

Pegcetacoplan compared with supportive care for 26 weeks for participants with paroxysmal nocturnal hemoglobinuria: a plain language summary

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Summary

What is this summary about?

This plain language summary describes the phase 3 PRINCE study. The study looked at adults with paroxysmal nocturnal hemoglobinuria (PNH), a rare blood disorder that is acquired (not inherited), usually during adulthood. PNH causes hemolysis, which is the destruction of red blood cells.










The PRINCE study compared a new medicine, pegcetacoplan, with the older treatment of supportive care (includes red blood cell blood transfusions; blood thinners; steroid medicines; and supplements, like iron, folate or vitamin B12). Supportive care was the standard treatment worldwide until eculizumab, the first C5 complement inhibitor medicine, was approved by the United States Food and Drug Administration and the European Medicines Agency in 2007 for the treatment of PNH. Supportive care is still the standard treatment for PNH in countries where C5 complement inhibitor medicines are not available. The PRINCE trial aimed to show if pegcetacoplan reduced hemolysis and if side effects occurred with pegcetacoplan in patients who had not received C5 complement inhibitor medicines recently.

How was the study carried out?

Participants were adults with PNH and anemia. Anemia was defined as a hemoglobin level of less than 13.6 grams per deciliter of blood for men and less than 12.0 grams per deciliter of blood for women. Hemoglobin is a protein inside red blood cells. Participants in the trial had not recently been treated with a C5 complement inhibitor medicine (eculizumab or ravulizumab).

The participants were split into 2 groups: a pegcetacoplan group and a supportive care group. 35 participants received pegcetacoplan for 26 weeks, and 18 participants received supportive care. Those who received supportive care could switch to pegcetacoplan if their anemia got worse. Researchers monitored the participants' blood markers for hemolysis, how participants felt during the trial and the participants' side effects. The study started in 2019 and ended in 2021.

How to say (double click sound icon to play sound)...

- **Anemia:** uh-NEE-mee-uh 
- **Eculizumab:** ek-yoo-LIZ-ah-mab 
- **Hemoglobin:** hee-moh-GLOH-bin 
- **Hemolysis:** hee-MOH-lih-sis 
- **Lactate dehydrogenase:** LAK-tayt dee-HIGH-druh-juh-neyz 
- **Paroxysmal nocturnal hemoglobinuria:** PAH-rock-siz-muhl nok-TURN-ul hee-moh-gloh-bin-OR-ree-ah 
- **Pegcetacoplan:** peg-set-ah-COE-plan 
- **Ravulizumab:** rav-yoo-LIZ-yoo-mab 
- **Reticulocyte:** ri-TIK-yuh-luh-sahyt 

This summary reports the results of a single study. Other studies may have different results. Healthcare professionals should use all available evidence to make treatment decisions, not just the results from a single study.

Side effect: a medical problem that occurs during a clinical trial. It may be caused by the study medicine or by a different medical problem.

What were the results?

Participants who received pegcetacoplan had fewer signs of hemolysis after 26 weeks of treatment with pegcetacoplan compared with participants who received supportive care. Although participants in both groups had side effects, most were not serious. No serious **side effects** were related to pegcetacoplan.

What do the results show?

These results show that pegcetacoplan reduced hemolysis in adults with PNH better than supportive care. None of the side effects related to pegcetacoplan were serious. Results from the PRINCE study were published in *Blood Advances* in 2023.

Pegcetacoplan was approved by the United States Food and Drug Administration and the European Medicines Agency in 2021. In the United States, pegcetacoplan is available to treat adults with PNH, the condition discussed in this summary. In Europe, it is licensed to treat adults with PNH who have anemia, despite being treated with a C5 complement inhibitor medicine such as eculizumab or ravulizumab for at least 3 months.

Who is this article for?

This article may be helpful for healthcare professionals, patient advocates, people with PNH and caregivers.

If you participated in this study and have questions about the results, please speak with the doctor or staff at your study site.

Where can I find the original article on which this summary is based?

The original PRINCE study article is titled 'Pegcetacoplan controls hemolysis in complement inhibitor-naïve patients with paroxysmal nocturnal hemoglobinuria.' It was published in *Blood Advances* in 2023.

You can read the original article for free by clicking this link: <https://ashpublications.org/bloodadvances/article/7/11/2468/494713/Pegcetacoplan-controls-hemolysis-in-complement>

Who sponsored this study?

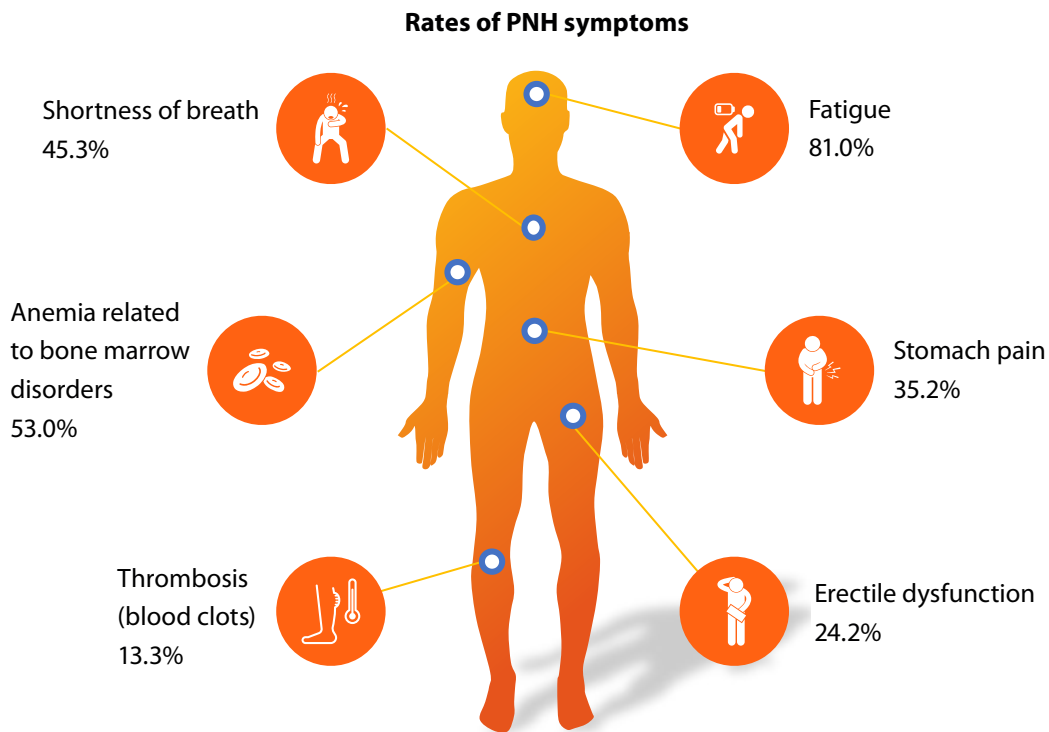
Apellis Pharmaceuticals, Inc., **sponsored** this study.

