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Cabozantinib in Patients with Advanced and Progressing Hepatocellular Carcinoma

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Abstract

BACKGROUND—Cabozantinib inhibits tyrosine kinases, including vascular endothelial growth factor receptors 1, 2, and 3, MET, and AXL, which are implicated in the progression of hepatocellular carcinoma and the development of resistance to sorafenib, the standard initial treatment for advanced disease. This randomized, double-blind, phase 3 trial evaluated cabozantinib as compared with placebo in previously treated patients with advanced hepatocellular carcinoma.

METHODS—A total of 707 patients were randomly assigned in a 2:1 ratio to receive cabozantinib (60 mg once daily) or matching placebo. Eligible patients had received previous treatment with sorafenib, had disease progression after at least one systemic treatment for hepatocellular carcinoma, and may have received up to two previous systemic regimens for

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advanced hepatocellular carcinoma. The primary end point was overall survival. Secondary end points were progression-free survival and the objective response rate.

RESULTS—At the second planned interim analysis, the trial showed significantly longer overall survival with cabozantinib than with placebo. Median overall survival was 10.2 months with cabozantinib and 8.0 months with placebo (hazard ratio for death, 0.76; 95% confidence interval [CI], 0.63 to 0.92; P = 0.005). Median progression-free survival was 5.2 months with cabozantinib and 1.9 months with placebo (hazard ratio for disease progression or death, 0.44; 95% CI, 0.36 to 0.52; P<0.001), and the objective response rates were 4% and less than 1%, respectively (P = 0.009). Grade 3 or 4 adverse events occurred in 68% of patients in the cabozantinib group and in 36% in the placebo group. The most common high-grade events were palmar–plantar erythrodysesthesia (17% with cabozantinib vs. 0% with placebo), hypertension (16% vs. 2%), increased aspartate aminotransferase level (12% vs. 7%), fatigue (10% vs. 4%), and diarrhea (10% vs. 2%).

CONCLUSIONS—Among patients with previously treated advanced hepatocellular carcinoma, treatment with cabozantinib resulted in longer overall survival and progression-free survival than placebo. The rate of high-grade adverse events in the cabozantinib group was approximately twice that observed in the placebo group. (Funded by Exelixis; CELESTIAL ClinicalTrials.gov number, NCT01908426.)

THE RATE OF DEATH FROM LIVER CANCER is rising faster than the rate of death from any other cancer in the United States.[1,2] The systemic treatment options available for most cases are limited.[3–5] Despite several advances,[6–10] outcomes in the majority of patients remain poor, and additional treatment options are needed.

The vascular endothelial growth factor (VEGF) pathway is an established therapeutic target in hepatocellular carcinoma, but the clinical benefit from targeting this pathway has been modest, which suggests that inhibition of additional signaling pathways may improve efficacy.[11] Like VEGF, the receptor tyrosine kinases MET and AXL are induced by tumor hypoxia.[12,13] MET and AXL play diverse roles in tumor biology, including promotion of the epithelial-to-mesenchymal transition, invasion, and metastasis,[14,15] and both kinases are implicated in resistance to antiangiogenic therapy.[16–18] High expression of MET or AXL may be associated with poor prognosis in patients with hepatocellular carcinoma,[19,20] and increased MET expression or activation has been associated with previous sorafenib treatment in patients with hepatocellular carcinoma and with sorafenib resistance in preclinical models.[21–24]

Cabozantinib, an inhibitor of tyrosine kinases including VEGF receptors 1, 2, and 3, MET, and AXL, inhibits tumor growth in murine models of hepatocellular carcinoma.[23,25] In a phase 2, randomized discontinuation trial, cabozantinib showed clinical activity in patients with advanced hepatocellular carcinoma, regardless of whether they had received previous treatment with sorafenib[26]; median overall survival was 11.5 months and median progression-free survival was 5.2 months. On the basis of these results, we conducted a randomized, double-blind, placebo-controlled, phase 3 trial to evaluate cabozantinib (Cabometyx, Exelixis) in previously treated patients with advanced hepatocellular carcinoma.

METHODS

PATIENTS

Eligible patients were 18 years of age or older, had received a pathological diagnosis of hepatocellular carcinoma that was not amenable to curative treatment, and had Child–Pugh class A liver function (a score of 5 to 6 points out of a possible 15, with higher scores indicating more advanced liver disease; the score is the total of five clinical measures of liver function: total bilirubin, serum albumin, prothrombin time, ascites, and hepatic encephalopathy). Eligible patients had received previous treatment with sorafenib and had had disease progression after at least one systemic treatment for hepatocellular carcinoma, but they could have received up to two previous systemic treatments. Additional inclusion criteria were an Eastern Cooperative Oncology Group (ECOG) performance-status score of 0 or 1 (on a 5-point scale, with higher scores indicating greater disability), adequate hematologic measures, and adequate renal function. Patients could not have had previous treatment with cabozantinib and could not have uncontrolled clinically significant illness. Additional eligibility criteria are listed in the Supplementary Appendix, available with the full text of this article at NEJM.org.

