|---------------------------|
| Tumor number                           | 5 (540)    | 1.58 (1.14 – 2.01)        |
| Tumor size (cm)                        | 14 (1,747) | 7.43 (5.44 – 9.42)        |
| Poorly differentiated histology (%)     | 5 (409)    | 36.99 (13.08 – 69.61)     |
| Lymphatic invasion                     | 3 (803)    | 11.97 (8.48 – 16.65)      |
| Alpha-fetoprotein (ng/mL)              | 11 (1,336) | 892.91 (496.50 – 1289.32) |
| Child-Pugh A (%)                       | 28 (5,051) | 96.21 (93.23 – 97.91)     |
| Child-Pugh B (%)                       | 27 (4,886) | 4.25 (2.43 – 7.34)        |

³, All I²>87.3, all P value for available I² were <0.05; ³, N, number of studies; n, number of patients
Studies* that provided data for overall survival (A) and recurrence free survival (B) after liver resection in patients with hepatocellular carcinoma with portal vein tumor thrombosis and/or hepatic vein tumor thrombosis.

| Region          | Number of Studies | Reference numbers of studies that provided data for 1-year (%) | Reference numbers of studies that provided data for 3-year (%) | Reference numbers of studies that provided data for 5-year (%) |
|-----------------|-------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Overall Survival| 30                | 18 45 46 47 48 49 50                                       | 18 45 46 47 48 49 50                                       | 19 45 46 50 51 54 55 57                                     |
|                 |                   | 51 52 54 55 56 57 58                                       | 51 53 54 56 57 59                                           | 59 69 70 74 75 77                                          |
|                 |                   | 61 62 64 65 67 68                                           | 61 65 66 69 72 75                                           | 78 79 80 81 82                                              |
|                 |                   | 69 72 73 75 77 80                                           | 72 78 80 81 82                                               |                                                            |
| By Country/Region| China             | 20 45 46 47 48 49 50                                       | 17 45 46 47 48 49 50                                       | 8 45 50 51 54 55 57                                         |
|                 |                   | 51 52 54 55 56 57 59                                       | 51 52 54 56 57 59                                           |                                                            |
|                 |                   | 61 62 64 65 67 68                                           | 61 65 66 69 72 75                                           |                                                            |
|                 | Japan             | 2 68 69                                                    | 2 68 69                                                    | 3 68 69                                                    |
|                 | Korea             | 2 72 73                                                    | 1 72                                                        | 0 --                                                       |
|                 | Taiwan            | 1 75                                                        | 1 75                                                        | 2 74 75                                                    |
|                 | France            | 2 77 80                                                    | 2 77 80                                                    | 2 77 80                                                    |
|                 | Italy             | 1 78                                                        | 1 78                                                        | 1 78                                                       |
|                 | Spain             | 1 81                                                        | 1 81                                                        | 1 81                                                       |
|                 | United States     | 0 --                                                       | 0 --                                                       | 1 --                                                       |
| Recurrence-Free Survival| Overall | 15 45 46 47 48 49 50 51 52 54 55 57 58 72 73 78 80 81 82 | 13 46 48 49 51 54 57 59 66 72 78 80 81 82                | 6 51 59 78 80 81 82                                         |
| By Country| China             | 9 45 46 49 51 54 57 59                                       | 8 45 46 49 51 54 57                                         | 2 51 59                                                    |
|                 |                   | 65 57                                                      | 65 57                                                      | 65 57                                                      |
|                 | Korea             | 2 72 73                                                    | 1 72                                                        | 0 --                                                       |
|                 | France            | 1 80                                                        | 1 80                                                        | 1 80                                                       |
|                 | Italy             | 1 78                                                        | 1 78                                                        | 1 78                                                       |
|                 | Spain             | 1 81                                                        | 1 81                                                        | 1 81                                                       |
|                 | United States     | 0 --                                                       | 0 --                                                       | 1 --                                                       |

*References are listed in the supplemental reference list.