Sponsor: A sponsor is a company or organization that oversees and pays for a clinical research study. The sponsor also collects and analyzes the information that was generated during the study.

What is paroxysmal nocturnal hemoglobinuria?

Paroxysmal nocturnal hemoglobinuria, or PNH, is a rare and serious blood disorder, usually diagnosed in adults. People with PNH do not have enough red blood cells. This is called anemia. Anemia happens in PNH because red blood cells are destroyed by hemolysis.

Red blood cells carry oxygen from the lungs to the rest of the body. Therefore, the organs and tissues of people with PNH do not get enough oxygen. This causes them to feel fatigued, or extremely tired. People with PNH may also have other symptoms, like abdominal pain, difficulty swallowing, erectile dysfunction, dark urine and shortness of breath. They may also develop organ damage and blood clots that can be life threatening.



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What causes PNH?

Red blood cells are made by the bone marrow. People with PNH have a genetic mutation in a gene called PIG-A in the bone marrow. The mutation causes red blood cells to be made without important surface proteins called CD55 and CD59. The surface proteins are responsible for protecting red blood cells from our own immune system. Without this protection provided by the surface proteins, the immune system destroys the red blood cells. This process is called hemolysis.

The part of the immune system that causes hemolysis in PNH is known as the complement cascade. The complement cascade causes 2 types of hemolysis: extravascular hemolysis and intravascular hemolysis. The complement cascade proteins C3 and C5 play important roles in this hemolysis.

The C3 and C5 proteins are activated in a cascade, which is like a chain reaction. C3 always activates first and C5 always follows it. Therefore, if C3 does not activate, neither does C5.

- Extravascular hemolysis happens in the liver and spleen. It occurs when the C3 protein becomes activated by the complement cascade
- Intravascular hemolysis happens in the veins and arteries. It occurs when the C5 protein becomes activated by the complement cascade

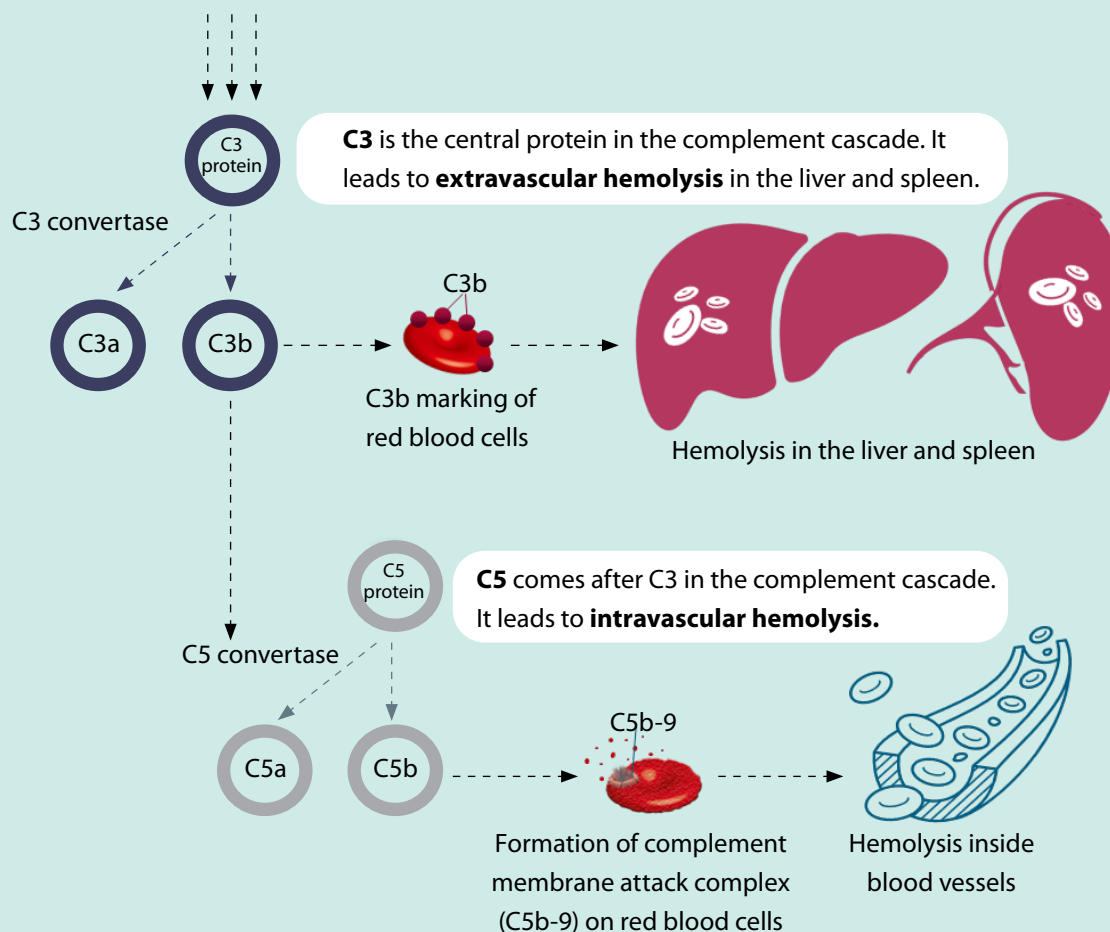
Inhibiting, or blocking, C3 from activating keeps both extravascular and intravascular hemolysis from happening.

Inhibiting C5 from activating blocks intravascular hemolysis only. Extravascular hemolysis still happens because C3 was activated.

The complement cascade

The complement cascade is like a chain reaction.

Multiple complement activation pathways



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How is PNH currently treated?

People with PNH are treated with medicines called complement inhibitors. These medicines inhibit the C3 and C5 proteins from activating and causing hemolysis. These medicines do not cure PNH and are not 100% effective.

The symptoms of PNH that are caused by hemolysis can be treated with supportive care. This includes treatments that can be used with complement inhibitor medicines, such as red blood cell transfusions and supplements (like iron, folate or vitamin B12). Supportive care also includes blood thinners and steroid medicines, which are not used with complement inhibitors. Supportive care treatments do not block hemolysis.

About the study medicine

What is pegcetacoplan?

Pegcetacoplan is a C3 complement inhibitor medicine that is available in the United States and in Europe.

