ELSEVIER

Clinical Imaging 37 (2013) 327–333

CLINICAL IMAGING

Computed tomography for assessing resectability of gallbladder carcinoma: a systematic review and meta-analysis

Bing Li[a,b], Xiao Xue Xu[a,b], Yong Du[a,b], Han Feng Yang[a,b,*], Yang Li[a,b], Qing Zhang[a,c], Dong Mei Xiao[a,b], Ya Yong Huang[a,b], Jun Meng[a,b], Wen Xuan Wang[a,b]

[a]*Sichuan Key Laboratory of Medical Imaging, Affiliated Hospital of North Sichuan Medical College, Nanchong City, Sichuan Province 637000, China*
[b]*Department of Radiology, Affiliated Hospital of North Sichuan Medical College, Nanchong City, Sichuan Province 637000, China*
[c]*Department of Ultrasound, Affiliated Hospital of North Sichuan Medical College, Nanchong City, Sichuan Province 637000, China*

Received 29 April 2012; accepted 14 May 2012

Abstract

Purpose: The purpose was to calculate the sensitivity and specificity of computed tomography (CT) in assessing the resectability of gallbladder carcinoma (GBCA) with meta-analysis. **Materials and methods:** A meta-analysis of the reported sensitivity and specificity of each study with 95% confidence intervals (CI) was performed. **Results:** Pooled sensitivity was 99% (95% CI), and pooled specificity was 76% (95% CI). **Conclusion:** CT can be used as an appropriate choice for the diagnosis and assessment of resectability of GBCA.
Published by Elsevier Inc.

Keywords: Computed tomography; Gallbladder carcinoma; Resectability; Meta-analysis

1. Introduction

Gallbladder carcinoma (GBCA) is the most common malignancy of the biliary tree and is the fifth most common malignancy of the gastrointestinal tract [1]. In spite of improved diagnostic capabilities, better perioperative care, and more aggressive surgical approaches, overall survival remains low [2]. Surgery is the only definitive cure [3]; preoperative diagnosis and a precise assessment of the extent of spread of disease may help to achieve a high resection rate for GBCA and avoid a laparotomy in some patients.

Broadly, GBCA categorized as stage I or II is potentially resectable with curative intent, whereas stage III generally indicates locally unresectable disease from vascular invasion or involvement of multiple adjacent organs. Stage IV represents unresectable disease secondary to distant metastases [4]. But no agreement regarding the particular criteria for unresectability was found [5].

Some investigators have reported that computed tomographic (CT) imaging is useful in demonstrating the primary lesion and staging of GBCA [6–10]. But to our knowledge, until now, there has been no published systematic review regarding the performance of CT in the evaluation of the resectability of GBCAs. The aim of this systematic review and meta-analysis was to calculate the sensitivity and specificity of CT in assessing the resectability of GBCA and discuss the criteria of unresectable and resectable of GBCA.

2. Methods

2.1. Eligibility criteria

We considered all studies for the period from January 1990 to December 2011 in which patients underwent CT for the diagnosis of GBCA with subsequent surgery for verification of the CT findings. For a study to be included in our review, its focus had to be evaluation of the resectability of GBCAs, and it had to include surgery result to

* Corresponding author. Department of Radiology, Affiliated Hospital of North Sichuan Medical College, 63 Wenhua Road, Nanchong City, Sichuan Province 637000, China.
E-mail addresses: yhfctjr@yahoo.com (B. Li), yhf5nc@yahoo.com (H.F. Yang).

0899-7071/$ – see front matter. Published by Elsevier Inc.
http://dx.doi.org/10.1016/j.clinimag.2012.05.009

determine the range of tumor invasion. Studies without sufficient details regarding surgery result were excluded. Raw data (for true-positive: unresectable, false-positive: resectable and palliative surgery, true-negative, and false-negative results) could be found in all of the studies. Additional exclusion criteria included studies with fewer than 15 patients, review articles, position papers, editorials, commentaries, and book chapters. If there was any suspicion of cohort overlap between studies, potential duplicate studies were excluded.

2.2. Information sources

A literature search was performed for relevant publications in PubMed and China National Knowledge Infrastructure. The Medical Subject Headings, or MeSH, terms *CT*, *computed tomography*, *gallbladder carcinoma, gallbladder neoplasms* were used (Fig. 1). A preliminary search performed by using other search engines (e.g., EMBASE and Scopus) failed to detect any additional references not already identified by PubMed, so we did not use these search engines further. The full articles of all potential studies that satisfied our inclusion criteria were retrieved, and additional manual searches of their reference lists were performed to identify any additional studies that may have been missed by using the above-mentioned procedure.

2.3. Data extraction

For each study, the following count data were entered into a 2×2 table: (a) true-positive results (disease cases in which findings of the reference standard and the index test were positive for the studied target condition), (b) false-negative results (diseased cases that were misdiagnosed as nondiseased according to the index test), (c) true-negative results (nondiseased cases that were correctly identified with the index test), and (d) false-positive results (nondiseased cases that were misdiagnosed as diseased according to the index test). Two reviewers independently selected articles on the basis of the title and abstract; if one or both reviewers considered the study potentially eligible, the full article was evaluated by both reviewers. Two reviewers abstracted the data from each article and recorded data using a standardized form. Disagreement was resolved by means of consensus.

pubmed search terms:

1. "Gallbladder Neoplasms"[Mesh]
2. gallbladder carcinoma
3. gallbladder cancer
4. biliary carcinoma
5. #1 OR #2 OR #3 OR #4
6. "Tomography, X-Ray Computed"[Mesh]
7. Computed tomography
8. Computed tomgraphic
9. #6 OR #7 OR #8
10. #5 AND #9

Fig. 1. Search strategy.

2.4. Quality assessment

Methodological quality was assessed independently by the same reviewers based on the Quality Assessment of Studies of Diagnostic Accuracy included on Systematic Reviews (QUADAS) guidelines [11]; disagreement was resolved by consensus. This evidence-based tool was developed specifically to assess the quality of diagnostic accuracy studies and includes 14 quality items. The 14 items, phrased as questions, are scored as "yes," "no," or "unclear." The quality assessment score can range from 0 to 14, where 14 is the maximum attainable score. A more detailed description of each item, together with a guide on how to score each item, is provided by Whiting et al. in 2003 [11]. Additionally, we noted whether the study design was prospective or retrospective.

2.5. Statistical analysis

Primary outcomes of this meta-analysis were sensitivity and specificity at the patient level. Pooling of data was performed within the bivariate mixed-effects binary regression modeling framework. Model specification, estimation, and prediction were performed with software (midas in Stata). Using the model-estimated coefficients and variance–covariance matrixes, this program calculates summary operating sensitivity and specificity values (with confidence and prediction contours in summary receiver operating characteristic space). A forest plot was generated that contained the individual study sensitivities and specificities with 95% confidence intervals (CIs) and the pooled sensitivity and specificity estimates.

Heterogeneity was tested by using the Higgins and Thompson test to calculate the I^2 statistic [12]. This statistic uses the conventional Cochran Q statistic to calculate the percentage of tool variation heterogeneity on a scale ranging from 0% (no heterogeneity) to 100% (all variance due to heterogeneity). In contrast to the Cochran Q, the I^2 is less affected by the number of studies included in a meta-analysis. If no or moderate heterogeneity is found ($2 \leq 50\%$), pooling is justified.

The presence of publication bias was visually assessed by producing a funnel plot. In the Stata software, linear regression of log odds ratios on the inverse root of effective sample sizes was performed as a test for funnel plot asymmetry. The log odds ratios were defined as the log-