Polycythemia Vera

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February 11, 2017 By National Institutes of Health

Polycythemia vera is a condition characterized by an increased number of red blood cellsin the bloodstream (erythrocytosis). Affected people may also have excess white blood cells and platelets. Conditions where the body makes too many of these cells are known as myeloproliferative neoplasms.[1] These extra cells cause the blood to be thicker than normal, increasing the risk for blood clots that can block blood flow in arteries and veins. If a blood clot occurs in the veins deep in the arms and the legs, it is known as deep vein thrombosis (DVT). A DVT can sometimes travel through the blood stream to the lungs, which can cause a pulmonary embolism and is very dangerous. A blood clot could also travel to the heart or brain, which leads to an increased risk for heart attack or stroke.

Most cases of PV are not inherited and are acquired during a person's lifetime. PV is more common as a person ages, and it typically presents for the first time around 60-years-old. PV occurs more frequently in men than it does in women. The condition has been associated with mutations in the JAK2 and TET2 genes. In rare cases, the risk for PV runs in families and may be inherited in an autosomal dominant manner.[2]

Symptoms

Polycythemia vera is characterized by having too many red blood cells in the bloodstream. This can cause problems because the blood is thicker than it would normally be, which causes an increased risk for blood clots that can cause serious health problems such as heart attack or stroke. Other symptoms of PV include headaches, dizziness, ringing in the ears (tinnitus), and impaired vision.[2] The skin may also become itchy (pruritus) or reddened (erythema). Affected individuals may also have an enlarged spleen (splenomegaly) and an increased risk for heart disease, and there is a small chance that PV may progress to cause leukemia (cancer of the blood).[1]

This table lists symptoms that people with this disease may have. For most diseases, symptoms will vary from person to person. People with the same disease may not have all the symptoms listed. This information comes from a database called the Human Phenotype Ontology (HPO) . The HPO collects information on symptoms that have been described in medical resources. The HPO is updated regularly. Use the HPO ID to access more in-depth information about a symptom.

Medical Terms	Other Names	Learn More: HPO ID
80%-99% of people have these symptoms		
Abdominal pain	Pain in stomach [more]	0002027
Acute leukemia		0002488
Angina pectoris		0001681
Bruising susceptibility	Bruise easily [more]	0000978
Epistaxis	Bloody nose [more]	0000421
Gingival bleeding	Bleeding gums	0000225
Headache	Headaches	0002315
Hepatomegaly	Enlarged liver	0002240
Myelodysplasia		0002863
Myelofibrosis		0011974
Splenomegaly	Increased spleen size	0001744
Tinnitus	Ringing in ears [more]	0000360
Vertigo	Dizzy spell	0002321
Weight loss		0001824
30%-79% of people have these symptoms		
Arthralgia	Joint pain	0002829
Fatigue	Tired [more]	0012378
Respiratory insufficiency	Respiratory impairment	0002093
5%-29% of people have these symptoms		
Arterial thrombosis	Blood clot in artery	0004420
Budd-Chiari syndrome		0002639
Gastrointestinal hemorrhage	Gastrointestinal bleeding	0002239
Intermittent claudication		0004417
Portal hypertension		0001409
Portal vein thrombosis	Blood clot in portal vein	0030242
Pruritus	Itching [more]	0000989
Pulmonary embolism		0002204
Stroke		0001297
Percent of people who have these symptoms is not available through HPO		
Autosomal dominantinheritance		0000006
Cerebral hemorrhage		0001342
Cerebral ischemia		0002637
Increased hematocrit		0001899

Increased hemoglobin		0001900
Increased megakaryocyte count		0005513
Increased red blood cellmass		0001898
Leukocytosis	Elevated white blood count [more]	0001974
Somatic mutation		0001428
Sporadic		0003745
Thrombocytopenia	Low platelet count	0001873
Thrombocytosis		0001894
Thromboembolism		0001907

Cause

Polycythemia vera is frequently caused by mutations (changes) affecting the JAK2 gene, and less frequently by mutations affecting the TET2 gene. JAK2 is known to provide the body with instructions to produce blood cells. When there is a mutation in this gene, the gene is constantly turned on, and the body therefore produces too many red blood cells.[2]Having too many red blood cells cause the blood to be thicker than normal so it cannot travel as efficiently through the bloodstream. This causes an increased risk for blood clots, and it can cause the skin to be reddened. It also can mean that the organs of the body are not getting enough oxygen due to reduced blood flow, so the organs such as the spleen may swell resulting in splenomegaly.