Pegcetacoplan approvals in the United States and Europe

United States
Adults with PNH



Europe

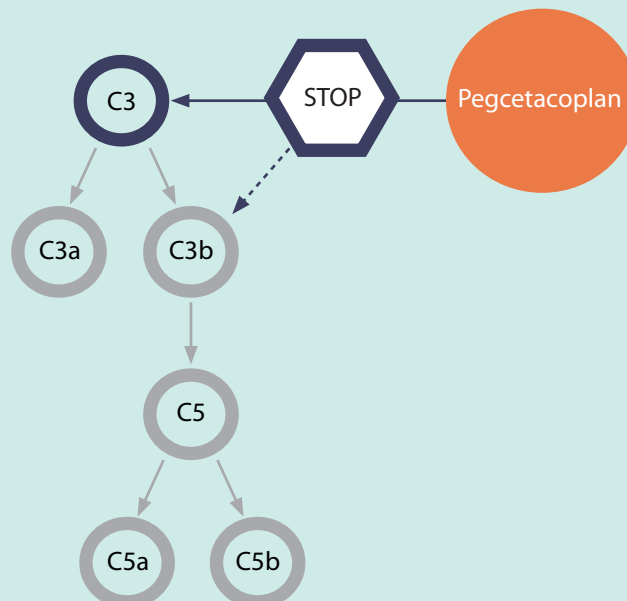
Adults with PNH who still have anemia after receiving a C5 inhibitor medicine such as eculizumab or ravulizumab for at least 3 months



Patients self-administer pegcetacoplan 1080 mg as a subcutaneous (under the skin) infusion twice per week. The infusion lasts about 30 minutes to 1 hour.

How does pegcetacoplan work?

Pegcetacoplan blocks both extravascular and intravascular hemolysis by inhibiting the activation of the C3 protein. This, in turn, inhibits the activation of the C5 protein.



Study details

What was the goal of the study?

The goal of the PRINCE study was to see how effective pegcetacoplan treatment was at blocking ongoing hemolysis compared with supportive care in adults with PNH who had anemia and had not been treated with complement inhibitors within the past 3 months.

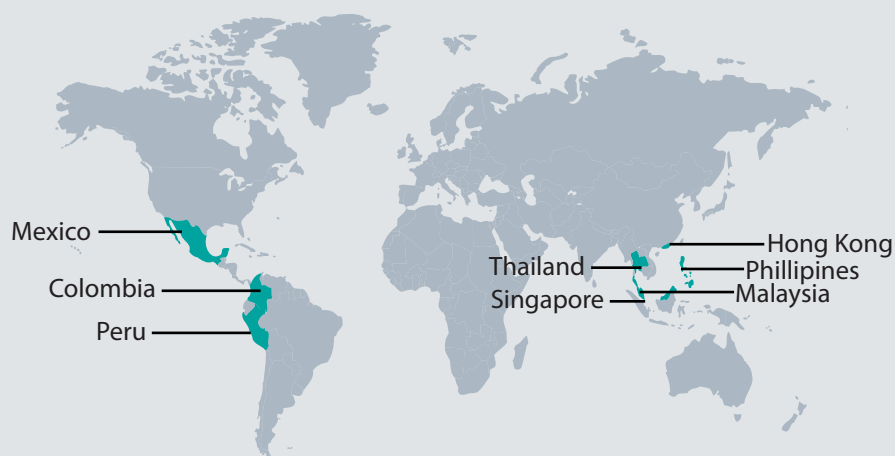
Why was the trial needed?

Before pegcetacoplan became available to treat adults with PNH, 2 medicines were available to treat PNH: eculizumab and ravulizumab. These medicines are C5 complement inhibitors. They block intravascular hemolysis but do not block extravascular hemolysis. This study was needed to determine if pegcetacoplan, which blocks both intravascular and extravascular hemolysis, was more effective than continued supportive care for patients with PNH who had not received a C5 complement inhibitor medicine recently.

When and where did the study take place?

The PRINCE study started in August 2019 and ended in June 2021. It took place in the following 8 countries in Asia, North America and South America:

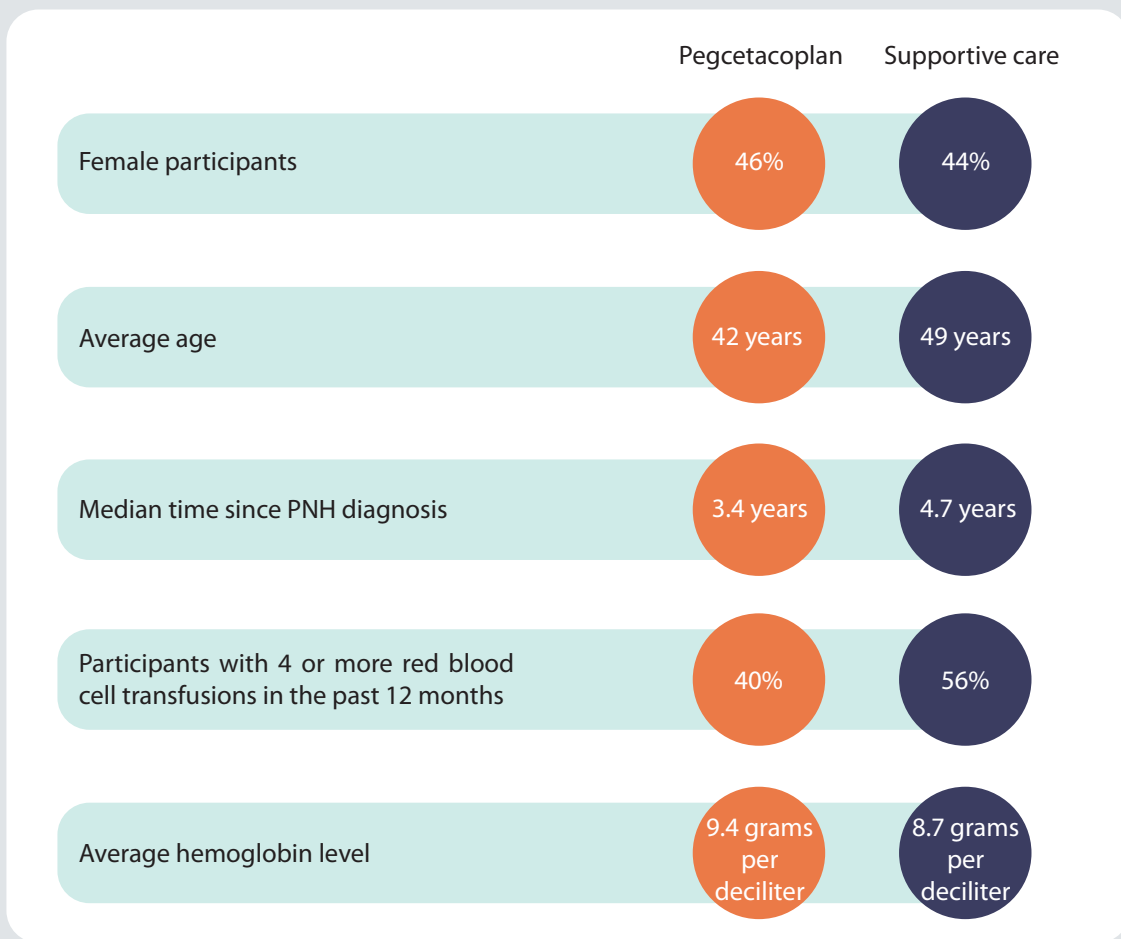
- **Asia:** Hong Kong, Malaysia, the Philippines, Singapore and Thailand
- **North America:** Mexico
- **South America:** Colombia and Peru



Complement inhibitors (pegcetacoplan, eculizumab and ravulizumab) were not approved or widely available in these countries during the study. Because of this, these participants with PNH were receiving only supportive care, including red blood cell transfusions, blood thinners, steroid medicines and supplements (like iron, folate or vitamin B12).

