

**T**he risk of developing deep vein thrombosis (DVT), pulmonary embolism and related blood-clotting problems doubles after flights of more than four hours and continues to increase as the duration of the flight increases — or if an individual makes multiple flights within a short time period, the United Nations World Health Organization (WHO) says.<sup>1</sup>

Even so, the results of the first phase of the WHO Research Into Global Hazards of Travel (WRIGHT) project indicated that, among healthy individuals, the risk of developing these problems is relatively low — a probability of about one in 6,000 — for anyone who is seated and immobile for more than four hours.

The project is studying occurrences of several ailments, known collectively as venous thromboembolism (VTE), whose two most common forms are:

- DVT, in which a thrombus, or blood clot, forms in a “deep” vein in the leg — a major vein that carries blood up the legs and back to the heart, as opposed to a “superficial” vein directly beneath the skin (see “How Blood Clots,” p. 43). Symptoms typically include pain in the affected leg, swelling and discoloration of the leg and unusual warmth in the skin. In some cases, however, there are no symptoms; and,
- Pulmonary embolism, in which a piece of a blood clot, called an embolus, from a DVT breaks off, travels through the blood vessels to the lungs and lodges there, blocking the flow of blood. Symptoms include chest pain, difficulty breathing and a cough. This is the most serious complication of DVT and, if untreated, can lead to death.

**New studies confirm a link between DVT and long-haul flights but show that, for most people, the risk of developing such blood-clotting disorders is slight.**

BY LINDA WERFELMAN

# The Clotting Factor

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## How Blood Clots

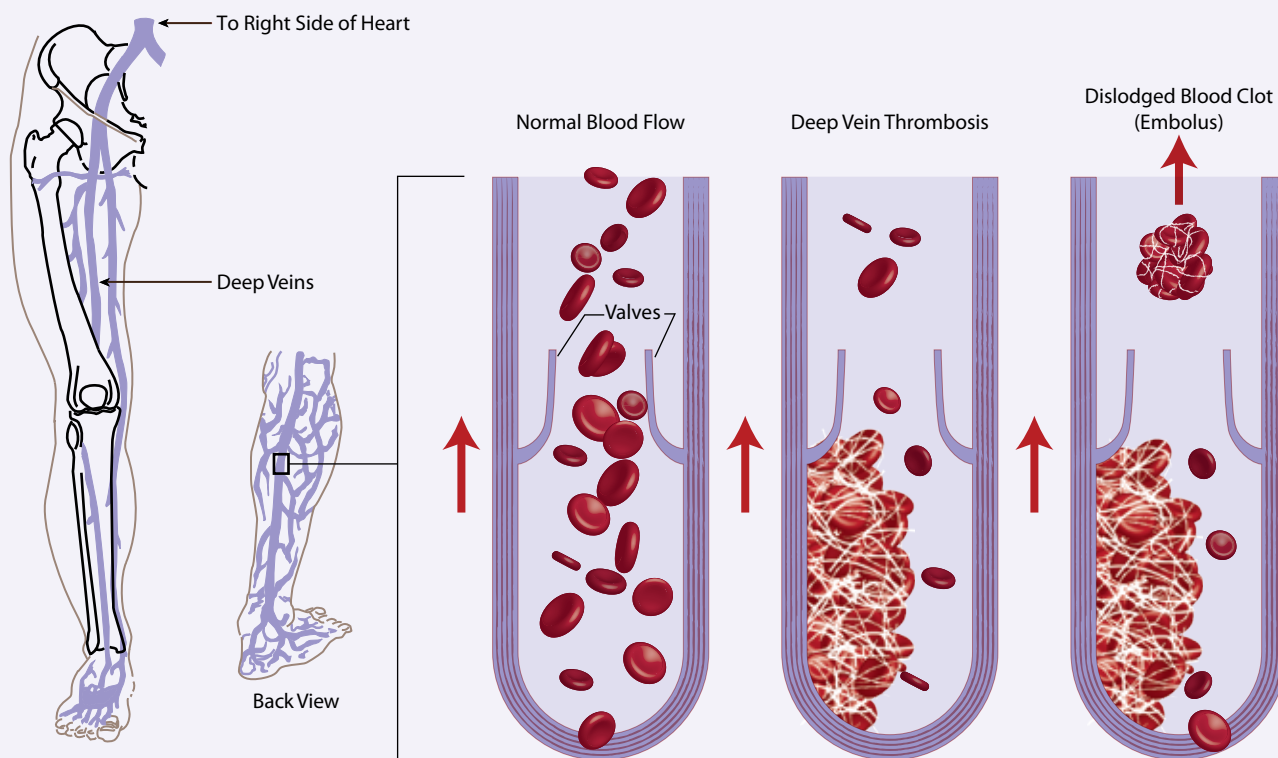
**B**lood usually clots as part of the healing process after a blood vessel is cut or otherwise damaged. Disc-shaped cells called blood platelets collect at the site of the injury, where blood proteins called clotting factors help trap the platelets in a clot that prevents further blood loss.

