ORIGINAL ARTICLE

Metal versus plastic stents for malignant biliary obstruction: An update meta-analysis

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Summary

Background and objective: The data on comparisons of stent patency, re-intervention rate and patient survival between metal and plastic stents in palliation of malignant biliary obstruction have never been pooled. We carry out a meta-analysis to summarise current evidence for clinical efficacy of metal and plastic stents in the treatment of malignant biliary obstruction.

Methods: A comprehensive search of several databases was conducted. A fixed-effects or random-effects model was used to pool data of all study endpoints. Sensitivity analysis and subgroup analysis (distal vs. hilar biliary obstruction) were also performed.

Results: Ten randomized clinical trials were identified. Compared with plastic stents, metal stents were associated with a significantly longer stent patency (HR = 0.36; 95% CI: 0.28–0.47; I² = 0%), fewer numbers of re-intervention (WMD = 0.59; 95% CI: 0.28–0.90; I² = 76.4%) and longer patient survival (HR = 0.74; 95% CI: 0.64–0.85; I² = 16.0%). These results were still significant by sensitivity analysis. All outcomes reached statistical significance except of the pooled WMD of number of re-intervention in the studies with hilar biliary obstruction. No publication bias was observed.

Conclusions: Metal stents were associated with a significantly longer stent patency, lower re-intervention rate and longer patient survival in palliation of malignant biliary obstruction when compared to plastic stents.

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Introduction

Malignant tumor is a common etiology for obstructive jaundice in elderly. However, few patients have opportunity of curative operation at diagnosis [1]. Biliary stent placement is a well-established palliative treatment for patients with inoperable malignant biliary obstruction. It results in lower morbidity or mortality than does surgical bypass [2]. Two
types of stents are routinely used in current practice: plastic stents and self-expanding metal stents. Several individual studies showed that metal stents are associated with longer stent patency but have no influence on survival when compared to plastic stents [1,3,4]. Two systematic reviews [5,6] on this subject reported that metal stents were associated with a lower risk of recurrent biliary obstruction than plastic stents while there was no significant difference in risk of technical failure, therapeutic failure, complications or 30-day mortality. However, the data on comparisons of stent patency, mean difference of re-intervention sessions during the follow-up and overall patient long time survival have never been pooled. And only results on distal biliary obstruction were evaluated in these reviews. Recently, two other randomized controlled trials have been published [7,8]. For above-mentioned reasons, we aimed to perform a quantitative review of the published data regarding clinical efficacy of metal and plastic stents in the palliation of malignant distal or hilar biliary obstruction.

Materials and methods

We searched Medline (via Pubmed), Embase databases from January 1985, to July 2012, for all randomized controlled trials that compared metal versus plastic stents for the treatment of malignant biliary obstruction. The study endpoints were to evaluate the cumulative patency of the first stents, re-intervention rate during the follow-up and overall survival. The methodological quality of the trials included in this study was assessed by using the Jadad composite scale [9]. Hazard ratio (HR) for cumulative patency of the first stents and overall survival with 95% confidence intervals (CI) were extracted from papers and/or presentations [10]. And weighted mean difference (WMD) with 95% CI was calculated for continuous outcomes. For each outcome, a fixed-effects model was used to pool the data unless statistical heterogeneity was significant. Heterogeneity between studies was evaluated by χ² tests and I². Publication bias was assessed by Egger’s test [11] and Begg’s test [12]. To minimize a type 1 error and to be sure not to find a difference when none exists, all analyses was performed according to the intention-to-treat method. A two-tailed P value less than 0.05 was considered to be significant in all analyses.

Results

Ten randomized clinical trials satisfied all of the inclusion criteria [1−4,7,8,13−16]. There were 785 patients included in the meta-analysis, of whom 392 received metal stents as first therapy and 393 were allocated to a plastic stent group. In methodological assessment, all trials scored 3 points except for one trial scored 1 point on the Jadad scale [15]. Since it is not feasible to double blind these endoscopic interventions, 3 was the maximum attainable Jadad score.