What did researchers learn about the participants before the study started?

Before the treatments started, participants in both groups had similar characteristics, including sex, time since PNH diagnosis and hemoglobin level. Participants in the pegcetacoplan group were younger than those in the supportive care group. The pegcetacoplan group had a lower percentage of participants who received 4 or more red blood cell transfusions during the 12 months before the study.



Who participated in the study?

People could participate in the PRINCE study if they met all of the following conditions:

- Were adults (18 years or older)
- Were diagnosed with PNH
- Had anemia, which is measured by levels of hemoglobin, a protein in red blood cells
 - Men entering the study had hemoglobin levels of less than 13.6 grams per deciliter of blood. A healthy hemoglobin level for men is 13.6 to 18 grams per deciliter of blood
 - Women entering the study had a hemoglobin level of less than 12.0 grams per deciliter of blood. A healthy hemoglobin level for women is 12 to 16 grams per deciliter of blood
- Had intravascular hemolysis, which is measured by lactate dehydrogenase (LDH). LDH is a protein inside red blood cells that is released during intravascular hemolysis
 - Participants entering the study had an LDH level that was greater than or equal to 1.5 times the upper limit of normal
- Had received vaccinations to prevent bacterial meningitis (a serious infection that causes inflammation of the membranes that protect the brain and spinal cord)

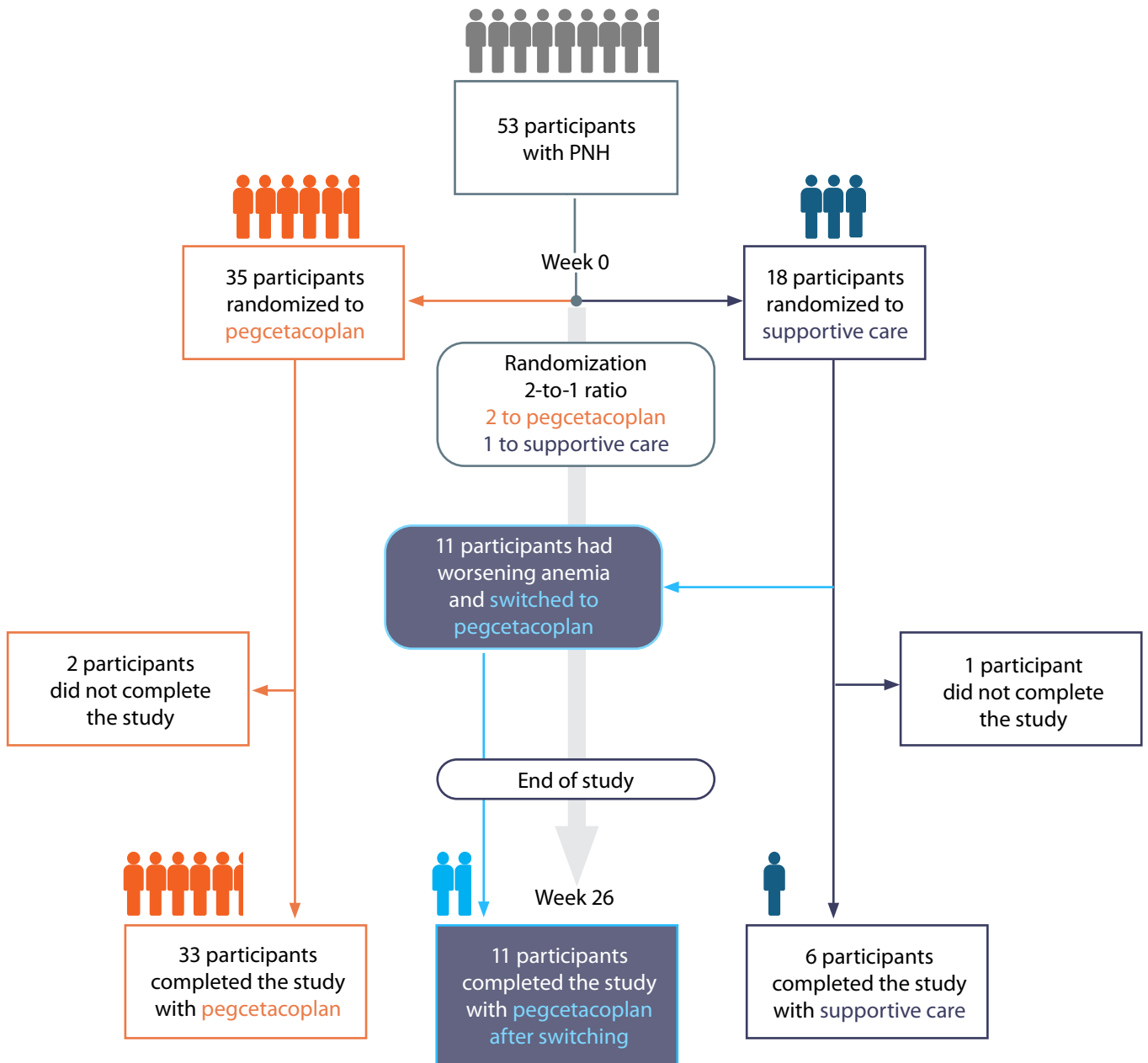
People with PNH could not participate in the PRINCE study if any one of the following was true:

- They had received a C5 inhibitor (eculizumab or ravulizumab) during the 3 months before the study
- They had an inherited disorder that kept the complement cascade from working normally
- They had undergone a bone marrow transplant
- They were breastfeeding

What happened in the study?

- Participants were adults with PNH and anemia who were not being treated with eculizumab or ravulizumab
- Researchers used a computer program to randomly assign participants in a 2-to-1 ratio to either receive pegcetacoplan or continue their supportive care for 26 weeks
- 35 participants were assigned to receive pegcetacoplan
 - Participants in the pegcetacoplan group gave themselves a 1080-mg subcutaneous infusion twice per week at home
 - The infusions lasted about 30 minutes to 1 hour
- 18 participants were assigned to receive supportive care
 - Participants in the supportive care group continued to receive the same supportive care they were receiving before the trial
 - This supportive care included red blood cell transfusions, blood thinners, steroid medicines and supplements such as iron, folate or vitamin B12
 - Participants in the supportive care group could switch to pegcetacoplan treatment if they had signs of worsening anemia. These signs included:
 - a hemoglobin decrease of greater than or equal to 2 grams per deciliter of blood, or
 - a blood clot caused by PNH that blocked blood flow
 - 11 participants in the supportive care group switched to pegcetacoplan
- One participant in the pegcetacoplan group started the study but did not complete it. Another participant in this group died of sepsis before the study ended
- In the supportive care group, 1 participant died of sepsis and respiratory failure before the study ended
- All participants who switched to pegcetacoplan during the study completed the trial
- After 26 weeks, participants who qualified could receive pegcetacoplan for up to 4 more years in a long-term extension study

Number of patients	Treatment
6 participants with PNH before randomization	Before treatment
6 participants randomized to pegcetacoplan	Pegcetacoplan
6 participants randomized to supportive care	Supportive care
6 participants switched to pegcetacoplan	Switched to pegcetacoplan



How did researchers measure the effectiveness of the treatments in the study?