TRIAL DESIGN

In this double-blind, phase 3 trial, patients were randomly assigned, in a 2:1 ratio, to receive cabozantinib or placebo. Randomization was performed at a central location through an interactive response system with the use of permuted blocks, stratified according to etiologic factor (hepatitis B virus [HBV], with or without hepatitis C virus [HCV]; HCV without HBV; or other), geographic region (Asia or other), and evidence of extrahepatic spread of disease, macrovascular invasion, or both (yes or no).

Patients received either a 60-mg tablet of cabozantinib or a matched placebo tablet to be taken orally once per day. Treatment interruptions and dose reductions (to 40 mg and then to 20 mg) were used to manage adverse events. Patients continued the assigned trial regimen as long as they had clinical benefit, as judged by the investigator, or until they had unacceptable toxic effects. Patients were allowed to receive cabozantinib or placebo beyond radiographic progression as long as they continued to have clinical benefit.

END POINTS AND ASSESSMENTS

The primary end point was overall survival, defined as the time from randomization to death from any cause. Secondary efficacy end points were progression-free survival (defined as the time from randomization to radiographic progression or death from any cause, whichever occurred first) and objective response rate (the percentage of patients with a confirmed complete or partial response). Tumors were assessed by computed tomography or magnetic resonance imaging at baseline and every 8 weeks after randomization; assessments were performed until 8 weeks after radiographic progression or discontinuation of cabozantinib or placebo, whichever occurred later. Tumor response and progression were assessed by the investigator according to Response Evaluation Criteria in Solid Tumors (RECIST), version 1.1.[27] Safety was evaluated continuously, and the severity of adverse events was assessed by the investigator according to the National Cancer Institute Common Terminology Criteria

for Adverse Events, version 4.0. Results of analyses of pharmacokinetics, health-related quality of life, and biomarkers are not reported here.

TRIAL OVERSIGHT

The protocol (available at NEJM.org) was approved by the ethics committee or institutional review board at each center, and the trial was conducted in accordance with the International Conference on Harmonisation Good Clinical Practice guidelines and the principles of the Declaration of Helsinki. Written informed consent was obtained from every patient. An independent data and safety monitoring committee reviewed safety and efficacy during the trial. The trial was designed by the first and last authors in collaboration with the sponsor, and the authors and the sponsor were responsible for data collection and analysis. The authors vouch for the fidelity of the trial to the protocol and for the accuracy and completeness of the data. The first and last authors wrote the first draft of the manuscript in collaboration with the sponsor. Medical writing support was provided by the sponsor.

STATISTICAL ANALYSIS

Up to three analyses of the primary end point of overall survival were planned, when approximately 50%, 75%, and 100% of the expected deaths had occurred. We estimated that a sample size of 760 patients, with a total of 621 deaths, would provide the trial with 90% power to detect a hazard ratio of 0.76 favoring cabozantinib over placebo, with a two-sided log-rank test at a 5% level of significance. Assuming a median overall survival of 8.2 months in the placebo group (as shown in the Brivanib Study in HCC Patients at Risk Post Sorafenib [BRISK-PS][28]) and exponential distribution, this would correspond to 32% longer median overall survival (10.8 months) in the cabozantinib group. Inflation of the type 1 error associated with interim analyses was controlled with the use of the Lan–DeMets O'Brien–Fleming alpha spending function.[29] If the null hypothesis of no difference in overall survival was rejected at either the first or second interim analysis, testing of secondary end points would proceed, and subsequent analyses of overall survival would not be performed.

Efficacy was assessed in all randomly assigned patients according to the intention-to-treat principle. Safety was assessed in all patients who received at least one dose of the trial regimen. For time-to-event end points, hypothesis testing was performed with the stratified log-rank test with adjustment for the stratification factors used at randomization; median durations and associated 95% confidence intervals were estimated with the Kaplan–Meier method. Hazard ratios were estimated with univariate Cox regression models, with the randomized group as the only predictor. Hazard ratios for overall analyses were calculated from models adjusted for the randomization stratification factors. Hypothesis testing of objective response was performed with the Cochran–Mantel–Haenszel method. All subgroup analyses of overall survival and progression-free survival were prespecified except those based on extrahepatic spread of disease or macrovascular invasion as separate factors and on sorafenib as the only previous therapy. For subgroup analyses, no adjustments were made for multiplicity, and confidence intervals are considered to be descriptive. Hazard ratios for subgroup analyses were calculated from unstratified models except those calculated for the subgroup of patients whose only previous therapy was sorafenib. All analyses were performed with SAS software, version 9.1 or higher (SAS Institute).

RESULTS

PATIENTS

From September 2013 through September 2017, a total of 773 patients underwent randomization at 95 centers in 19 countries. As of the data cutoff date of June 1, 2017, for the second interim analysis, 707 patients had undergone randomization: 470 patients had been assigned to receive cabozantinib, and 237 to receive placebo; these patients made up the intention-to-treat population for efficacy analyses (Fig. 1). The safety population comprised 704 patients: 467 patients who received cabozantinib and 237 who received placebo. As of the data cutoff date, 73 patients (16%) in the cabozantinib group and 26 (11%) in the placebo group were still following the assigned trial regimen. The most common reason for discontinuation of cabozantinib or placebo was radiographic disease progression. Baseline demographics and clinical characteristics were balanced between the groups (Table 1, and Table S1 in the Supplementary Appendix). All the patients had previously received sorafenib, and 27% had received two previous systemic anticancer regimens for advanced hepatocellular carcinoma.