In deep vein thrombosis (DVT), the clotting process occurs in the wrong place — inside a vein, usually in the lower leg. Small clots usually dissolve before they cause damage, but larger clots — those that develop in major veins in the leg can be several inches long — may

break apart and travel through the bloodstream.

If these fragments become lodged in the lungs — in a condition known as pulmonary embolism — they can result in chest pain, shortness of breath and, if the condition is untreated, death.

— LW



Source: Stanley R. Mohler, M.D./U.S. National Institutes of Health

The project's first phase comprised five studies, designed to determine the incidence of VTE among the general population, among passengers and among pilots; the effects, if any, of exposure to the low-air-pressure environment of an aircraft cabin and on development of VTE; and what factors might be associated with development of VTE during flight.

"The combined results from these studies provide a consistent picture

in line with previous reports, which highlighted the possible link between air travel and VTE, and a similar association for other types of travel," the report said.

"The findings ... demonstrated that the increased risk of VTE observed in long-haul travelers is due mainly to prolonged immobility. It is possible that there is an interaction between pre-existing risk factors and flight-specific factors, which may further increase the

risk during air travel. In view of the substantial number of people undertaking long-haul air travel and the fact that many travelers will have one or more known or unknown risk factors for thrombosis, air travel-related VTE is an important public health issue."

### 'SIT Syndrome'

DVT is not restricted to people who spend long stretches of time in aircraft — or even to those traveling in

other modes of transportation, such as train, bus or automobile. It occurs among people with specific risk factors, especially when those risk factors are combined with limited mobility.

For example, researchers from the Medical Research Institute of New Zealand found that office workers were at risk from an ailment they characterized as “seated immobility thromboembolism” (SIT) syndrome.<sup>2</sup>

“There are considerably more people who are seated for long periods at work as part of their normal day than there are traveling,” lead researcher Richard Beasley said.<sup>3</sup>

A 2005 study involved 62 hospital patients suffering from blood clots; 34 percent had been at work, seated, for long periods, before developing the ailment, compared with 1.4 percent who had recently traveled on long-haul flights. All of the patients were older than 40 and had a history of “regular seated immobility of at least eight hours” with no other recognized risk factors.

### Risk Factors

DVT occurs when one of several factors is present:<sup>4</sup>

- Decreased blood flow, often caused by poorly functioning valves in the veins or by inactive muscles in the affected part of the body;
- Injury to a vein, sometimes caused by a bone fracture or by external pressure;
- Increased blood clotting, resulting from clotting disorders, from some medications such as oral contraceptives or similar hormones, or from some illnesses such as cancer; or,
- Genetic or environmental risk factors, such as overweight, personal or family history of VTE, varicose veins and smoking. In addition, VTE is especially likely among people over age 40 and among those who are very tall — more than 1.9 m (75 in) — or very short — less than 1.6 m (63 in).

VTE affects passengers far more frequently than flight crewmembers, although pilots have — very rarely — developed the problem during flight.