Researchers collected blood samples before, during and at the end of the study. They looked for a change in the levels of the following blood markers, or signs, of PNH:

Hemoglobin

- Hemoglobin is a protein inside red blood cells that can measure the destruction of red blood cells (hemolysis in people with PNH)
- The hemoglobin level in the blood indicates the amount of red blood cells
- Higher hemoglobin levels show that there are more red blood cells and less hemolysis
- If hemoglobin levels were stable in the participants in the study (did not decrease by more than 1 gram per deciliter of blood), the medicine was keeping hemolysis from getting worse

The stabilization of hemoglobin at 26 weeks was one of the most important measurements of the effectiveness of the medicine in the study. In previous studies, pegcetacoplan improved hemoglobin to normal levels in approximately 30% of patients in less than 3 months, and improvements were maintained for 1 year.

- If hemoglobin levels increased, the medicine was blocking hemolysis
- If a participant's hemoglobin level increased by 1 or more grams per deciliter of blood, the patient was classified as having a hemoglobin response

Lactate dehydrogenase

- LDH is a protein inside red blood cells that can be used to measure intravascular hemolysis in people with PNH
- If the C5 protein is destroying red blood cells by intravascular hemolysis, LDH is released from the destroyed red blood cells
- If LDH levels decreased in the participants in the study, the medicine was blocking intravascular hemolysis

The change in LDH level from the start of the study to week 26 was also one of the most important measurements in the study.

Absolute reticulocyte count (ARC)

- ARC is the number of immature red blood cells (reticulocytes) in the blood
- People with PNH have a high ARC because their bone marrow is trying to replace the red blood cells lost during hemolysis
- If the ARC decreased in the participants in the study, the medicine was blocking hemolysis

Need for red blood cell transfusions

- People with PNH sometimes need red blood cell transfusions to replace the red blood cells lost during hemolysis
- Researchers kept track of how many participants needed red blood cell transfusions during the study
- If fewer red blood cell transfusions were needed, the medicine was blocking hemolysis

Did the researchers study anything besides blood markers?

Researchers also studied how the participants felt during the PRINCE trial. Participants completed 2 surveys (or questionnaires) before they began treatment and after 26 weeks of being in the study: the FACIT-Fatigue Scale and the EORTC QLQ-C30 Questionnaire. Researchers monitored safety as well.

FACIT-Fatigue Scale (FACIT stands for Functional Assessment of Chronic Illness Therapy)

- Researchers use this common survey to find out if fatigue decreases when a participant is being treated with a medicine
- Participants rated how much they agreed with each survey statement on a scale from 0 to 4, where 0 meant “not at all” and 4 meant “very much”
- Total scores range from 0 to 52; higher scores meant that a participant had less fatigue
- If a participant’s total score increased by 3 points from the start of the study, this was considered clinically relevant, or an important difference

EORTC QLQ-C30 Questionnaire (EORTC QLQ-C30 stands for European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30)

- Researchers use this survey to learn how the quality of life, or well-being, of a participant is affected when being treated with a medicine
- The questions measure physical, psychological and social functioning, along with some symptoms, overall health and quality of life
- Scores for each section of the survey range from 0 to 100; higher scores mean that the medicine improved the participant’s well-being

Side effects (also called adverse events)

- Researchers kept track of the kind and number of side effects that the participants in the PRINCE trial had during the study
- Researchers decided if the side effect was related to the study medicine or happened for another reason, and whether the side effect was serious

What did researchers learn about the participants during the study?

After 26 weeks of treatment, researchers found the following changes between the participants in the 2 groups.

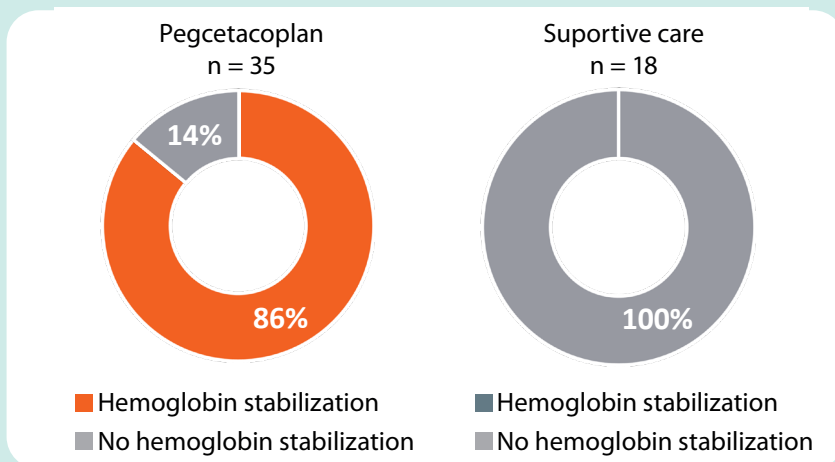
Hemoglobin

Most participants in the pegcetacoplan group had hemoglobin stabilization after 26 weeks, compared with no participants in the supportive care group.

Participants had hemoglobin stabilization if their hemoglobin level did not decrease by more than 1 gram per deciliter. This means that hemolysis was not getting worse.

At week 26, 71% of participants in the pegcetacoplan group had a hemoglobin response. Only 6% of participants in the supportive care group had a hemoglobin response.

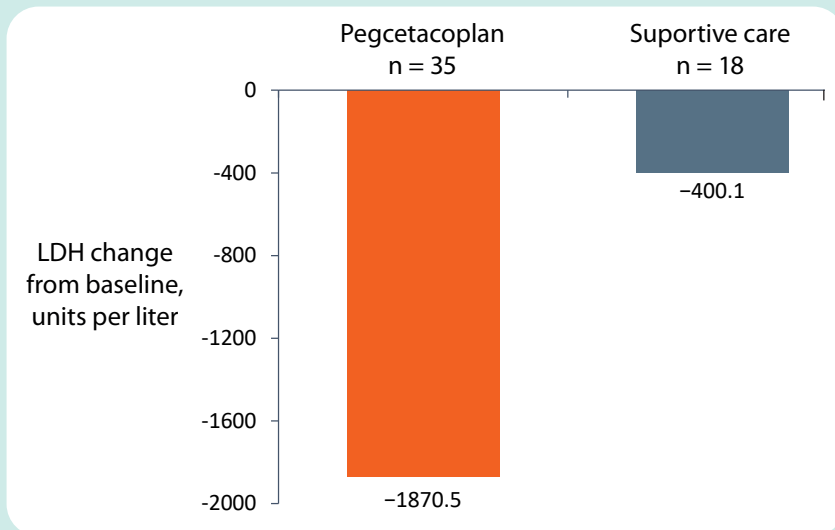
Participants had a hemoglobin response if their hemoglobin level increased by 1 or more grams per deciliter of blood. This means that there was less hemolysis.