EFFICACY

The median overall survival was 10.2 months (95% confidence interval [CI], 9.1 to 12.0) in the cabozantinib group and 8.0 months (95% CI, 6.8 to 9.4) in the placebo group (Fig. 2A). The stratified hazard ratio for death was 0.76 (95% CI, 0.63 to 0.92), and the stratified log-rank P value was 0.005, which met the criterion for statistical significance. Overall survival was significantly longer with cabozantinib than with placebo at the second planned interim analysis, which had a data cutoff date of June 1, 2017, and included 484 deaths, representing 78% of the 621 deaths planned for the prespecified final analysis. The stopping boundary according to the prespecified alpha-spending function was a P value of 0.02. Landmark estimates of overall survival according to the Kaplan–Meier method at 6, 12, 18, and 24 months showed a higher percentage of patients alive in the cabozantinib group than in the placebo group at each time point (Table S2 in the Supplementary Appendix). As of June 2017, a total of 123 patients (26%) in the cabozantinib group and 78 (33%) in the placebo group had received subsequent systemic or local liver-directed anticancer therapy that did not include radiation (Table S3 in the Supplementary Appendix). These overall survival results are consistent with the findings of the first interim analysis, which had a data cutoff date of June 2016 and included 321 patient deaths, representing 52% of the 621 deaths planned for the prespecified final analysis. At that time point, the observed hazard ratio for death was 0.71 and the P value was 0.0041, which did not cross the stopping boundary for the first interim analysis (P = 0.0037).

The median progression-free survival according to RECIST, version 1.1, as assessed by the investigator, was 5.2 months (95% CI, 4.0 to 5.5) in the cabozantinib group and 1.9 months (95% CI, 1.9 to 1.9) in the placebo group. The stratified hazard ratio for disease progression or death was 0.44 (95% CI, 0.36 to 0.52; P<0.001 by stratified log-rank test) (Fig. 2B). The objective response rate according to RECIST, version 1.1, was 4% (18 partial responses among 470 patients) in the cabozantinib group and less than 1% (1 partial response among 237 patients) in the placebo group (P = 0.009) (Table S4 in the Supplementary Appendix).

Disease control (defined as a partial response or stable disease) was achieved in 64% of the patients (300 patients) in the cabozantinib group, as compared with 33% (79 patients) in the placebo group.

Subgroup analyses of progression-free survival consistently favored cabozantinib, which showed the clinical activity of cabozantinib across subgroups of patients with various etiologic factors and demographic characteristics (Fig. 3, and Table S5 in the Supplementary Appendix). The results for overall survival across subgroups were more variable. In the subgroup of patients whose only previous systemic therapy was sorafenib, the median overall survival was 11.3 months with cabozantinib and 7.2 months with placebo (stratified hazard ratio for death, 0.70; 95% CI, 0.55 to 0.88), and the median progression-free survival was 5.5 months with cabozantinib and 1.9 months with placebo (stratified hazard ratio for disease progression or death, 0.40; 95% CI, 0.32 to 0.50).

SAFETY

The median duration of receipt of the trial drug or placebo was 3.8 months in the cabozantinib group and 2.0 months in the placebo group. Dose reductions occurred in 291 patients (62%) in the cabozantinib group and in 30 patients (13%) in the placebo group. The median average daily dose was 35.8 mg for cabozantinib and 58.9 mg for placebo, with a median time to first dose reduction of 38 days in the cabozantinib group. The rate of discontinuation of cabozantinib or placebo owing to adverse events that were considered to be related to the trial regimen was 16% (76 patients) in the cabozantinib group and 3% (7 patients) in the placebo group. Adverse events leading to treatment discontinuation in more than 1.0% of patients in the cabozantinib group were palmar–plantar erythrodysesthesia, fatigue, decreased appetite, diarrhea, and nausea.

Adverse events of any grade regardless of causality were reported in 99% of the patients in the cabozantinib group and in 92% in the placebo group, and adverse events of grade 3 or 4 were reported in 68% of the patients in the cabozantinib group and in 36% in the placebo group (Table 2). The most common grade 3 or 4 adverse events in the cabozantinib group were palmar–plantar erythrodysesthesia (17%, vs. 0% with placebo), hypertension (16% vs. 2%), increased aspartate aminotransferase level (12% vs. 7%), fatigue (10% vs. 4%), and diarrhea (10% vs. 2%). The most common adverse events of any grade leading to dose reductions in the cabozantinib group were palmar–plantar erythrodysesthesia (22%), diarrhea (10%), fatigue (7%), hypertension (7%), and increased aspartate aminotransferase level (6%). Serious adverse events were reported in 50% of the patients who received cabozantinib and in 37% of the patients who received placebo. A serious adverse event was defined as an adverse event of any grade that caused death, was life-threatening, resulted in hospitalization or prolongation of hospitalization, was deemed medically important, or resulted in disability or birth defect. Grade 5 adverse events occurring within 30 days after the last dose of cabozantinib or placebo were reported in 55 patients (12%) in the cabozantinib group and in 28 (12%) in the placebo group and were commonly related to disease progression. Grade 5 adverse events that were considered to be related to cabozantinib or placebo were reported in 6 patients in the cabozantinib group (one event each of hepatic failure, bronchoesophageal fistula, portal-vein thrombosis, upper

gastrointestinal hemorrhage, pulmonary embolism, and the hepatorenal syndrome) and in 1 patient in the placebo group (hepatic failure).