A report in the *Indian Journal of Aerospace Medicine* described the case of a 59-year-old senior airline pilot with more than 12,000 flight hours, who experienced “mild swelling” of his left ankle about four hours into a long-haul flight in April 2003.<sup>5</sup>

“Over the next six hours, the swelling gradually increased from the ankles to involve the entire left leg, accompanied by a nagging pain,” the report said.

After landing, he was admitted to a hospital, where tests showed “extensive” DVT. The pilot was treated with anticoagulants. When the report was published later in 2003, the pilot still had swelling of the lower third of his left leg, continued to take anticoagulant medication and wore a compression stocking to prevent the pooling of blood in the lower leg.

“There were no risk factors in the case [and no] abnormality was detected in the coagulation studies,” the report said. “DVT and life-threatening pulmonary embolism should be added to the list of causes for pilot incapacitation. The risk of repeat episodes of DVT, development of [side effects] and the continuing anticoagulant therapy make it difficult to re-flight the aircrew.”

One of the WHO project’s studies involved 2,499 Dutch commercial pilots (96 percent of whom were male, with an average age of nearly 36 years) who were observed for 10,165 person-years; during that time, six cases of VTE were diagnosed — a rate similar to that of the general Dutch population. The study found no association between the occurrence of VTE and the number of hours flown.

“Although these results excluded a high risk of thrombosis in pilots who fly very frequently, a mildly increased risk could not be ruled out since it is difficult to estimate the expected rate of VTE for this exceedingly healthy group,” the WHO report said.

## A Hypoxia Link?

Another of the WHO project's studies found no connection between development of DVT and the hypobaric hypoxia — low blood oxygen levels caused by low cabin pressure — that would be found in the cabin of a commercial airplane.

In the study, conducted from 2003 to 2005 in the United Kingdom, 73 healthy volunteers were seated, in eight-hour sessions at least one week apart, in pressure and oxygen conditions that would be experienced in an airplane with a cabin pressure of 8,000 ft, as well as in those that would be experienced at “ground level,” the WHO report said.

“The results of the hypobaric chamber studies with healthy volunteers predominantly without risk factors for VTE failed to demonstrate any association between hypobaric hypoxia (of a degree that might be encountered during commercial air travel) and prothrombotic alterations in the [blood] system,” the WHO report said.

A “travel and non-travel immobility study” included in the WHO project found that some factors related to the airplane environment “flight-specific factors” may interact with existing risk factors in an individual to cause “increased coagulation activation in susceptible individuals over and above that related to immobility,” the report said.

The study, conducted in 2004, involved 71 healthy volunteers, some of whom had an inherited blood-clotting disorder known as the Factor V Leiden mutation and/or used oral contraceptives. Results of the study indicated that “one or more flight-associated factors, possibly hypobaric hypoxia or the type of seating in the airplane, lead to increased thrombin [a blood enzyme that promotes clot formation] generation after air travel in some individuals, especially those with the Factor V Leiden mutation who also took oral contraceptives,” the report said.

The next phase of the WHO project is designed to further explore the possibility that an interaction between pre-existing risk factors and flight-specific factors may increase the possibility of developing DVT, as well as to identify effective prevention measures.

“There is a clear need for travelers to be given appropriate information regarding the risks,” the report said.

Existing recommendations from WHO and other organizations advise people with one or more risk factors to consult their doctor or a travel medicine specialist before any flight that will last three hours or longer.<sup>6</sup>

For travelers without risk factors, however, recommendations emphasize frequent exercise for the legs and feet (see “Preventing DVT”).

“It is thought that exercise of the calf muscles can stimulate the circulation; reduce discomfort, fatigue and stiffness; and ... may reduce the risk of developing DVT,” WHO guidelines say.

