Randomized Trial of Clazosentan in Patients With Aneurysmal Subarachnoid Hemorrhage Undergoing Endovascular Coiling

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Background and Purpose—Clazosentan, an endothelin receptor antagonist, has been shown to reduce vasospasm after aneurysmal subarachnoid hemorrhage (aSAH). CONSCIOUS-3 assessed whether clazosentan reduced vasospasm-related morbidity and all-cause mortality postaSAH secured by endovascular coiling.

Methods—This double-blind, placebo-controlled, phase III trial randomized patients with aSAH secured by endovascular coiling to /H11349 14 days intravenous clazosentan (5 or 15 mg/h) or placebo. The primary composite end point (all-cause mortality; vasospasm-related new cerebral infarcts or delayed ischemic neurological deficits; rescue therapy for vasospasm) was evaluated 6 weeks postaSAH. The main secondary end point was dichotomized extended Glasgow Outcome Scale (week 12).

Results—CONSCIOUS-3 was halted prematurely following completion of CONSCIOUS-2; 577/1500 of planned patients (38%) were enrolled and 571 were treated (placebo, n/H11005 189; clazosentan 5 mg/h, n/H11005 194; clazosentan 15 mg/h, n/H11005 188). The primary end point occurred in 50/189 of placebo-treated patients (27%), compared with 47/194 patients (24%) treated with clazosentan 5 mg/h (odds ratio [OR], 0.786; 95% CI, 0.479–1.289; \( P \leq 0.340 \), and 28/188 patients (15%) treated with clazosentan 15 mg/h (OR, 0.474; 95% CI, 0.275–0.818; \( P = 0.007 \)). Poor outcome (extended Glasgow Outcome Scale score \( \leq 4 \)) occurred in 24% of patients with placebo, 25% of patients with clazosentan 5 mg/h (OR, 0.918; 95% CI, 0.546–1.544; \( P = 0.748 \), and 28% of patients with clazosentan 15 mg/h (OR, 1.337; 95% CI, 0.802–2.227; \( P = 0.266 \)). Pulmonary complications, anemia, and hypotension were more common in patients who received clazosentan than in those who received placebo. At week 12, mortality was 6%, 4%, and 6% with placebo, clazosentan 5 mg/h, and clazosentan 15 mg/h, respectively.

Conclusions—Clazosentan 15 mg/h significantly reduced postaSAH vasospasm-related morbidity/all-cause mortality; however, neither dose improved outcome (extended Glasgow Outcome Scale).

Clinical Trial Registration—URL: http://clinicaltrials.gov. Unique identifier: NCT00940095.

Key Words: aneurysmal subarachnoid hemorrhage ■ clazosentan ■ CONSCIOUS-3 ■ phase III ■ placebo-controlled ■ randomized ■ endovascular coiling

Angiographic vasospasm is an important cause of mortality and disability following aneurysmal subarachnoid hemorrhage (aSAH). Vasospasm contributes to delayed ischemic neurological deficits (DIND) that occur in up to 40% of aSAH cases, and half of patients with DIND develop ischemic infarctions. As vasospasm after aSAH is unpredictable, common, difficult to manage, and associated with poor outcome, prevention is a highly desired management strategy; prophylactic nimodipine is widely used, although its efficacy is limited.

Clazosentan is a selective endothelin receptor antagonist, which was investigated for prevention of angiographic vasospasm in patients with aSAH in the phase IIb CONSCIOUS-1 (Clazosentan to Overcome Neurological Ischemia and Infarct Occurring After Subarachnoid Hemorrhage) study. In CONSCIOUS-1, clazosentan (1, 5, and 15 mg/h doses)
produced a dose-dependent reduction in moderate or severe angiographic vasospasm, with a 65% relative risk reduction with the highest dose ($P<0.0001$); this suggests that endothelin-1 plays an important role in the pathogenesis of angiographic vasospasm.5,6