Table S7B: Studies* that provided data for overall survival (A) and recurrence free survival (B) after liver resection in patients with hepatocellular carcinoma with portal vein tumor thrombosis.

| Region          | Number of Studies | Reference numbers of studies that provided data for 1-year (%) | Reference numbers of studies that provided data for 3-year (%) | Reference numbers of studies that provided data for 5-year (%) |
|-----------------|-------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Overall Survival| 20                | 16 46 47 48 49 50 51                                       | 16 46 47 48 49 50 51                                       | 9 45 50 51 54 57 59                                         |
|                 |                   | 52 54 57 59 63 64 65                                       | 52 54 57 59 65 68 72                                       | 73 80                                                      |
| By Country/Region| China             | 15 46 47 48 49 50 51                                       | 12 46 47 48 49 50 51                                       | 6 45 50 51 54 57 59                                         |
|                 |                   | 52 54 57 59 63 64 65                                       | 52 54 57 59 65 68 72                                       |                                                            |
|                 | Japan             | 1 68                                                        | 1 68                                                        | 1 68                                                       |
|                 | Korea             | 2 72 73                                                    | 1 72                                                        | 0 --                                                       |
|                 | Taiwan            | 1 75                                                        | 1 75                                                        | 1 75                                                       |
|                 | France            | 1 80                                                        | 1 80                                                        | 1 80                                                       |
| Recurrence-Free Survival| Overall | 11 46 48 49 51 54 57 59                                       | 9 46 48 49 51 54 57                                         | 3 51 59 80                                                |
| By Country| China             | 8 45 46 47 48 49 50 51                                       | 7 46 48 49 51 54 57                                         | 2 51 59                                                    |
|                 |                   | 67 59                                                      | 67 59                                                      |                                                            |
|                 | Korea             | 2 72 73                                                    | 1 72                                                        | 0 --                                                       |
|                 | France            | 1 80                                                        | 1 80                                                        | 1 80                                                       |

*References are listed in the supplemental reference list.

Table S7C: Studies* that provided data for overall survival (A) and recurrence free survival (B) after liver resection in patients with hepatocellular carcinoma with portal vein tumor thrombosis and/or hepatic vein tumor thrombosis.

| Region          | Number of Studies | Reference numbers of studies that provided data for 1-year (%) | Reference numbers of studies that provided data for 3-year (%) | Reference numbers of studies that provided data for 5-year (%) |
|-----------------|-------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Overall Survival| 10                | 45 55 56 61 66 69 77                                         | 10 45 55 56 61 66 69 77                                      | 10 45 55 69 70 74 77                                         |
|                 |                   | 79 81 82                                                   | 79 81 82                                                   | 79 81 82                                                   |
| By Country| China             | 5 45 45 56 61 66                                           | 5 45 45 56 61 66                                           | 2 65 66 69 72                                                |
|                 | Japan             | 1 69                                                        | 1 69                                                        | 1 69                                                       |
|                 | Taiwan            | 0 --                                                       | 0 --                                                       | 1 --                                                       |
|                 | France            | 1 77                                                        | 1 77                                                        | 1 77                                                       |
|                 | Italy             | 1 78                                                        | 1 78                                                        | 1 78                                                       |
|                 | Spain             | 1 81                                                        | 1 81                                                        | 1 81                                                       |
|                 | United States     | 0 --                                                       | 0 --                                                       | 1 --                                                       |
| Recurrence-Free Survival| Overall | 4 66 78 81 82                                              | 4 66 78 81 82                                              | 3 78 81 82                                                |
| By Country| China             | 1 66                                                        | 1 66                                                        | 0 --                                                       |
|                 | Italy             | 1 78                                                        | 1 78                                                        | 1 78                                                       |
|                 | Spain             | 1 81                                                        | 1 81                                                        | 1 81                                                       |

*References are listed in the supplemental reference list.
Table S8  Studies that provided data for overall survival (A) and recurrence free survival (B) after liver resection in patients with hepatocellular carcinoma by presence of and sub-classification of portal vein tumor thrombosis.