DISCUSSION

This randomized, phase 3 trial showed that cabozantinib treatment significantly prolonged survival in patients with previously treated advanced hepatocellular carcinoma. The median overall survival was 10.2 months with cabozantinib and 8.0 months with placebo, with a hazard ratio for death of 0.76. Corresponding to this survival benefit, a longer duration of progression-free survival was also observed: the median progression-free survival was 5.2 months with cabozantinib and 1.9 months with placebo, with a hazard ratio for disease progression or death of 0.44. Subgroup analyses of progression-free survival suggested that cabozantinib had clinical activity across subgroups of patients with various etiologic factors and across subgroups with other baseline characteristics. Subgroup analyses of overall survival were more variable, with broader confidence intervals. Hazard ratios in subgroups can be affected by statistical variability from evaluation of smaller populations or imbalances in prognostic factors or subsequent anticancer therapies. It is noteworthy that in an analysis of overall survival, the hazard ratio for death was 0.69 in patients with disease caused by HBV and 1.11 in patients with HCV, and the hazard ratio for death was 0.86 in patients of Asian race but 1.01 in patients enrolled in Asia. Further analyses are necessary to help understand these differences.

The safety results for cabozantinib were consistent with results from an earlier phase 2 study involving patients with hepatocellular carcinoma[26] and with the known safety profile of cabozantinib. The most common adverse events were similar to those observed with other VEGF-receptor tyrosine kinase inhibitors in patients with hepatocellular carcinoma. Adverse events were managed with dose modifications and supportive care. Dose reductions occurred in the majority of patients, and the rate of discontinuation due to adverse events from cabozantinib or placebo was 16%. The median average daily dose of cabozantinib was 35.8 mg, which was similar to the median dose (43 mg) received in a phase 3 trial involving patients with advanced renal-cell carcinoma, which also showed therapeutic efficacy.[30]

The patient population included in this trial represents a small percentage of patients with hepatocellular carcinoma. Because the survival of patients who have hepatocellular carcinoma with Child–Pugh liver disease of class B or worse is determined by liver failure, and it may be impossible to discern any effect of treatment on the cancer, it is justified to exclude these patients from pivotal clinical trials. Thus, as with all other agents approved for treatment of hepatocellular carcinoma, additional studies are required to confirm the safety and efficacy of cabozantinib in patients with more compromised liver function or poorer performance status.

MET expression has been shown to increase in tumors after sorafenib exposure in patients with hepatocellular carcinoma, which underscores a possible role for MET in the development of sorafenib resistance.[21,22] Tivantinib, an allosteric inhibitor of MET, was evaluated in a phase 3 trial involving patients pretreated with sorafenib who had high tumor MET expression, but it did not result in longer overall survival or progression-free survival

than placebo.[22] By inhibiting MET and AXL in addition to VEGF receptors, cabozantinib targets multiple oncogenic and angiogenic pathways, which may provide additional efficacy and help overcome resistance to agents that target VEGF receptors.[14–18,23,24] Cabozantinib also improved clinical outcomes in patients with advanced renal-cell carcinoma after previous antiangiogenic therapy, which further supports a role for targeting MET and AXL in overcoming resistance to VEGF-pathway inhibition.[30,31]