Stent patency

The HR for each study and the corresponding confidence intervals for cumulative patency of the first stents are shown in Fig. 1. Individual HRs ranged from 0.29 [13] to 0.49 [15]. The pooled estimate for stent patency showed that metal stents were associated with a statistically significant 64% reduction in the hazard of stents dysfunction (HR = 0.36; 95% CI: 0.28–0.47; P < 0.001). No heterogeneity was observed (I² = 0%, P = 0.951).

Number of re-intervention

In individual trials, the needed mean number of endoscopic re-intervention per patient in the plastic stents group and the metal stents group varied from 0.23 [8] to 2.4 [16], 0.16 [8] to 0.8 [14] respectively. A random-effect model was used to pool the data because significant heterogeneity was seen during studies (I² = 76.4%, P < 0.001). Pooled data analysis showed that plastic group needed more times of re-intervention for stent-related problems as compared to the metal stent group during the follow-up (WMD = 0.59; 95% CI: 0.28–0.90; P < 0.001) (Fig. 2). Because a study by Sangchan et al. [8] included only patients with complex hilar cholangiocarcinoma. After the exclusion of this study, there was no evidence of heterogeneity (I² = 7.9%, P = 0.366) and the revised pooled WMD were higher (WMD = 0.67; 95% CI: 0.52–0.82; P < 0.001).

Survival

Eight trials evaluated overall survival as an outcome measure. There was no significant heterogeneity in the HRs for overall survival among the individual trials ($I^2 = 16.0\%$, $P = 0.304$). Using a fixed-effect model, metal stents was associated with a statistically significant 26% reduction in the hazard of death as compared with plastic stents (HR = 0.74; 95% CI: 0.64–0.85; $P < 0.001$) (Fig. 3).

Sensitivity analysis and subgroup analysis

After we ruled out a study [15] with low Jadad score, the pooled estimates of stent patency, number of re-intervention and survival were still significant (Table 1). When we stratify the trials with respect to location of biliary obstruction, all outcomes reached statistical significance except of the pooled WMD of number of re-intervention in the studies with hilar biliary obstruction (Table 2).

Publication bias

Regarding to every study endpoints, neither Egger’s nor Begg’s tests provided evidence of publication bias. Fig. 4 shows the funnel plot of publication bias analysis on the cumulative patency of the first stents data (Egger test, $P = 0.70$; Begg test, $P = 1.0$).

Discussion

As expect, our results indicated that metal stents were associated with a statistically significant 64% reduction in the hazard of stents dysfunction when compared to plastic stents (HR = 0.36; 95% CI: 0.28—0.47). Subgroup analysis showed the pooled HRs of patency was lower in the studies with hilar biliary obstruction than that with distal biliary obstruction (0.30 vs. 0.37), which suggested that use of a metal stent other than plastic stent in patent with hilar biliary obstruction could result in more patency benefits than in patent with distal biliary obstruction. Those results also were similar to recent reports that the median patency time in the metal and plastic stent groups in patients with hilar cholangiocarcinoma were 3.4 [8] to 5.56 [17] months, 1.2 [8] to 1.86 [17] months, respectively, while the median patency of metal and plastic stent in distal malignant obstruction has been reported to be greater than 8 months and ranging from 4 to 6 months, respectively [17]. Because of longer duration of stent patency, metal stent had fewer opportunity of developing stent dysfunction than plastic stent. Our meta-analysis indicated that the mean re-intervention sessions for stent dysfunction in plastic group during the follow-up were 0.59 (95% CI: 0.28–0.90) more than that in the metal stent group. These would shorten patient’s hospital stay and reduce frequency of occurrence of complicating diseases due to stents dysfunction. As a result, patients with implantation of metal stents would achieve a more improved quality of life, which play an important role in palliation treatment [5]. Subgroup analysis showed the pooled WMD number of re-intervention in the studies with distal biliary obstruction reached a statistical significance while it did not with hilar biliary obstruction. This may be partly due to small sample or heterogeneity of included studies (e.g., almost half of the patients in the study by Sangchan et al. [8] had Bismuth type IV hilar cholangiocarcinoma). So, comparison of number of re-intervention between metal and plastic stent in hilar biliary obstruction is warrant in the future.