Lactate dehydrogenase

The pegcetacoplan group had a much greater improvement (measured as a decrease) in LDH, the protein released from destroyed red blood cells, after 26 weeks.

– This shows that there was less intravascular hemolysis



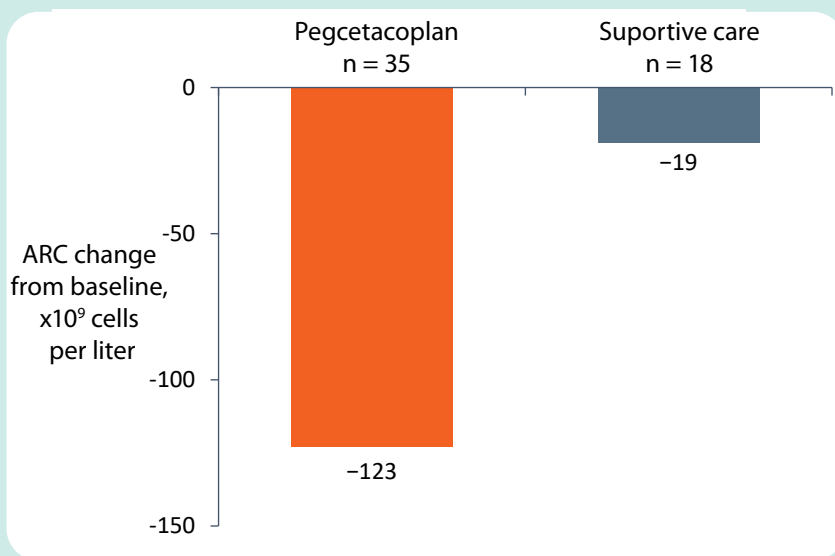
Absolute reticulocyte count

The pegcetacoplan group had fewer immature red blood cells (measured by ARC).

– This showed that hemolysis was controlled
 – Fewer immature red blood cells means that the bone marrow was not working as hard to replace red blood cells lost during hemolysis

The supportive care group had a small decrease in ARC, meaning that there were slightly fewer immature red blood cells.

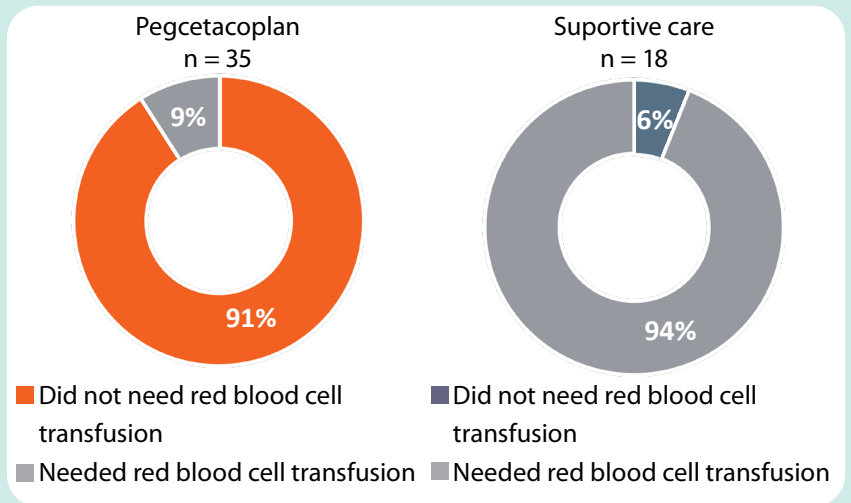
– This showed a slight improvement in hemolysis control, but much less than with pegcetacoplan



Need for red blood cell transfusions

Most participants treated with pegcetacoplan did not need a red blood cell transfusion during the 26 weeks of the study.

Most participants treated with supportive care did need a red blood cell transfusion during the 26 weeks of the study.



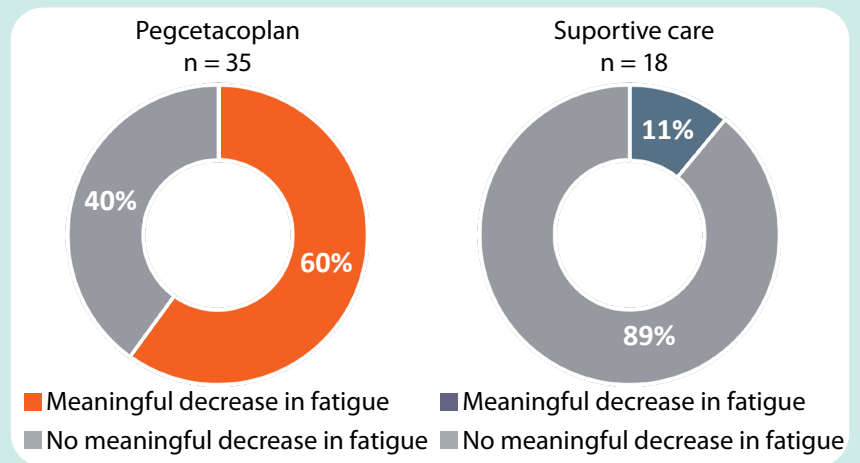
FACIT-Fatigue Scale

Both groups had improved FACIT-Fatigue scores, meaning that they reported feeling less fatigued.

– Scores increased 8 points, on average, with pegcetacoplan and 3 points with supportive care

More participants in the pegcetacoplan group had a meaningful decrease in fatigue than in the supportive care group.