Inheritance

Even though most people with polycythemia vera (PV) have mutations in JAK2 or TET2, that does not mean that the condition is inherited from the parents. Instead, most cases of polycythemia vera are associated with genetic changes (mutations) that are somatic. This means that the mutations occur in the cells that produce red blood cells(hematopoietic stem cell), but generally not in the egg and sperm cells which pass on genetic information to offspring.[2]

In rare cases, the mutation to a gene that causes PV does occur in the egg or sperm cells, which increases the risk that a person with PV will pass the mutation on to their children. In these cases, the condition appears to have an autosomal dominant pattern of inheritance. This means that only one altered copy of a gene is enough to give a person an increased risk for PV. However, not every person who has a mutation in JAK2 or TET2will necessarily develop PV. Rather, if a person has a mutation in one of these genes, he or she has an increased risk to develop PV during his or her lifetime.[3]

Diagnosis

Polycythemia vera is diagnosed by testing the blood for levels of

a hormone called erythropoietin as well as testing the blood for mutations in JAK2 or TET2.[1]

Erythropoietin is a hormone that is released by the kidneys and helps control the creation of red blood cells. When the body senses that red blood cell levels are too high, as they are in people who have PV, the body secretes less erythropoietin in an effort to reduce the number of red blood cells. However, because people with PV have mutations that cause red blood cells to be created constantly, lower levels of erythropoietin do not control the number of red blood cells. Because people with PV have consistently high number of red blood cells, the body tries to control this problem by secreting low levels of erythropoietin.[4]

If low levels of erythropoietin are found in the blood as well as mutations in either JAK2 or TET2, an individual can be diagnosed with polycythemia vera. If mutations are not found in the red blood cells but the doctors still suspect a diagnosis of polycythemia vera, a bone marrow biopsy may be done to look for mutations in the hematopoietic blood cells which are located in the bone marrow.[1]

Testing Resources

- The Genetic Testing Registry (GTR) provides information about the genetic tests for this condition. The intended audience for the GTR is health care providers and researchers. Patients and consumers with specific questions about a genetic test should contact a health care provider or a genetics professional.

Treatment

The goal of treatment for polycythemia vera is to decrease the risk for developing deep vein thrombosis. This risk is about 20% for individuals who are above 60 years old or have a history of deep vein thrombosis. The risk can be reduced by keeping the hematocrit, which is the ratio of red blood cells to the amount of total blood, below 45%. In order to decrease the number of blood cells, doctors may recommend phlebotomy, which is the process of removing blood from the veins.[5] A person with polycythemia vera may also be told to take low-dose aspirin daily, which has been shown to help reduce blood thickening. If these treatments do not work to reduce the number of red blood cells, a therapy called hydroxyurea may be used to reduce the number of blood cells in the bone marrow.[1] In some cases, a bone marrow transplant may be necessary to reduce the number of blood cells in the bone marrow.[3]

There are several treatments for the itching (pruritus) related to polycythemia vera. No single treatment has been found to be effective for all individuals. For mild cases, treatment may include avoiding triggers of itching and dry skin such as hot environment or bathing water.[1] Several other treatments are available for more severe itching or itching that does not respond to initial treatments. Interferon-alpha is a medication that has been effective for reducing itching in a majority of individuals with PV who received this therapy, but there may be some side-effects to

this treatment.[6] Selective serotonin reuptake inhibitors, typically used to treat depression, may also reduce itching for some individuals with PV.[7] If severe symptoms continue, medications targeting the causative gene, such as JAK inhibitors, may be helpful in reducing symptoms.[1]

Management Guidelines

- The NORD Physician Guide for Polycythemia vera was developed as a free service of the National Organization for Rare Disorders (NORD) and it's medical advisors. The guides provide a resource for clinicians about specific rare disorders to facilitate diagnosis and treatment of their patients with this condition.