On the basis of CONSCIOUS-1, 2 phase III studies (CONSCIOUS-2 and CONSCIOUS-3) were designed to assess the effect of clazosentan on the incidence of cerebral vasospasm-related morbidity and all-cause mortality, and clinical outcome, in patients with aSAH. In CONSCIOUS-2, patients who had their aneurysm secured by clipping received placebo or clazosentan 5 mg/h; however, no significant effect was seen with clazosentan.7,8 Use of 15 mg/h clazosentan in CONSCIOUS-3 was based on CONSCIOUS-1, where the effect of clazosentan was less with 5 mg/h in patients with aneurysms secured by clipping than by clipping, as explained in detail previously.4,8

CONSCIOUS-3 was initiated on July 10, 2009. Recruitment was halted prematurely (October 2010) after completion of CONSCIOUS-2, in part because the 5 mg/h dose did not achieve its primary end point in clipped patients; also, this dose had a similar relative risk reduction in angiographic vasospasm in CONSCIOUS-1 as did the highest dose (15 mg/h) being tested in CONSCIOUS-3 in coiled patients.7 In addition, stopping the study was recommended by the Data and Safety Monitoring Board.

After coiling, patients were randomized (1:1:1) to receive intravenous clazosentan (5 or 15 mg/h) or placebo for up to 14 days postaSAH; the investigator completed a randomization form on an interactive, independent, Web-response system, which assigned a randomization number for each patient according to a predefined scheme. Randomization was stratified by site. The randomization code was only available to authorized individuals with no involvement in study conduct or analysis until the time of unblinding.

Sites managed patients according to guidelines developed for the study and were consistent with published recommendations.3,8 Early detection and management of lung complications were addressed. Drugs or procedures not considered standard care were prohibited. Oral, but not intravenous, nimodipine was permitted.

The study protocol was approved by local Institutional Review Boards and was completed in accordance with Good Clinical Practice guidelines, the Declaration of Helsinki, and with the laws and regulations of the country in which the clinical research was conducted.

Assessments

Before the coiling procedure, all patients underwent CT scan and digital subtraction angiography or CT angiography. Additional CT scans were performed 12 to 48 hours after the coiling procedure (a 12-hour postprocedure CT scan was mandatory for sedated patients; up to 48 hours for neurologically assessable patients), at discharge (unless this occurred after the 6-week visit; a scan at 14 days postaSAH was also acceptable), 6 weeks after aSAH, and in cases of worsening neurological condition or DIND. Angiograms were performed after coiling to document the completeness of occlusion, or with symptoms suggestive of DIND and/or cerebral infarct. In patients who were sedated or in whom neurological scales were not assessable, an angiogram was performed at 9±2 days postaSAH. When neurological worsening occurred, investigators performed investigations to determine whether medical complications (including, but not limited to: hydrocephalus, neurological or systemic infection, hypotension, adult respiratory distress syndrome, pulmonary edema, renal failure, multiorgan failure, metabolic disorders, myocardial infarction, diffuse brain swelling, intracerebral hemorrhage, seizures, and/or rebleeding) were the primary or contributing cause.

After treatment, neurological assessments were performed every 6 hours until day 14 (irrespective of study drug duration) using the modified Glasgow Coma Scale and the abbreviated National Institutes of Health Stroke Scale.9,10 Assessment of Glasgow Outcome Scale, extended version (GOSE), mRS, modified Rankin Scale; GOSE, Assessment of Glasgow Outcome Scale, extended version.

Clinical and imaging data were reviewed by a centralized Critical Events Committee.8 The Critical Events Committee included an image review committee of neuroradiologists, who provided independent evaluation of CT scans and angiograms (each brain image was reviewed by 2 neuroradiologists, with a third adjudicating if discrepancies occurred), and a Clinical Review Committee (CRC; cases were reviewed by 2 neurosurgeons and 1 neurointensivist from a pool of 9 CRC members; unanimity or consensus agreement was required). Consensus meetings were held to discuss cases where

**Methods**

This was a phase III, prospective, multicenter, international, randomized, double-blind, placebo-controlled trial (NCT00940095; Figure 1). Eligible patients were age 18 to 75 years with aSAH caused by ruptured saccular aneurysm, which was secured by endovascular coiling; they had any thick clot (short axis ≥4 mm) on baseline computed tomographic (CT) scan, World Federation of Neurological Surgeons (WFNS) grades I-IV before coiling procedure, and were able to start study drug within 56 hours of aneurysm rupture. Women of childbearing potential were included only following a negative pregnancy test. Written informed consent was obtained.