In conclusion, treatment with cabozantinib, a tyrosine kinase inhibitor that targets MET, VEGF receptors, and AXL, resulted in longer overall survival and progression-free survival than placebo in patients with previously treated advanced hepatocellular carcinoma. Adverse events were consistent with the known safety profile of cabozantinib, and the rate of high-grade adverse events in the cabozantinib group was approximately twice that observed in the placebo group.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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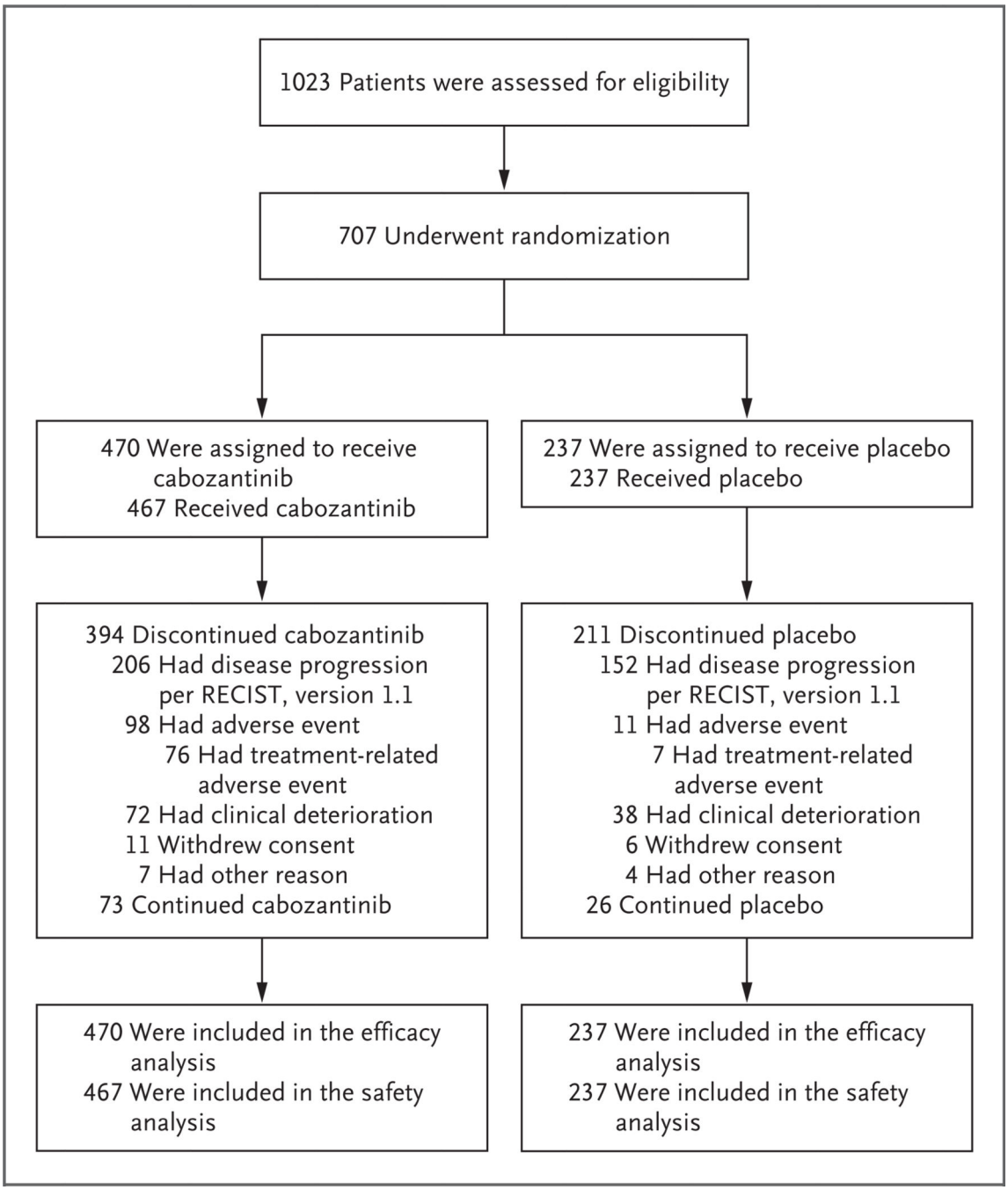


Figure 1. Eligibility, Randomization, and Follow-up.
RECIST denotes Response Evaluation Criteria In Solid Tumors.