FDA-Approved Treatments

The medication(s) listed below have been approved by the Food and Drug Administration (FDA) as orphan products for treatment of this condition. Learn more orphan products.

- Ruxolitinib Phosphate (Brand name: Jakafi) - Manufactured by Incyte Corporation

  FDA-approved indication: Treatment of patients with intermediate or high-risk myelofibrosis, including primary myelofibrosis, post-polycythemia vera myelofibrosis and post-essential thrombocythemia myelofibrosis. Treatment of patients with polycythemia vera who have had an inadequate response to or are intolerant of hydroxyurea.

Find a Specialist

If you need medical advice, you can look for doctors or other healthcare professionals who have experience with this disease. You may find these specialists through advocacy organizations, clinical trials, or articles published in medical journals. You may also want to contact a university or tertiary medical center in your area, because these centers tend to see more complex cases and have the latest technology and treatments.

If you can't find a specialist in your local area, try contacting national or international specialists. They may be able to refer you to someone they know through conferences or research efforts. Some specialists may be willing to consult with you or your local doctors over the phone or by email if you can't travel to them for care.

You can find more tips in our guide, How to Find a Disease Specialist. We also encourage you to explore the rest of this page to find resources that can help you find specialists.

Healthcare Resources

- To find a medical professional who specializes in genetics, you can ask your doctor for a referral or you can search for one yourself. Online directories are provided by the American College of Medical Genetics and the National Society of Genetic Counselors. If you need additional help, contact a GARD Information Specialist. You can also learn more about genetic consultations from Genetics Home Reference.

Prognosis

The long-term outlook for individuals affected by polycythemia vera may depend on the response to treatment. The most dangerous symptom of polycythemia vera is the chance for a thrombotic event that can cause a heart attack or stroke. There is also a small chance that polycythemia vera could cause an individual to develop leukemia. With proper treatment, however, these symptoms have not been shown to greatly affect the expected lifespan of a person with polycythemia vera.[1]

Another complication that can affect the long-term outlook for a person with polycythemia vera is the uncomfortable itching (pruritus) that can occur as part of the condition.[6] However, many people are able to control the itching with the use of the medications listed above.

Research

Research helps us better understand diseases and can lead to advances in diagnosis and treatment. This section provides resources to help you learn about medical research and ways to get involved.

Clinical Research Resources

- ClinicalTrials.gov lists trials that are related to Polycythemia vera. Click on the link to go to ClinicalTrials.gov to read descriptions of these studies.

  Please note: Studies listed on the ClinicalTrials.gov website are listed for informational purposes only; being listed does not reflect an endorsement by GARD or the NIH. We strongly recommend that you talk with a trusted healthcare provider before choosing to participate in any clinical study.
- The Myeloproliferative Disorders Research Consortium (MPD-RC) is an international, multi-institutional non-profit consortium funded by the National Cancer Institute (NCI) at the National

Institutes of Health and set up to coordinate, facilitate, and perform basic and clinic research investigating the genetics of MPDs with the goal of developing therapy. To learn more, click on the link.

Support and advocacy groups can help you connect with other patients and families, and they can provide valuable services. Many develop patient-centered information and are the driving force behind research for better treatments and possible cures. They can direct you to research, resources, and services. Many organizations also have experts who serve as medical advisors or provide lists of doctors/clinics. Visit the group's website or contact them to learn about the services they offer. Inclusion on this list is not an endorsement by GARD.

Organizations Supporting this Disease

Leukemia and Lymphoma Society

3 International Drive, Suite 200

Rye Brook, NY 10573

Toll-free: 800-955-4572 Telephone:914-949-5213

Fax: 914-949-6691

E-mail: infocenter@lls.org

Website: http://www.lls.org/

- MPN Research Foundation

  180 N. Michigan Avenue

  Suite 1870

  Chicago, IL 60601

  Toll-free: +1-855-258-1943 (Support)

  Telephone: +1-312-683-7249

  Fax: +1-312-332-0840

  E-mail: rrosen@MPNResearchFoundation.org

  Website: http://www.mpnresearchfoundation.org/

Social Networking Websites

- MPD-Support: Myeloproliferative Diseases Support and Daily E-mail Digest

Living With

Living with a genetic or rare disease can impact the daily lives of patients and families. These resources can help families navigate various aspects of living with a rare disease.