Exclusion criteria included: giant aneurysms (largest diameter ≥25 mm); intraventricular or intracerebral blood in the absence of subarachnoid blood; vasospasm on precociling angiogram; a major complication during coiling procedure; current ruptured aneurysm previously secured (successfully or not) by clipping; missing digital subtraction angiography at the end of the coiling procedure; or several aneurysms, among which the ruptured one was not identifiable with certainty and that were not all secured during the coiling procedure. Intravenous nimodipine or intravenous nicardipine within 4 hours, or intravenous fasudil within 24 hours, before study drug initiation, was not permitted.
there was disagreement; if unanimity was not achieved after the consensus meeting, the CRC chairman (or should the chairman already be involved in the primary review, the deputized neurointensivist) adjudicated the case, made the final assessment, and documented the assessment in a CRC adjudication form. The CRC made the final assessment via a Web-based system, which provided electronic access to the brain images, whereas the image review committee reported on the clinical data for each patient under review. Operating through a charter, the CRC considered whether events for each component of the primary efficacy end point were met, and also gauged the contribution of vasospasm to poor clinical outcome (GOSE ≤ 4) at week 12.

The primary efficacy end point assessed vasospasm-related morbidity and all-cause mortality within 6 weeks postaSAH, as defined by at least 1 of: death; vasospasm-related cerebral infarction (where vasospasm was the primary cause or a relevant contributing factor); DIND caused by vasospasm (where vasospasm was the primary cause or a relevant contributing factor); or neurological signs or symptoms, in the presence of a positive angiogram, leading to rescue therapy. DIND was defined as a decrease of ≥2 modified Glasgow Coma Scale points or an increase of ≥2 points on the abbreviated National Institutes of Health Stroke Scale lasting for ≥2 hours. For patients in whom neurological scales were not assessable, DIND was defined as administration of valid rescue therapy, which included initiation or increase in dose of an intravenous vasopressor with or without fluid therapy, intra-arterial vasodilator, or balloon angioplasty.

The main secondary end point was the GOSE, dichotomized as good (>4) or poor (≤4), at week 12. Additional secondary end points included occurrence of the individual components of the composite primary end point and total volume of all new or worsened cerebral infarcts at week-6 postaSAH. Planned supplementary analyses assessed the impact of subgroups (WFNS grade, clot size, age, and sex) on the primary and main secondary end point. Safety end points included death up to week 12 and treatment-emergent adverse events (AE).

Results

Baseline Characteristics

CONSCIOUS-3 was conducted between July 10, 2009 and January 26, 2011 (last patient, last visit) at 106 centers in 27 countries; 577 of 1500 patients (38% of the planned sample size) had been randomized at the time of study termination, and 571 patients (placebo, n = 189; clazosentan 5 mg/h, 150 completed per protocol (80% of exposed)

Figure 2. Participant flow. aSAH indicates aneurysmal subarachnoid hemorrhage; GOSE, Assessment of Glasgow Outcome Scale, extended version.
n = 194; clazosentan 15 mg/h, n = 188) had received treatment. Participant flow is shown in Figure 2. AEs were the most common reason for discontinuation of study drug in all arms; administrative/other reasons included: stopping drug by mistake, early hospital discharge, and other technical/logistical reasons. Demographic and clinical characteristics were similar across all groups at baseline (Table 1).

Patients received study treatment for a mean ± SD of 12 ± 2 days, 12 ± 3 days, and 12 ± 3 days in the placebo, clazosentan 5 mg/h, and 15 mg/h groups, respectively; treatment commenced 18 ± 12 hours, 20 ± 12 hours, and 18 ± 12 hours, respectively, after aneurysm coiling. Oral nimodipine was administered to 94% (placebo), 95% (clazosentan 5 mg/h), and 95% (clazosentan 15 mg/h) of patients.