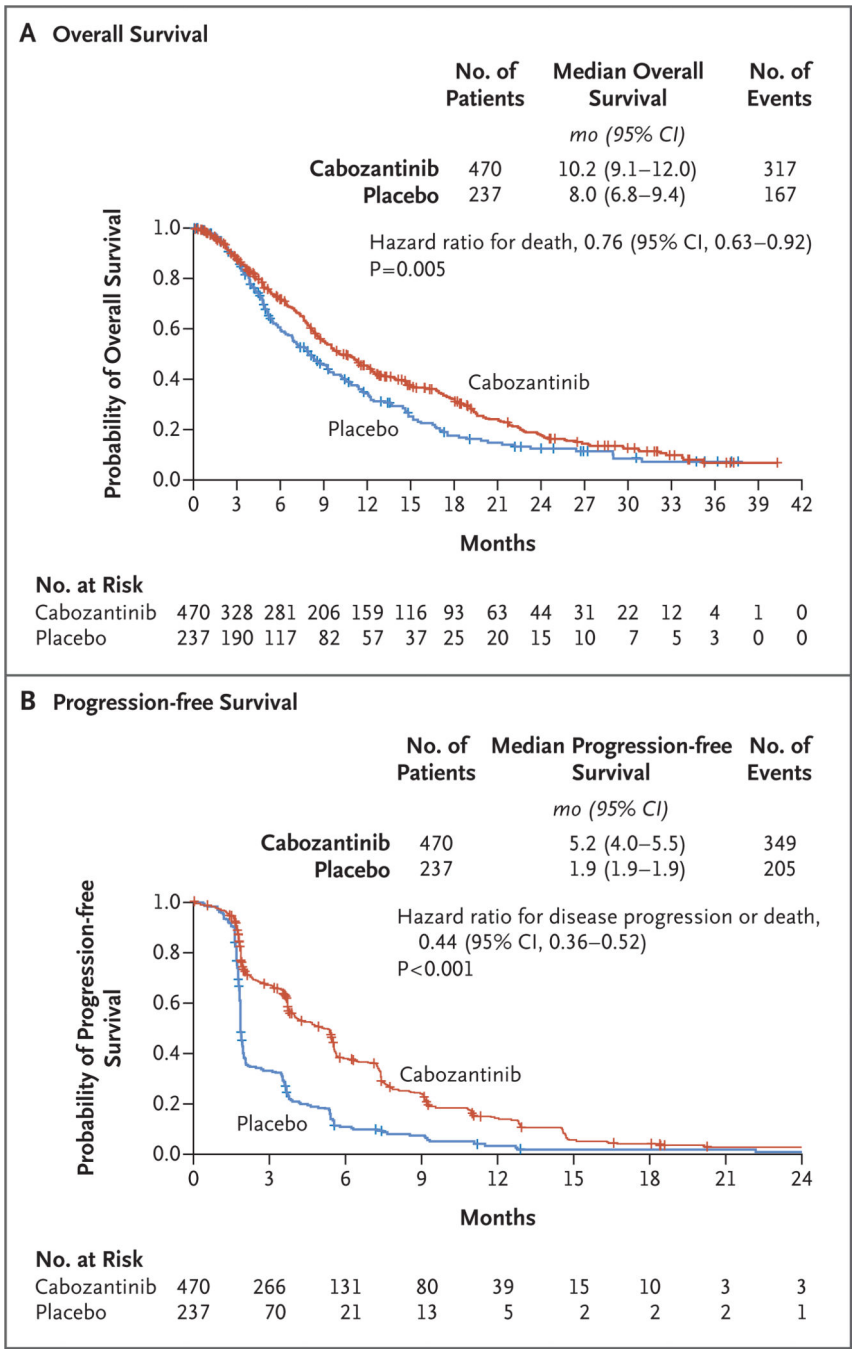
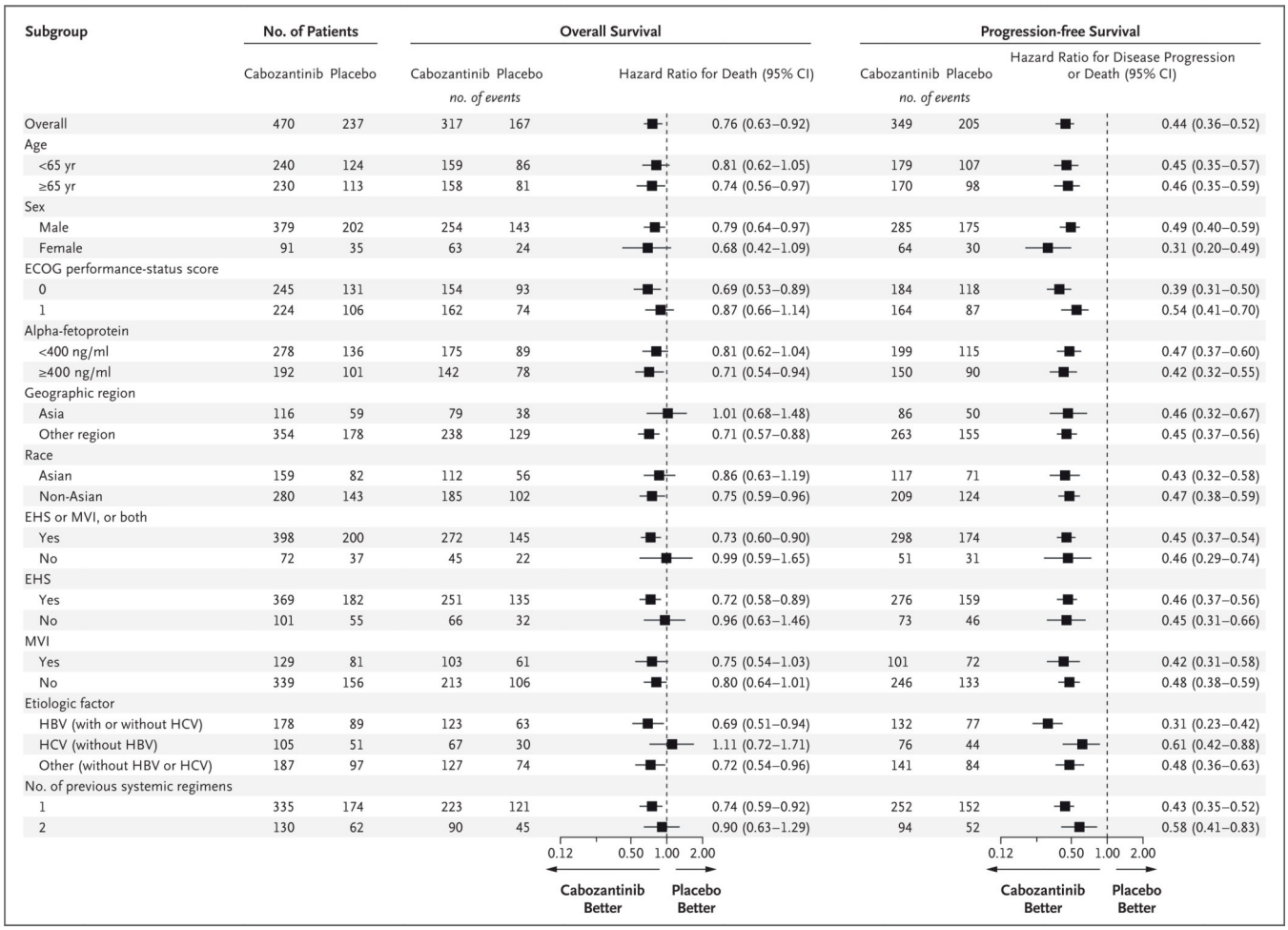


Figure 2. Kaplan–Meier Analysis of Overall Survival and Progression-free Survival.