Financial Resources

- Good Daysprovides help to patients with life-altering conditions. Assistance includes help with the cost of medications and travel.
- Patient Access Network Foundation(PAN Foundation) has Assistance Programs for those with health insurance who reside in the United States. The disease fund status can change over time, so you may need to check back if funds are not currently available.

Learn More

These resources provide more information about this condition or associated symptoms. The in-depth resources contain medical and scientific language that may be hard to understand. You may want to review these resources with a medical professional.

Where to Start

- Genetics Home Reference (GHR)contains information on Polycythemia vera. This website is maintained by the National Library of Medicine.
- MedlinePluswas designed by the National Library of Medicine to help you research your health questions, and it provides more information about this topic.
- The Merck Manuals Online Medical Libraryprovides information on this condition for patients and caregivers.
- The CMPD Education Foundationprovides online information on myeloproliferative disorders (MPD). Click on the link to view the resource.
- The National Heart, Lung, and Blood Institute(NHLBI) has information on this topic. NHLBI is part of the National Institutes of Health and supports research, training, and education for the prevention and treatment of heart, lung, and blood diseases.
- The National Organization for Rare Disorders(NORD) has a report for patients and families about

this condition. NORD is a patient advocacy organization for individuals with rare diseases and the organizations that serve them.

In-Depth Information

- Medscape Reference provides information on this topic. You may need to register to view the medical textbook, but registration is free.

  Polycythemia Vera (Hematology)

  Pediatric Polycythemia Vera
- The Monarch Initiative brings together data about this condition from humans and other species to help physicians and biomedical researchers. Monarch's tools are designed to make it easier to compare the signs and symptoms (phenotypes) of different diseases and discover common features. This initiative is a collaboration between several academic institutions across the world and is funded by the National Institutes of Health. Visit the website to explore the biology of this condition.
- Online Mendelian Inheritance in Man (OMIM)is a catalog of human genes and genetic disorders. Each entry has a summary of related medical articles. It is meant for health care professionals and researchers. OMIM is maintained by Johns Hopkins University School of Medicine.
- Orphanetis a European reference portal for information on rare diseases and orphan drugs. Access to this database is free of charge.
- PubMedis a searchable database of medical literature and lists journal articles that discuss Polycythemia vera. Click on the link to view a sample search on this topic.

Related Diseases

The following diseases are related to Polycythemia vera. If you have a question about any of these diseases, you can contact GARD.

- Chronic myeloproliferative disorders

GARD Answers

Questions sent to GARD may be posted here if the information could be helpful to others. We remove all identifying information when posting a question to protect your privacy. If you do not want your question posted, please let us know. Submit a new question

- My polycythemia vera is being controlled, but I still have itching after a shower. Is there anything I can do to prevent the awful itching? See answer
- I was living in a home that had a slow leak of carbon monoxide poisoning and was never sick with this until we were exposed to carbon monoxide poisoning. Is there a correlation between carbon monoxide poisoning and polycythemia vera? See answer
- I was diagnosed with polycythemia vera 20 years ago, and I am JAK2 positive. My brother recently learned that his red blood cell count is very high and will now be seeing a hematologist. Is it strange that my brother may have the same condition, even though it is so rare? I researched a polycythemia vera cluster that occurred in several counties and learned that my brother and I had lived in one of them. Has anyone else researched this issue? See answer
- I have polycythemia vera. Can this condition be passed on to my children? See answer

References

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3. Polycythemia Vera, PV. Online Mendelian Inheritance in Man; November 25, 2014; https://omim.org/entry/263300.
4. Erythropoietin (EPO), Serum. Mayo Clinic Mayo Medical Libraries; 2017; http://www.mayomedicallaboratories.com/test-catalog/Clinical+and+Interpretive/80173.
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7. Tefferi A, Fonseca R. Selective serotonin reuptake inhibitors are effective in the treatment of polycythemia vera-associated pruritus. Blood. 2002; 99(7):2627. http://www.ncbi.nlm.nih.gov/pubmed/11926187. Accessed 9/7/2014.

This article was originally published on the National Institute of Health's National Center for Advancing Translational Science website. It was last updated February 11, 2017.