**Table 1** Sensitivity analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study</th>
<th>Model</th>
<th>HR/WMD (95% CI)</th>
<th>$P$</th>
<th>Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patency</td>
<td>[1–4,7,13,14]</td>
<td>F</td>
<td>HR = 0.35 (0.27–0.46)</td>
<td>&lt; 0.001</td>
<td>0.947</td>
</tr>
<tr>
<td>Number of intervention</td>
<td>[1,2,7,8,14,16]</td>
<td>R</td>
<td>WMD = 0.62 (0.25–0.98)</td>
<td>0.001</td>
<td>80.3</td>
</tr>
<tr>
<td>Survival</td>
<td>[1–4,7,8,13]</td>
<td>F</td>
<td>HR = 0.72 (0.62–0.84)</td>
<td>&lt; 0.001</td>
<td>12.1</td>
</tr>
</tbody>
</table>

F: fixed-effect; R: random-effect; HR: Hazard ratio; WMD: weighted mean difference.

Table 2  Subgroup analysis according to location of biliary obstruction.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study</th>
<th>Model</th>
<th>HR/WMD (95% CI)</th>
<th>P</th>
<th>Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Patency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal</td>
<td>[1–4,13,14]</td>
<td>F</td>
<td>HR = 0.37 (0.28–0.48)</td>
<td>&lt; 0.001</td>
<td>0.921</td>
</tr>
<tr>
<td>Hilar</td>
<td>[7]</td>
<td>F</td>
<td>HR = 0.30 (0.12–0.74)</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Number of intervention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal</td>
<td>[1,2,14]</td>
<td>F</td>
<td>WMD = 0.64 (0.48–0.79)</td>
<td>0.001</td>
<td>0.703</td>
</tr>
<tr>
<td>Hilar</td>
<td>[7,8,16]</td>
<td>R</td>
<td>WMD = 0.80 (−0.226–0.64)</td>
<td>0.126</td>
<td>84.4</td>
</tr>
<tr>
<td>Survival</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal</td>
<td>[1–4,13]</td>
<td>F</td>
<td>HR = 0.81 (0.68–0.96)</td>
<td>0.014</td>
<td>0.813</td>
</tr>
<tr>
<td>Hilar</td>
<td>[7,8]</td>
<td>R</td>
<td>HR = 0.58 (0.44–0.77)</td>
<td>0.025</td>
<td>55.6</td>
</tr>
</tbody>
</table>

F: fixed-effect; R: random-effect; HR: Hazard ratio; WMD: weighted mean difference.

It was controversial that whether patients with metal stents implantation were associated with a prolonged overall survival as compared to plastic stents [7,8]. One study reported that endoscopic biliary drainage with metal stent provides longer survival compared with the plastic stent in patients with complex hilar cholangiocarcinoma [8], whereas most studies [1–4,7,13] did not achieve a statistical difference in overall survival between metal and plastic stents groups in patients either with hilar or distal biliary obstruction. The present study demonstrated that metal stents was associated with a longer survival when compared to plastic stents (HR = 0.74; 95% CI: 0.64–0.85) and the survival benefits were maintained in patients with both hilar and distal biliary obstruction by subgroup analysis. One of the possible explanations for this difference was that low statistical power in individual trials due to small sample enrolled. The other explanation was that many old patients (mean age > 70 years in all trials except one [8]) were included, which may limit the possibility of long term follow-up.

No publication bias was observed and sensitivity analysis showed that our inclusions of every study endpoints were significant. Nevertheless, our meta-analysis has several limitations. First, we included a study in which a percutaneous approach to stent placement was exclusively used [13]. However, it was pointed out by Saleem et al. [18] that although insertion complications differ when stents are placed percutaneously compared with those placed endoscopically, the method of stent placement does not affect subsequent stent outcome. Second, when overall patient survival was compared, we could not separate patients who died of concomitant diseases from patients who died of stents dysfunction because these were not reported in all studies.

In conclusion, our meta-analysis shows metal stents were associated a significantly longer stent patency, lower re-intervention rate and longer overall patient survival in palliation of malignant bile duct obstruction when compared to plastic stents.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Acknowledgements

This study was supported in part by Wenzhou Municipal Science and Technology Bureau (No. Y20120014) and Zhejiang Provincial Health Department (No. 2012ZB103).

References


Stents for biliary obstruction