Overall survival was defined as the time from randomization to death from any cause, and progression-free survival as the time from randomization to radiographic progression or death from any cause. Tick marks indicate censored data.



Subgroup	No. of Patients		Overall Survival			Progression-free Survival		
	Cabozantinib	Placebo	Cabozantinib (no. of events)	Placebo (no. of events)	Hazard Ratio for Death (95% CI)	Cabozantinib (no. of events)	Placebo (no. of events)	Hazard Ratio for Disease Progression or Death (95% CI)
Overall	470	237	317	167	0.76 (0.63–0.92)	349	205	0.44 (0.36–0.52)
Age								
<65 yr	240	124	159	86	0.81 (0.62–1.05)	179	107	0.45 (0.35–0.57)
≥65 yr	230	113	158	81	0.74 (0.56–0.97)	170	98	0.46 (0.35–0.59)
Sex								
Male	379	202	254	143	0.79 (0.64–0.97)	285	175	0.49 (0.40–0.59)
Female	91	35	63	24	0.68 (0.42–1.09)	64	30	0.31 (0.20–0.49)
ECOG performance-status score								
0	245	131	154	93	0.69 (0.53–0.89)	184	118	0.39 (0.31–0.50)
1	224	106	162	74	0.87 (0.66–1.14)	164	87	0.54 (0.41–0.70)
Alpha-fetoprotein								
<400 ng/ml	278	136	175	89	0.81 (0.62–1.04)	199	115	0.47 (0.37–0.60)
≥400 ng/ml	192	101	142	78	0.71 (0.54–0.94)	150	90	0.42 (0.32–0.55)
Geographic region								
Asia	116	59	79	38	1.01 (0.68–1.48)	86	50	0.46 (0.32–0.67)
Other region	354	178	238	129	0.71 (0.57–0.88)	263	155	0.45 (0.37–0.56)
Race								
Asian	159	82	112	56	0.86 (0.63–1.19)	117	71	0.43 (0.32–0.58)
Non-Asian	280	143	185	102	0.75 (0.59–0.96)	209	124	0.47 (0.38–0.59)
EHS or MVI, or both								
Yes	398	200	272	145	0.73 (0.60–0.90)	298	174	0.45 (0.37–0.54)
No	72	37	45	22	0.99 (0.59–1.65)	51	31	0.46 (0.29–0.74)
EHS								
Yes	369	182	251	135	0.72 (0.58–0.89)	276	159	0.46 (0.37–0.56)
No	101	55	66	32	0.96 (0.63–1.46)	73	46	0.45 (0.31–0.66)
MVI								
Yes	129	81	103	61	0.75 (0.54–1.03)	101	72	0.42 (0.31–0.58)
No	339	156	213	106	0.80 (0.64–1.01)	246	133	0.48 (0.38–0.59)
Etiologic factor								
HBV (with or without HCV)	178	89	123	63	0.69 (0.51–0.94)	132	77	0.31 (0.23–0.42)
HCV (without HBV)	105	51	67	30	1.11 (0.72–1.71)	76	44	0.61 (0.42–0.88)
Other (without HBV or HCV)	187	97	127	74	0.72 (0.54–0.96)	141	84	0.48 (0.36–0.63)
No. of previous systemic regimens								
1	335	174	223	121	0.74 (0.59–0.92)	252	152	0.43 (0.35–0.52)
2	130	62	90	45	0.90 (0.63–1.29)	94	52	0.58 (0.41–0.83)

Figure 3. Overall Survival and Progression-free Survival in Selected Subgroups.

Eastern Cooperative Oncology Group (ECOG) performance-status scores are assessed on a 5-point scale, with higher scores indicating greater disability. Race was reported by the patient. EHS denotes extrahepatic spread of disease, HBV hepatitis B virus, HCV hepatitis C virus, and MVI macrovascular invasion.

Table 1.