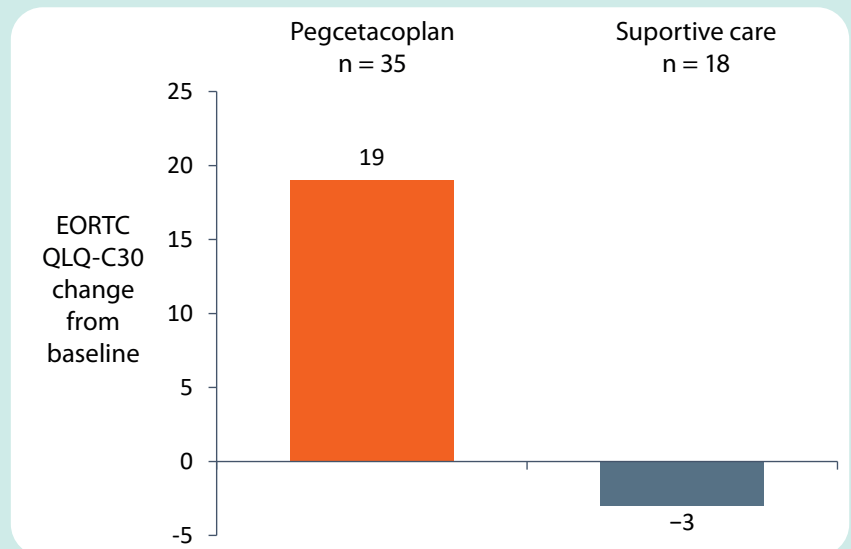
– An increase of greater than or equal to 3 points in FACIT-Fatigue scores is considered a meaningful decrease in fatigue



EORTC QLQ-C30 Questionnaire

The pegcetacoplan group had improved quality of life, as shown by the increase in the average EORTC QLQ-C30 score during the study.

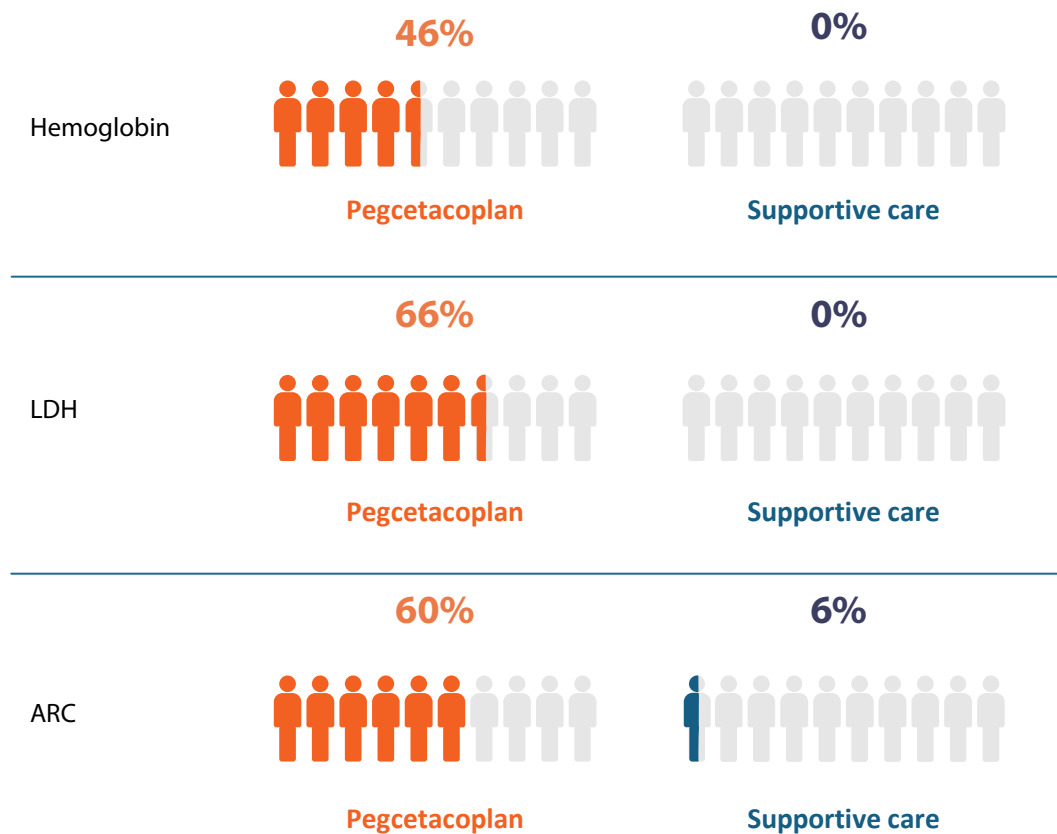
However, the average EORTC QLQ-C30 score for the supportive care group decreased, showing no improvement in quality of life during the study.



Did blood markers return to normal (normalize) with pegcetacoplan treatment in any participants?

- In the pegcetacoplan group, almost half of the participants had normal hemoglobin. Levels of LDH were normal in 66% of participants in the pegcetacoplan group. In the pegcetacoplan group, 60% of participants had normal ARCs
- In the supportive care group, no participants had normal hemoglobin or LDH levels at the end of the study. Fewer than 1 in 10 participants had normal ARCs

Participants with normal blood marker levels at the end of the study



Did participants have side effects in the study?

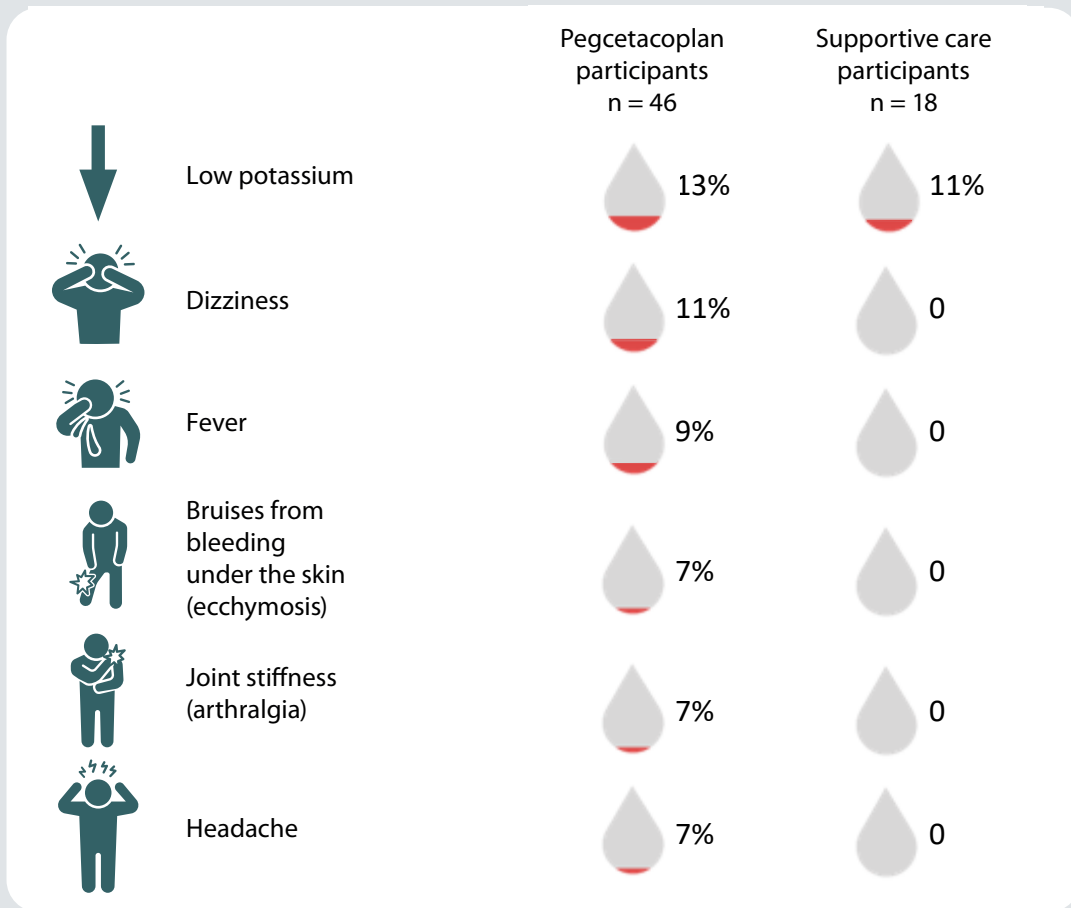
Yes, participants in both groups had side effects (also known as adverse events).