As long flights have become more common, many airlines have increased their emphasis on passenger exercise. For example,

## Preventing DVT

Guidelines for preventing deep vein thrombosis (DVT) and related blood-clotting disorders in airplane passengers include:<sup>1,2</sup>

- Stay active. Walk around the airplane cabin every two to three hours. Exercise the feet and legs — rotate the ankles, flex the feet and raise the legs — every hour. Many airlines provide passengers with diagrams of suggested exercises;
- Stay well hydrated. Drink water and juice, and avoid alcoholic and caffeinated beverages, which are associated with dehydration;
- Avoid sitting with crossed legs. This position compresses the veins in the backs of the legs, increasing susceptibility to blood clots;
- Wear loose-fitting clothing during flight, and avoid stockings with tight elastic bands below the knees; and,
- Avoid medications that can induce long periods of sleep.

— LW

### Notes

1. Garr, Jennifer. “DVT: Understanding and Preventing Deep Vein Thrombosis.” In *Safety: The Foundation for Excellence, Final Proceedings of the 52nd Annual Corporate Aviation Safety Seminar*. Alexandria, Virginia, U.S.: Flight Safety Foundation, 2007.
2. Mohler, Stanley R. “Blood Clotting Presents Serious Medical Problems for Passengers and Crews, Especially on Long Flights.” *Human Factors & Aviation Medicine* Volume 44 (July–August 1997).



Singapore Airlines — which operates flights as long as 18 hours — and other airlines provide advice cards at every seat that contain diagrams of recommended leg/foot exercises to be performed at regular intervals; flight attendants also periodically prompt passengers to do their exercises or move around the airplane.<sup>7</sup>

Other airlines, including British Airways, have posted information on their Web sites describing the risk factors for DVT and recommendations for in-flight activities to reduce risks of developing problems. Similar information is printed in the in-flight magazine and presented on the in-flight entertainment system.<sup>8</sup>

Travelers should consult their doctors before trying several suggestions that might help some passengers and result in serious side effects for others. Among these suggestions are:

- Wearing compression stockings, which some researchers say might reduce the incidence of DVT for some passengers, but only if they are fitted properly; and,
- Taking aspirin, which has been one of the most controversial issues associated with DVT. Its use is recommended by some medical specialists but cautioned against by others, who warn that it could lead to stomach irritation or gastrointestinal bleeding.

Other blood-thinning medications, such as heparin, sometimes are prescribed for people in high-risk groups. Specialists disagree on how it should be used against travel-related DVT, although many prescribe injections of the medication beginning the day before a flight and ending the day after.<sup>9</sup> However, health authorities, as well as the manufacturer, have warned that, in some cases, heparin might be associated with the development of blood clots in the weeks after an individual stops taking it.<sup>10</sup>

If a passenger or crewmember develops DVT, prompt medical attention is necessary.

DVT can occur as long as one month after travel — sometimes longer. During the post-travel period, individuals who experience swelling in the legs, muscle cramping or changes in skin color should seek medical attention. ●

### Notes

1. United Nations World Health Organization (WHO). *WHO Research Into Global Hazards of Travel (WRIGHT) Project, Final Report of Phase 1*. Geneva, Switzerland, 2007.
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3. Lilley, Ray. "Office Workers More Prone to Blood Clots." Associated Press. March 13, 2007.
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5. Shrivastava, J.K. "Deep Vein Thrombosis in Commercial Pilot: A Case Report." *Indian Journal of Aerospace Medicine* Volume 47 (2003).
6. WHO. "Travel by Air: Health Considerations," Chapter 2 in *International Travel and Health*. 2005.
7. FSF Editorial Staff. "Cabin Crews Adapt Readily to Challenges of Ultra-Long-Range Flight." *Flight Safety Digest* Volume 24 (August–September 2005).
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9. British Medical Association Board of Science and Education. *The Impact of Flying on Passenger Health*. 2004.
10. Wakinine, Yael. *Risk for Thrombosis Persists After Discontinuation of Heparin Therapy*. <[www.medscape.com/viewarticle/549112](http://www.medscape.com/viewarticle/549112)>.

### Further Reading From FSF Publications

Mohler, Stanley R. "Blood Clotting Presents Serious Medical Problems for Passengers and Crews, Especially on Long Flights." *Human Factors & Aviation Medicine* Volume 44 (July–August 1997).