Data for the primary end point were substituted for 1 patient with missing data in the clazosentan 5 mg/h group. For the GOSE secondary end point, 4 patients had data substituted in the placebo group (2 patients, GOSE score 3; 2 patients, GOSE score 5), 6 in the clazosentan 5 mg/h group (6 patients, GOSE score 3; 0 patients, GOSE score 5), and 3

Table 1. Baseline Demographic and Disease Characteristics (All-Treated)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Placebo n = 189</th>
<th>Clazosentan 5 mg/h n = 194</th>
<th>Clazosentan 15 mg/h n = 188</th>
<th>Total n = 571</th>
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<tbody>
<tr>
<td>Men</td>
<td>55 (29)</td>
<td>59 (30)</td>
<td>58 (31)</td>
<td>172 (30)</td>
</tr>
<tr>
<td>Mean (SD) age, y</td>
<td>54 (11)</td>
<td>52 (11)</td>
<td>53.6 (11)</td>
<td>53.1 (11)</td>
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<tr>
<td>Age range, y</td>
<td>23 to 75</td>
<td>23 to 75</td>
<td>19 to 76</td>
<td>19 to 76</td>
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<tr>
<td>WFNS admission grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade I</td>
<td>96 (51)</td>
<td>99 (51)</td>
<td>103 (55)</td>
<td>298 (53)</td>
</tr>
<tr>
<td>Grade II</td>
<td>56 (30)</td>
<td>48 (25)</td>
<td>53 (28)</td>
<td>157 (28)</td>
</tr>
<tr>
<td>Grade III</td>
<td>6 (3)</td>
<td>5 (3)</td>
<td>3 (2)</td>
<td>14 (3)</td>
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<tr>
<td>Grade IV</td>
<td>24 (13)</td>
<td>37 (19)</td>
<td>26 (14)</td>
<td>87 (15)</td>
</tr>
<tr>
<td>Grade V</td>
<td>5 (3)</td>
<td>4 (2)</td>
<td>2 (1)</td>
<td>11 (2)</td>
</tr>
<tr>
<td>Motor deficit present at admission</td>
<td>19 (10)</td>
<td>21 (11)</td>
<td>18 (10)</td>
<td>58 (10)</td>
</tr>
<tr>
<td>No. of aneurysms secured (ruptured and unruptured)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>183 (97)</td>
<td>183 (94)</td>
<td>177 (94)</td>
<td>543 (95)</td>
</tr>
<tr>
<td>2</td>
<td>6 (3)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>26 (5)</td>
</tr>
<tr>
<td>&gt;2</td>
<td>0</td>
<td>1 (&lt;1)</td>
<td>1 (&lt;1)</td>
<td>2 (&lt;1)</td>
</tr>
<tr>
<td>Size of coiled ruptured aneurysm</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤15 mm</td>
<td>183 (98)</td>
<td>193 (100)</td>
<td>181 (97)</td>
<td>557 (98)</td>
</tr>
<tr>
<td>&gt;15 mm</td>
<td>5 (3)</td>
<td>1 (&lt;1)</td>
<td>6 (3)</td>
<td>12 (2)</td>
</tr>
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<td>Key locations of ruptured aneurysms</td>
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<td></td>
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<tr>
<td>Supraclinoid ICA</td>
<td>19 (10)</td>
<td>22 (11)</td>
<td>31 (17)</td>
<td>72 (13)</td>
</tr>
<tr>
<td>MCA</td>
<td>16 (9)</td>
<td>19 (10)</td>
<td>23 (12)</td>
<td>58 (10)</td>
</tr>
<tr>
<td>ACA</td>
<td>10 (5)</td>
<td>21 (11)</td>
<td>13 (7)</td>
<td>44 (8)</td>
</tr>
<tr>
<td>ACoA</td>
<td>74 (39)</td>
<td>62 (32)</td>
<td>62 (33)</td>
<td>198 (35)</td>
</tr>
<tr>
<td>PCoA</td>
<td>31 (16)</td>
<td>39 (20)</td>
<td>35 (19)</td>
<td>105 (18)</td>
</tr>
<tr>
<td>Distal VA</td>
<td>11 (6)</td>
<td>5 (3)</td>
<td>8 (4)</td>
<td>24 (4)</td>
</tr>
<tr>
<td>Basilar artery</td>
<td>22 (12)</td>
<td>22 (11)</td>
<td>15 (8)</td>
<td>59 (10)</td>
</tr>
<tr>
<td>Clot size at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diffuse thick</td>
<td>116 (61)</td>
<td>118 (61)</td>
<td>111 (59)</td>
<td>345 (61)</td>
</tr>
<tr>
<td>Local thick</td>
<td>58 (31)</td>
<td>54 (28)</td>
<td>56 (30)</td>
<td>168 (30)</td>
</tr>
<tr>
<td>Diffuse thin</td>
<td>12 (6)</td>
<td>17 (9)</td>
<td>17 (9)</td>
<td>46 (8)</td>
</tr>
<tr>
<td>Local thin</td>
<td>3 (2)</td>
<td>2 (1)</td>
<td>4 (2)</td>
<td>9 (2)</td>
</tr>
<tr>
<td>Unable to assess</td>
<td>0</td>
<td>2 (1)</td>
<td>0</td>
<td>2 (&lt;1)</td>
</tr>
<tr>
<td>Common CT findings at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraventricular hemorrhage</td>
<td>162 (85.7)</td>
<td>161 (83.4)</td>
<td>156 (83.0)</td>
<td>479 (84.0)</td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>122 (64.6)</td>
<td>117 (60.6)</td>
<td>115 (61.2)</td>
<td>354 (62.1)</td>
</tr>
<tr>
<td>Intraparenchymal hemorrhage</td>
<td>35 (18.5)</td>
<td>36 (18.7)</td>
<td>32 (17.0)</td>
<td>103 (18.1)</td>
</tr>
</tbody>
</table>