| Sub-classification                        | Number of Studies | Reference numbers of studies that provided data for 1-year (%) | Number of Studies | Reference numbers of studies that provided data for 3-year (%) | Number of Studies | Reference numbers of studies that provided data for 5-year (%) | Reference numbers of studies that provided data for Median Survival |
|-------------------------------------------|-------------------|---------------------------------------------------------------|-------------------|---------------------------------------------------------------|-------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| Overall Survival                          |                   |                                                               |                   |                                                               |                   |                                                               |                                                               |
| Segmental & Second-Order Branch           | 3                 | 48 78 83                                                      | 3                 | 48 78 83                                                      | 1                 | 78                                                            | 3                 | 48 58 83                                                      |
| First-Order Branch                        | 4                 | 48 67 78 83                                                  | 3                 | 48 78 83                                                      | 1                 | 78                                                            | 3                 | 48 58 83                                                      |
| Main Trunk & Superior Mesenteric Vein     | 3                 | 48 65 67                                                      | 2                 | 48 65                                                        | 1                 | 65                                                            | 2                 | 48 58                                                        |
| Recurrence-Free Survival                  |                   |                                                               |                   |                                                               |                   |                                                               |                                                               |
| Segmental & Second-Order Branch           | 1                 | 48                                                            | 1                 | 48                                                           | 0                 | –                                                             | 0                 | –                                                            |
| First-Order Branch                        | 2                 | 48                                                            | 1                 | 48                                                           | 0                 | –                                                             | 0                 | –                                                            |
| Main Trunk & Superior Mesenteric Vein     | 2                 | 48 67                                                        | 1                 | 48                                                           | 0                 | –                                                             | 0                 | –                                                            |

References are listed in the supplemental reference list.

Table S9  Meta-regression of variables associated with 5-year overall survival after surgical resection

| Characteristics                  | N (n)\(^a\) | Coefficient | 95% CI        | P      |
|----------------------------------|------------|-------------|---------------|--------|
| Age, per year                    | 15 (2,242) | 0.0213      | -0.0591 – 0.1016 | 0.6037 |
| Tumor size, cm                   | 8 (1,335)  | 0.1056      | -0.0373 – 0.2486 | 0.1475 |
| Cirrhosis                        | 10 (1,237) | 0.0027      | -0.0038 – 0.0092 | 0.4168 |
| Platelet (per 10\(^9\) increase) | 7 (1,531)  | 0.0045      | -0.0121 – 0.0211 | 0.5944 |
| Hepatitis B                      | 13 (2,441) | -0.0011     | -0.0080 – 0.0059 | 0.7638 |
| Hepatitis C                      | 11 (1,869) | 0.0027      | -0.0032 – 0.0085 | 0.3711 |

\(^a\), N, number of studies; n, number of patients
**Table S10** Systematic review of overall survival (OS) after liver resection in patients with hepatocellular carcinoma and macrovascular invasion, by tumor characteristics and characteristics of liver disease

| Variable                  | Study author | Number of patients | Median survival (months) (95% CI) | 1-year OS (%) | 3-year OS (%) | 5-year OS (%) |
|---------------------------|--------------|--------------------|-----------------------------------|---------------|---------------|---------------|
| Tumor characteristics    |              |                    |                                   |               |               |               |
| AFP < 400                 | Chen JS<sup>52</sup> | 32                 | 10                               |               |               |               |
| AFP ≥ 400                 | Chen JS<sup>52</sup> | 56                 | 8                                |               |               |               |
| Characteristics of liver disease |              |                    |                                   |               |               |               |
| Non-Cirrhosis             | Chen JS<sup>52</sup> | 15                 | 9                                |               |               |               |
|                           | Pesi B<sup>53</sup>  | 6                  |                                   | 50            | 16.6          | 0             |
| Cirrhosis                 | Chen JS<sup>52</sup> | 73                 | 9                                |               |               |               |
|                           | Li J<sup>53</sup>    | 24                 | 30 (24.1 – 36.0)                 |               |               |               |
| Hepatitis B virus         | Shi J<sup>48</sup>  | 354                | 14.1                             |               |               |               |
|                           | Chen JS<sup>52</sup> | 79                 | 9                                |               |               |               |
|                           | Li J<sup>53</sup>    | 24                 | 30 (24.1 – 36.0)                 |               |               |               |

* Number of patients within the specified subgroup

**Table S11** Systematic review of overall survival (OS) and recurrence-free survival (RFS) after liver resection in patients with hepatocellular carcinoma and macrovascular invasion, by viral versus non-viral etiology.