- 72% of participants in the pegcetacoplan group had a side effect
- 67% of participants in the supportive care group had a side effect

What were the most common side effects in the study?

Side effects were reported for participants who received pegcetacoplan, including those who switched from supportive care to pegcetacoplan, and for participants who received supportive care only. The side effects shown occurred in at least 5% of participants in one of the treatment groups. Most side effects were mild or moderate in severity.

- **A side effect is mild if it is not bothersome or dangerous. A moderate side effect may interrupt daily activities but is not dangerous.**



Were any of the side effects serious?

Yes, serious side effects occurred in participants in both treatment groups.

- Four participants (9%) who received pegcetacoplan had serious side effects.
 - One participant had neutropenia (lower-than-normal levels of a type of white blood cell)
 - One participant had a dermoid cyst (a pocket of tissue under the skin lined with oil and old skin cells)
 - One participant had anemia with symptoms that required a red blood cell transfusion
 - One participant had pancytopenia (low numbers of several types of blood cells), a fever with neutropenia (lower-than-normal levels of a type of white blood cell) and septic shock (dangerously low blood pressure after an infection)
 - Researchers concluded that none of the serious side effects were related to pegcetacoplan; these conclusions were made by looking at the side effects and the patient's condition
 - Three participants (17%) who received supportive care had serious side effects
 - Two participants died during the study. One participant who died was in the pegcetacoplan group and the other was in the supportive care group
 - Neither death was related to treatment
- **A side effect is serious if it is life threatening, requires hospitalization, or leads to disability or death. A side effect may not be related to the treatment, even if it occurs during the trial.**

What do the results of the study mean?

Pegcetacoplan blocks both extravascular and intravascular hemolysis by inhibiting the C3 and C5 proteins in the complement cascade.

Among participants with PNH who had not recently received a C5 complement inhibitor medicine and had anemia (a hemoglobin level of less than 13.6 grams per deciliter of blood for men and less than 12.0 grams per deciliter of blood for women), pegcetacoplan was more effective than supportive care after 26 weeks of treatment.

- 86% of participants in the pegcetacoplan group had hemoglobin stabilization (hemolysis was not getting worse), compared with 0% in the supportive care group
- A hemoglobin response (less hemolysis) occurred in 71% of participants in the pegcetacoplan group and 6% of participants in the supportive care group
- Participants in the pegcetacoplan group had a much greater improvement in LDH (less intravascular hemolysis) than participants in the supportive care group
- The number of immature red blood cells decreased more with pegcetacoplan than with supportive care:
 - This shows that the bone marrow of participants who received pegcetacoplan did not have to work as hard to replace red blood cells lost to hemolysis
- In the pegcetacoplan group, 91% of participants did not need a red blood cell transfusion. In the supportive care group, 6% of participants did not need a red blood cell transfusion
- Fatigue improved in both groups
- Quality-of-life improved with pegcetacoplan but not with supportive care

The most common side effects during pegcetacoplan treatment were low potassium levels, dizziness, fever, bruises from bleeding under the skin, joint stiffness and headache.

Participants in the supportive care group experienced low potassium levels but none of the other side effects of pegcetacoplan.

What were the limitations of this study?

Many of the participants in the supportive care group switched to pegcetacoplan during the study because their anemia got worse.

As a result, few participants received supportive care throughout the study.

This made it difficult to directly compare some efficacy endpoints and side effects, such as blood clots, between participants who received pegcetacoplan and participants who received only supportive care.

What are the next steps for this research?

Participants in the PRINCE study could receive pegcetacoplan for up to 4 more years in a long-term extension study.

The extension study will test if pegcetacoplan is effective when used for a long time and report any side effects of long-term use.

Where can I find more information about the PRINCE study?

You can view a visual summary about PRINCE for free by clicking this link:

<https://ashpublications.org/bloodadvances/article/7/11/2468/494713/Pegcetacoplan-controls-hemolysis-in-complement>

You can read more about the PRINCE clinical trial on www.clinicaltrials.gov. Type the trial number NCT04085601 into the 'Other terms' line of the search page, or go to clinicaltrials.gov/ct2/show/NCT04085601 to find the PRINCE study description.

Educational resources

You can read more about PNH at the following websites:

www.aamds.org/diseases/pnh
rarediseases.org/rare-diseases/paroxysmal-nocturnal-hemoglobinuria
pnhca.org/the-guide-to-living-well-with-pnh
pnhglobalalliance.org/what-is-pnh

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Author contributions

All authors contributed to manuscript development and reviewed and approved the content of the submitted manuscript.

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Financial interests disclosure

RSMW has received consulting fees, honoraria, research funding and speaker's bureau fees from Alexion and F. Hoffmann-La Roche Ltd, and research funding and speaker's bureau fees from Apellis Pharmaceuticals, Inc. DGA has served in speaking and advising roles from Teva, Roche, Amgen, Bristol Myers Squibb, Takeda, Janssen, AbbVie and Astellas. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

Competing interests disclosure

MAA, TA and JS were employees of Apellis Pharmaceuticals, Inc., at the time of the study. PD, CF and FG are employees and current equity holders of Apellis Pharmaceuticals, Inc. PA is a former consultant for Apellis Pharmaceuticals, Inc. JRNC, NSC, YTG, DK and TD declare no competing interests. The authors have no other competing interests or relevant affiliations with any organization or entity with the subject matter or materials discussed in the manuscript apart from those disclosed.

Writing disclosure

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Ethical disclosure

The study protocol was designed and monitored in accordance with the ethical principles of Good Clinical Practice and the Declaration of Helsinki. An institutional review board or independent ethics committee at each center approved the protocol. Each patient provided written informed consent before undergoing study-related procedures.

Data sharing statement

To request access to data from the PRINCE trial or the study protocol, please contact federico@apellis.com. The study protocol will be available with no end date. All proposals requesting data access will need to specify how the data will be used and will need the approval of the trial investigator team before data release. Individual participant data will not be shared.