Values are n (%) unless otherwise stated.

WFNS indicates World Federation of Neurological Surgeons; ICA, internal carotid artery; MCA, middle cerebral artery; ACA, anterior cerebral artery; ACoA, anterior communicating artery; PCoA, posterior communicating artery; CT, computed tomography; VA, vertebral artery.
patients in the clazosentan 15 mg/h group (2 patients, GOSE score 3; 1 patient, GOSE score 5).

**Efficacy**

Vasospasm-related morbidity and all-cause mortality occurred in the all-treated population in 50/189 of patients (27%) in the placebo group compared with 47/194 patients (24%) and 28/188 patients (15%) in the 5 and 15 mg/h clazosentan groups, respectively; a significant improvement was seen with 15 mg/h clazosentan (OR, 0.474; 95% CI, 0.275–0.818; \( P \leq 0.007 \)), but not with 5 mg/h (OR, 0.786; 95% CI, 0.479–1.289; \( P = 0.340 \); Figure 3A).

Event rates in the all-treated population for each individual component of the composite end point are shown in Figure 3B; a higher proportion of patients required rescue therapy in the placebo group (21%) compared with clazosentan 5 mg/h (15%) and 15 mg/h (7%). DIND was significantly reduced with clazosentan 15 mg/h (10%) as compared with placebo (21%). Rates of vasospasm-related new cerebral infarcts were 13%, 16%, and 7% with placebo, clazosentan 5 mg/h, and clazosentan 15 mg/h, respectively. There was no effect of treatment on mortality within 6 weeks (Figure 3B).

Poor functional outcome (GOSE score \( \leq 4 \); end point substituted) occurred in 24% of patients in the all-treated placebo group compared with 25% (OR, 0.918; 95% CI, 0.546–1.544; \( P = 0.748 \)) and 28% (OR, 1.337; 95% CI, 0.802–2.227; \( P = 0.266 \)) in the clazosentan 5 mg/h and clazosentan 15 mg/h groups, respectively.

In the placebo group, the Critical Events Committee-confirmed new cerebral infarct median total volume at week 6 was 14.4 cm\(^3\) (range, 0.44–376.6 cm\(^3\)) compared with 8.26 cm\(^3\) (range, 0.12–553.59 cm\(^3\)) and 8.26 cm\(^3\) (range, 0.05–794.47 cm\(^3\)) in the clazosentan 5 mg/h and clazosentan 15 mg/h groups, respectively.

Results from planned subgroup analyses of vasospasm-related morbidity and all-cause mortality according to sex, age, baseline clot size, and WFNS grade at baseline are shown in Figure 4.