| Study author | Median OS (months) (95% CI) | 1-year OS (%) | 3-year OS (%) | 5-year OS (%) | 1-year RFS (%) | 3-year RFS (%) | 5-year RFS (%) |
|--------------|-----------------------------|---------------|---------------|---------------|----------------|----------------|----------------|
| **Viral**    |                             |               |               |               |                |                |                |
| Cheng YQ<sup>53</sup> | 9.2                         | –             | –             | –             | –              | –              | –              |
| Pesi B<sup>38</sup>     | –                           | 57.10         | 34.80         | 21.70         | –              | –              | –              |
| Torzilli G<sup>52</sup> | –                           | 85            | 58            | 53            | 51             | 36             | 30             |
| **Non-Viral** |                             |               |               |               |                |                |                |
| Cheng YQ<sup>53</sup> | 16.0                        | –             | –             | –             | –              | –              | –              |
| Pesi B<sup>38</sup>     | –                           | 47.50         | 25.30         | 25.30         | –              | –              | –              |
| Torzilli G<sup>52</sup> | –                           | 77            | 53            | 0             | 52             | 0              | 0              |
Table S12 Systematic review of overall survival (OS) and recurrence-free survival (RFS) after liver resection in patients with hepatocellular carcinoma and macrovascular invasion for isolated hepatic vein tumor thrombosis (HVTT).

| Study author  | Number of patients | Median OS (months) (95% CI) | 1-year OS (%) | 3-year OS (%) | 5-year OS (%) | Median RFS (months) (95% CI) |
|---------------|--------------------|-----------------------------|---------------|---------------|---------------|-------------------------------|
| Peripheral hepatic vein tumor thrombosis | | | | | | |
| Chen ZH<sup>46</sup> | 21 | - | - | - | - | - |
| Kokudo T<sup>48</sup> | 305 | 58.20 | - | - | - | 28.32 |
| Major hepatic vein tumor thrombosis | | | | | | |
| Chen ZH<sup>46</sup> | 10 | - | - | - | - | - |
| Kokudo T<sup>48</sup> | 170 | 56.04 | - | - | - | 10.56 |
| Pesi B<sup>39</sup> | 8 | - | 75 | 45 | 31 | - |
| Cortese S<sup>41</sup> | 1 | - | - | - | - | - |
| Tumor thrombosis of the inferior vena cava | | | | | | |
| Chen ZH<sup>46</sup> | 74 | - | 52.70 | 14.86 | - | - |
| Kokudo T<sup>48</sup> | 71 | 16.44 | - | - | - | 9.84 |
| Pesi B<sup>39</sup> | 3 | - | - | - | - | - |

†, Number of patients within the specified subgroup

Table S13 Median overall survival (OS), overall survival, and recurrence-free survival (RFS) after liver resection in patients with hepatocellular carcinoma and macrovascular invasion by surgery type.

| Study author  | Median OS (months) (95% CI) | 1-year OS (%) | 3-year OS (%) | 5-year OS (%) | 1-year RFS (%) | 3-year RFS (%) | 5-year RFS (%) |
|---------------|----------------------------|---------------|---------------|---------------|----------------|----------------|----------------|
| Open surgery (%) | | | | | | | |
| Zhang F<sup>59</sup> | 21 | 67 | 30 | 10 | 57 | 21 | 4 |
| Chen ZH<sup>46</sup> | 19.4 | 64.2 | 19.7 | - | 51.9 | 22.6 | - |
| Lim C<sup>30</sup> | 4.8 | 30.8 | 20.5 | 15.4 | 32.5 | 11.6 | 11.6 |
| Minimally invasive surgery (%) | | | | | | | |
| Pesi B<sup>39</sup> | 12.9 | 53.30 | 30.10 | 20.00 | 31.70 | 20.80 | 15.60 |
Figure S1 Overall survival. (A) Forest plot for 1-year overall survival, overall and by the presence of only PVTT or with PVTT and/or HVTT. (B) Forest plot for 5-year overall survival overall and by the presence of only PVTT or with PVTT and/or HVTT. PVTT, portal vein tumor thrombosis; HVTT, hepatic vein tumor thrombosis.
Figure S2 Recurrence free survival. (A) Forest plot for 1-year recurrence free survival overall and by the presence of only PVTT or with PVTT and/or HVTT. (B) Forest plot for 3-year recurrence free survival overall and by the presence of only PVTT or with PVTT and/or HVTT. (C) Forest plot for 5-year recurrence-free survival overall and by the presence of only PVTT or with PVTT and/or HVTT. PVTT, portal vein tumor thrombosis; HVTT, hepatic vein tumor thrombosis.

Figure S3 Egger's test and funnel plot for 5-year overall survival.
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