Basic Baseline Characteristics.*

Characteristic	Cabozantinib (N = 470)	Placebo (N = 237)
Median age (range) — yr	64 (22–86)	64 (24–86)
Sex — no. (%)		
Male	379 (81)	202 (85)
Female	91 (19)	35 (15)
Geographic region — no. (%)		
Asia†	116 (25)	59 (25)
Europe	231 (49)	108 (46)
Canada and United States	108 (23)	59 (25)
Australia and New Zealand	15 (3)	11 (5)
ECOG performance-status score — no. (%)‡		
0	245 (52)	131 (55)
1	224 (48)	106 (45)
2	1 (<1)	0
Etiologic factor — no. (%)§		
HBV	178 (38)	89 (38)
HCV	113 (24)	55 (23)
Dual HBV and HCV infection	8 (2)	4 (2)
Alcohol use	112 (24)	39 (16)
Nonalcoholic steatohepatitis	43 (9)	23 (10)
Other	24 (5)	16 (7)
Unknown	75 (16)	47 (20)
Extrahepatic spread of disease — no. (%)	369 (79)	182 (77)
Macrovascular invasion — no. (%)	129 (27)	81 (34)
Extrahepatic spread of disease, macrovascular invasion, or both — no. (%)	398 (85)	200 (84)

*There were no significant differences (P<0.05) between the groups at baseline. Percentages may not total 100 because of rounding. More details are provided in Table S1 in the Supplementary Appendix. HBV denotes hepatitis B virus, and HCV hepatitis C virus.

†Asia included Hong Kong, South Korea, Singapore, and Taiwan.

‡Eastern Cooperative Oncology Group (ECOG) performance-status scores are assessed on a 5-point scale, with higher scores indicating greater disability. Although patients were required to have a score of 0 or 1, a few patients had a score of 2.

§Etiologic factors were assessed according to case-report forms. Some patients had more than one factor.

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Table 2.

Adverse Events.*

Event	Cabozantinib (N = 467)			Placebo (N = 237)		
	Any Grade	Grade 3	Grade 4	Any Grade	Grade 3	Grade 4
	number of patients (percent)					
Any adverse event	460 (99)	270 (58)	46 (10)	219 (92)	80 (34)	6 (3)
Diarrhea	251 (54)	45 (10)	1 (<1)	44 (19)	4 (2)	0
Decreased appetite	225 (48)	27 (6)	0	43 (18)	1 (<1)	0
Palmar–plantar erythrodysesthesia	217 (46)	79 (17)	0	12 (5)	0	0
Fatigue	212 (45)	49 (10)	0	70 (30)	10 (4)	0
Nausea	147 (31)	10 (2)	0	42 (18)	4 (2)	0
Hypertension	137 (29)	73 (16)	1 (<1)	14 (6)	4 (2)	0
Vomiting	121 (26)	2 (<1)	0	28 (12)	6 (3)	0
Increase in aspartate aminotransferase level	105 (22)	51 (11)	4 (1)	27 (11)	15 (6)	1 (<1)
Asthenia	102 (22)	31 (7)	1 (<1)	18 (8)	4 (2)	0
Dysphonia	90 (19)	3 (1)	0	5 (2)	0	0
Constipation	87 (19)	2 (<1)	0	45 (19)	0	0
Abdominal pain	83 (18)	7 (1)	1 (<1)	60 (25)	10 (4)	0
Weight loss	81 (17)	5 (1)	0	14 (6)	0	0
Increase in alanine aminotransferase level	80 (17)	23 (5)	0	13 (5)	5 (2)	0
Mucosal inflammation	65 (14)	8 (2)	0	5 (2)	1 (<1)	0
Pyrexia	64 (14)	0	0	24 (10)	1 (<1)	0
Upper abdominal pain	63 (13)	3 (1)	0	31 (13)	0	0
Cough	63 (13)	1 (<1)	0	26 (11)	0	0
Peripheral edema	63 (13)	4 (1)	0	32 (14)	2 (1)	0
Stomatitis	63 (13)	8 (2)	0	5 (2)	0	0
Dyspnea	58 (12)	15 (3)	0	24 (10)	1 (<1)	0
Rash	58 (12)	2 (<1)	0	14 (6)	1 (<1)	0
Ascites	57 (12)	17 (4)	1 (<1)	30 (13)	11 (5)	0
Dysgeusia	56 (12)	0	0	5 (2)	0	0
Hypoalbuminemia	55 (12)	2 (<1)	0	12 (5)	0	0

Event	Cabozantinib (N = 467)			Placebo (N = 237)		
	Any Grade	Grade 3	Grade 4	Any Grade	Grade 3	Grade 4
	number of patients (percent)					
Headache	52 (11)	1 (<1)	0	16 (7)	1 (<1)	0
Thrombocytopenia	52 (11)	16 (3)	0	1 (<1)	0	0
Insomnia	49 (10)	1 (<1)	0	17 (7)	0	0
Dizziness	48 (10)	2 (<1)	0	15 (6)	0	0
Dyspepsia	47 (10)	0	0	7 (3)	0	0
Anemia	46 (10)	18 (4)	1 (<1)	19 (8)	12 (5)	0
Back pain	46 (10)	5 (1)	0	24 (10)	1 (<1)	0
Increase in serum bilirubin level	45 (10)	10 (2)	4 (1)	17 (7)	2 (1)	2 (1)
Decrease in platelet count	45 (10)	13 (3)	4 (1)	7 (3)	2 (1)	0

*Listed are adverse events, regardless of causality, that were reported in at least 10% of patients in either group. Severity was graded according to National Cancer Institute Common Terminology Criteria for Adverse Events, version 4.0.