**Safety and Tolerability**

During the study, 91%, 86%, and 92% of patients receiving placebo, clazosentan 5 mg/h, and clazosentan 15 mg/h, respectively, experienced ≥1 AE. Severe AE incidence was 25% (placebo) 28% (clazosentan 5 mg/h), and 29% (clazosentan 15 mg/h); the rate of AEs considered by the investigator to be related to treatment was 24%, 34%, and 37%, respectively. A higher proportion of patients receiving clazosentan (5 mg/h and 15 mg/h) prematurely discontinued treatment compared with the placebo group; the main reason for discontinuation from study drug was AEs (Figure 2). Incidence of AEs of specific interest is shown in Table 2. Compared with placebo, pulmonary complications, hypotension, and anemia were more common with clazosentan; hypotension was more frequent in the 15 mg/h dose group than in the 5 mg/h dose group.

Of treated patients, 6% (placebo), 4% (clazosentan 5 mg/h), and 6% (clazosentan 15 mg/h) died within 12 weeks of aSAH; causes of death reported for >1% of patients in any group were cerebral infarction (2%, <1%, and <1%), cerebrovascular spasm (2%, <1%, and <1%), and brain edema (2%, <1%, and <1%), respectively.

**Discussion**

This randomized, double-blind, placebo-controlled, phase III trial investigated vasospasm-related morbidity and all-cause mortality with clazosentan 5 or 15 mg/h administered for up to 14 days in patients with aSAH secured by endovascular coiling. The trial was halted early because of nonsignificant findings with clazosentan 5 mg/h in the parallel CONSCIOUS-2 clipping study.\(^7 \) For the lower dose, data from the present study support findings from CONSCIOUS-2, ie, clazosentan 5 mg/h had no significant effect on vasospasm-related morbidity or all-cause mortality 6 weeks postaSAH (composite primary end point) or functional outcome, but the 15 mg/h of clazosentan did significantly reduce vasospasm-related morbidity or all-cause mortality within 6 weeks postaSAH. There was a marked reduction in rescue therapy with clazosentan 15 mg/h, likely because of the corresponding reduction of DIND. However, the

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Figure 3. Event rate (%) for: A, all-cause mortality and vasospasm-related morbidity at 6 weeks (all-treated, end point substituted); and B, each of the individual components of the primary composite end point (all-treated, end point substituted; planned analysis, secondary end point). DIND indicates delayed ischemic neurological deficits.
reduction in the primary end point did not lead to improved outcome at week 12, as measured by GOSE.

Despite an impressive and significant effect on vasospasm-related ischemic events, some explanations for the lack of effect of 15 mg/h clazosentan dose on GOSE can be hypothesized. The most important is that because of early stopping of this trial, the planned number of patients was not enrolled; therefore, its low statistical power may explain the lack of effect observed with 15 mg/h of clazosentan. The possibility exists that the tolerability profile of the drug negated any therapeutic benefit, or that interaction with oral nimodipine contributed to AEs. For example, intravenous nimodipine is associated with low blood pressure, and it is possible that oral administration of nimodipine with clazosentan may have contributed to the higher rate of hypotension in the active treatment groups compared with placebo. Microthromboembolism, microcirculatory dysfunction, cortical spreading ischemia, and delayed neuronal injury have been postulated to contribute to DIND and outcome, and might not be prevented by clazosentan.

Table 2. Adverse Events of Specific Interest Occurring Up to 1 Day After Study Drug Discontinuation and Up to Week 6 Post aSAH (Safety Population)

<table>
<thead>
<tr>
<th>Grouping of MedDRA Terms; Patients With ≥1 AE n (%)</th>
<th>Placebo</th>
<th>Clazosentan 5 mg/h</th>
<th>Clazosentan 15 mg/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung complications</td>
<td>40 (21)</td>
<td>70 (36)</td>
<td>70 (37)</td>
</tr>
<tr>
<td>Lung complications related to pulmonary edema</td>
<td>16 (9)</td>
<td>37 (19)</td>
<td>32 (17)</td>
</tr>
<tr>
<td>Hypotension</td>
<td>13 (7)</td>
<td>21 (11)</td>
<td>30 (16)</td>
</tr>
<tr>
<td>Hepatobiliary events</td>
<td>35 (19)</td>
<td>39 (20)</td>
<td>28 (15)</td>
</tr>
<tr>
<td>Anemia</td>
<td>18 (10)</td>
<td>25 (13)</td>
<td>24 (13)</td>
</tr>
<tr>
<td>Rhythm/conduction disorders</td>
<td>23 (12)</td>
<td>16 (8)</td>
<td>20 (11)</td>
</tr>
<tr>
<td>Cerebral hemorrhage</td>
<td>5 (3)</td>
<td>7 (4)</td>
<td>7 (4)</td>
</tr>
<tr>
<td>Cardiac ischemic events</td>
<td>3 (2)</td>
<td>8 (4)</td>
<td>6 (3)</td>
</tr>
<tr>
<td>Eye disorders</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>6 (3)</td>
</tr>
</tbody>
</table>

