Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Research Paper

The Chemistry of Blood Clotting

Chemistry

KEYWORDS : Blood Clotting, Heart attack, Stroke, Bleeding

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ABSTRACT

Hemostasis is mechanism to stop injured blood vessel from bleeding by formation of clot of the blood. Hemostasis involves Narrowing (constriction) of blood vessels,activity of platelets and activity of proteins to form clot. There is need for reverse of clotting when the purpose to stop bleeding has been accomplished. When clotting is poor, even a slight injury to a blood vessel may lead to severe blood loss. When clotting is excessive, small blood vessels in critical places can become clogged with clots. Blood clots in the brain can cause strokes, and clogged vessels of the heart can cause heart attacks. The blood supply to lungs is interrupted (pulmonary embolism) due to clots which travel from legs, pelvis or abdomen.

Composition of Blood: Blood constitutes 8% of total body weight. It contains 55%plasma and 45% of other elements.

Plasma is 91%water, 7%proteins (albumins,globulins and fibrinogen) and 2% of other solutes(ions, nutrients and waste products)

Other elements constitute platelets, white blood cells(neutrophills, Lymphocytes, Monocytes ,Eosinophills, Basophills) and red blood cells

Hemostasis is a dynamic process of preventing bleeding (Nathan, Orkin, Ginsburg, & Look, 2003).

When blood clots at the surface of body to stop bleeding it is a lifesaving mechanism but when clots are formed inside the body it can result in heart attacks and strokes. when the waxy cholerstrol plague inside the artery ruptures suddenly,thrombogenic substances inside plague are exposed to blood,triggering the formation of blood clot which results in heart attack or stroke.

There is abnormal heart rythm,due to formation of clot , it leads to Atrial fibrillation. Prolonged immobilization can reduce blood flow in the legs, increasing the risk for blood clots in leg veins (deep venous thrombosis, or DVT).

The major steps of blood clot formation are: The platelet plug formation, Chemical reactions forms the blood clot, Anti-clotting process, body dissolve the blood clot.

Platelet plug; When there is any cut on body, the platelets clump together and form a plug, which reduces bleeding, platelets starts clotting by releasing substances that start formation of blood clot

Chemical reactions forms blood clot; The dissolved proteins of blood proteins(clotting factor)promotes the chemical reaction to form fibrin(the main protein forming blood clot).this fibrin (Davie, Fujikawa, & Kisiel,1991) clot is much tougher and more durable than the platelet plug.

Anti-clotting process The anti-clotting enzymes present in blood such as antithrombin, protein C, protein S, and others stops clotting.

Body dissolve the blood clot. After the healing of damaged tissue, Plasmin(An enzyme) dissolves the tough fibrin strands in a blood clot

Role of vitamin K in blood clotting; Vitamin K is a fat soluble vitamin., it has important role in blood clotting , vitamin K is essential for the functioning of several proteins involved in the regulation of blood clotting(**Brody,1999**). Vitamin K exists as vitamin K_1 and vitamin K_2 . Vitamin K_1 (phylloquinone) is synthesized by plants . Vitamin K_2 includes a range of vitamin K forms collectively referred to as menaquinones. Most menaquinones are synthesized by human intestinal microbiota and found in fermented foods and in animal products.

Abnormal clotting is not related to excessive vitamin K intake, and there is no known toxicity associated with vitamin K_1 or vitamin K_2. Constant dietary intake of vitamin K is recommended by experts that meets current dietary recommendations (90-120 mcg/day).

As Vitamin K-dependent coagulation factors are synthesized in the liver. Vitamin K deficiency leads to severe liver disease affecting clotting factors and an increased risk of uncontrolled bleeding or haemorrhage (Olson 1999).Symptoms of deficiency include easy bruising and bleeding that may be manifested as nosebleeds, bleeding gums, blood in the urine, blood in the stool, tarry black stools, or extremely heavy menstrual bleeding. In infants, vitamin K deficiency may result in life-threatening bleeding within the skull (intracranial haemorrhage)

Alterations to the Blood Clotting Process

In Some people formation of blood clots is very rapid and so they are at high risk of heart attack and stroke so they are given drugs to decrease the risk. Some chemicals helps to stop clot formation by interfering with the activity of platelets are; Aspirin**,** clopidogrel ,prasugrel and ticagrelor , ticlodipine , and dipyridamole .

Aspirin (80 mg) particularly is used for coronary thrombosis in patients with atherosclerosis. Aspirin works by inhibiting an enzyme,cyclooxygenase-1 present in platelets and the endothelial cell. A single dose of aspirin works for the life of the platelet (about a week). Since platelets formation is regular, aspirin must be taken daily.

To some people at risk of forming blood clots may be given an anticoagulant, a drug that inhibits the action of blood proteins called clotting factors these are warfarin, given orally, and heparin, (Jorpes,1935) given by injection.Heparin interferes with thrombin, preventing blood clot formation. Heparin is a negatively charged, highly sulfated mucopolysaccharide with a molecular weight between 6,000 and 25,000 daltons. It is not absorbed from the gastrointestinal tract so it is injected into the veins (intravenous) or under the skin (subcutaneous). A single intravenous dose has a half-life of approximately 60 minutes. Heparin exerts its potent anticoagulant effect by activating a natural anticoagulant termed antithrombin III.

Tissue plasminogen activator (tPA). A clot-dissolving drug used as a treatment for Heart attack or stroke.

Hemophillia ; A genetic deficiency of certain functioning clotting factors results in poor blood clotting and excessive bleeding.

Volume : 4 | Issue : 6 | June 2015 • ISSN No 2277 - 8179

Von Willebrand factor deficiency (James & Lillicrap, 2006) A relatively common condition resulting in slow blood clot formation, which is usually mild.

CONCLUSIONS

Blood clotting is a defensive mechanism to stop excessive leakage of blood by blood vessels during any injury. Sometimes clotting inside the blood vessel can result in heart attack and stroke. Vitamin K has special role in blood clotting so it should be the part of routine diet.

The patients consume anti coagulation drugs to decrease the risk of heart attack this must be done under the guidance of specialised medical practitioners.

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