*aSAH indicates aneurysmal subarachnoid hemorrhage; MedDRA, medical dictionary for regulatory activities; AE, adverse events.*

The results from CONSCIOUS-2 and CONSCIOUS-3 raised questions regarding the efficacy of endothelin-1 antagonists in preventing vasospasm; however, the possibility remains that these agents may have clinical utility as part of a complex treatment regimen for aSAH. For future trials, investigating different (eg, shorter) durations of clazosentan...
administration could be considered to attempt to separate the positive effects from any deleterious consequences of treat-
ment.\(^{20,21}\) In addition, restricting the use ofnimodipine concomitantly with clazosentan may help to determine the relevant contributions of each agent to changes in cerebral vasospasm-related morbidity and all-cause mortality, and in functional outcome. Initiating surgical procedures as early as possible, and ensuring that this is coupled with the appropri-
ate pharmacological interventions, remains the current focal points for treatment of patients with aSAH.

Adverse events (lung complications, hypotension, and ane-
mia) were consistent with those observed in CONSCIOUS-1
and CONSCIOUS-2; it is likely that these side effects could be
managed using appropriate adjunct therapy. There were no new safety concerns in this study compared with in the previous 2 trials. An equal proportion of patients in the clazosentan 15 mg/h and placebo groups died during the study, with cerebral infarc-
tion being the most frequently reported primary cause of death in these groups.

## Conclusions

Clazosentan 15 mg/h reduced cerebral vasospasm-related morbidity and all-cause mortality. However, clazosentan did not improve outcome, possibly because of increased rescue therapy in the placebo group. Compared with placebo, pul-
monary complications, anemia, and hypotension were more common in patients receiving clazosentan. Although clazos-
entan does not appear to provide benefit in clinical outcome, it prevented DIND and rescue therapy, which could be further investigated based on analysis of the patients treated in the clazosentan studies.

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## Disclosures

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血管内コイル塞栓術を受けた脳動脈瘤性くも膜下出血患者における clazosentan の無作為試験

Randomized Trial of Clazosentan in Patients With Aneurysmal Subarachnoid Hemorrhage Undergoing Endovascular Coiling

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背景および目的: エンドセリン受容体拮抗薬 clazosentan は、動脈瘤性くも膜下出血 (aSAH) 後の血管攣縮を抑制することが明らかにされている。CONSCIOUS-3 試験では、clazosentan が、血管内コイル塞栓術によって治療された aSAH 後の血管攣縮に関連する罹病率と全死因による死亡を抑制するか否かを評価した。

方法: 本二重盲検プラセボ対照第 III 相試験では、血管内コイル塞栓術で治療した aSAH 患者を、14 日以下の静脈内 clazosentan (5 mg または 15 mg/時) またはプラセボ投与に無作為に割り付けた。主要複合評価項目 (全死因による死亡、血管攣縮に関連した新たな脳梗塞または遅発性虚血性神経障害、血管攣縮に対する救済療法) を aSAH 後 6 週時に評価した。主な副次評価項目は二分した拡張グラスゴー・アウトカムスケール (12 週時) であった。

結果: CONSCIOUS-3 試験は、CONSCIOUS-2 試験の完了後、早期に中止された。予定された 1,500 例中 577 例 (38%) が登録され、571 例に試験投与が実施された (プラセボ 189 例、clazosentan 5 mg/時 194 例、clazosentan 15 mg/時 188 例)。プラセボ群では 189 例中 50 例 (27%) に主要評価項目が発生したのに対し、clazosentan 5 mg/時群では 194 例中 47 例 (24%) [オッズ比 (OR) = 0.786, 95% CI：0.479～1.289, p = 0.340]、また clazosentan 15 mg/時群では 188 例中 28 例 (15%) (OR = 0.474, 95% CI：0.275～0.818, p = 0.007) に主要評価項目が発生した。予後不良 (拡張グラスゴー・アウトカムスケールスコア≦4) となったのは、プラセボ群の 24%、clazosentan 5 mg/時群の 25% (OR = 0.918, 95% CI：0.546～1.544, p = 0.748) および clazosentan 15 mg/時群の 28% (OR = 1.337, 95% CI：0.802～2.227, p = 0.266) の患者であった。肺合併症、貧血および低血圧は、プラセボを投与した患者よりも clazosentan を投与した患者に多く認められた。12 週時の死亡率は、プラセボ群、clazosentan 5 mg/時群および clazosentan 15 mg/時群でそれぞれ 6%、4%および 6%であった。

結論: clazosentan 15 mg/時は aSAH 後の血管攣縮関連の罹病率/全原因死を有意に抑制したが、いずれの用量の clazosentan によっても転帰 (拡張グラスゴー・アウトカムスケール) は改善されなかった。

Abstract

Randomized Trial of Clazosentan in Patients With Aneurysmal Subarachnoid Hemorrhage Undergoing Endovascular Coiling

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(Stroke. 2012;43:1463-1469.)

Key Words: aneurysmal subarachnoid hemorrhage • clazosentan • CONSCIOUS-3 • phase III • placebo-controlled • randomized • endovascular coiling

Major Clinical Trial

 배경과 목적

엔도테일 수용체 침해제 clazosentan은 동맥류성 기미막밑출혈 환자의 환자에서 치료한 후 clazosentan이 혈관내 코일링으로 치료한 후 clazosentan이 혈관내에 관련된 이환율과 사망률을 감소시키는지를 평가했다.

방법

이 연구는 위약과 3상상관은 혈관내 코일링으로 치료한 aSAH 환자를 14일 이내의 clazosentan 정주 또는 위약으로 무작위배정했다. aSAH 발생 6주 후에 일차복합결절(사망, 혈관내케롤, 단독 또는 격리된 뇌경색이나 암면, 혈관내소관, 근육성 혈관내소관, 혈관내에 대한 구조요법)을 평가하였다. 주요결점은 이 연구는 extended Glasgow Outcome Scale (12주)였다.

결과

CONSCIOUS-3는 CONSCIOUS-2의 완료 후 조기종료하였 다. 계획한 1,500명 중 577명을 등록하였고 571명을 치료하였다(위약, n=189: clazosentan 5 mg/h, n=194: clazosentan 15 mg/h, n=188). 일차결점은 위약의 환자의 50/189 (27%) 에게, clazosentan 5 mg/h 치료자시(OR, 0.786: 95% CI, 0.479~1.289; P=0.340)의 47/194 (24%)에게, clazosentan 15 mg/h 치료자시(OR, 0.474: 95% CI, 0.275~0.818; P=0.007)의 28/188 (15%)에게 발생하였다. 병원 환자(extended Glasgow Outcome Scale score ≤ 4)는 위약으로 치료한 환자의 24%, clazosentan 5 mg/h로 치료한 환자(OR, 0.918: 95% CI, 0.546~1.544; P=0.748)의 25%, clazosentan 15 mg/h으로 치료한 환자(OR, 1.337: 95% CI, 0.802~2.227; P=0.266)의 28%에서 발생했다. 호흡기계 합병증, 뇌혈 압은 위약군보다 clazosentan군에서 더 높았다. 12주 후의 사망률은 위약군에서 6%, clazosentan 5 mg/h군에서 4%, clazosentan 15 mg/h군에서 6%였다.

결론

Clazosentan 15 mg/h은 aSAH 이후의 혈관내 코일링 관련 이환율, 사망률을 의미 있게 감소시켰다. 그러나 어떠한 응용도 결과(extended Glasgow Outcome Scale)를 보도하지는 않았다.

Clinical Trial Registration