Dr. Charles R. Drew Blood Preservation Lesson

Watch and Discuss the Video Clip: Dr. Charles R Drew | Fun Facts | Black History | Biography for Students | Inventors

Read the following excerpt from The National Library of Medicine, Charles R. Drew Papers, and answer the analysis questions.

[1]Blood loses its integrity--and thus its utility--soon after it leaves the blood vessels: it starts to clot, and soon the cellular elements, especially the white blood cells, deteriorate and levels of electrolytes change. Before World War I, several researchers had discovered that sodium citrate would keep the blood from clotting and that dextrose would preserve it for up to two weeks under refrigeration. During the inter-war period, researchers in America and abroad studied blood's properties to better understand how it changed under various storage conditions and how such changes affected transfusion outcomes.

[2]Working in the Department of Surgery alongside Dr. John Scudder, one of the nation's first blood transfusion specialists, Dr. Charles R. Drew, a Black scientist, founded and administered an early prototype program for blood storage and preservation for the Blood Transfusion Betterment Association. Dr. Drew and Dr. Scudder evaluated all the variables that might affect the shelf life of stored blood: how it was collected (in open or closed vessels or under a vacuum), what types and amounts of anticoagulants and preservatives were used, the shape of the storage containers, storage temperatures, and so on.

[3]Plasma--the fluid portion of blood, containing various proteins and electrolytes but no cells--had been investigated as a blood substitute by several research teams, including Drew and Scudder, during the 1930s. Plasma has an average relative density of 1.027 g/mL and is 55% of the blood volume. Although it lacks oxygen-carrying red cells, it worked well to replace fluids and treat shock. And, especially for emergency or combat situations, it had advantages over whole blood: it keeps longer without refrigeration; it won't deteriorate when agitated during transport; it can be used with any blood type; it is much less likely to transmit diseases; it can be given intravenously, intramuscularly, or subcutaneously, and in large doses.

[4]Dr. Drew separated plasma from whole blood by centrifuging, based on the density of particles in the plasma fluid. The donor's blood is placed in centrifuge tubes, and the centrifuge rotates around a central axis to generate an artificial force known as the centrifugal force on the particles (cells, subcellular components, or large molecules) suspended in the plasma fluid. A rotation speed between 2200-2500 RPM for 10 minutes can be used.

[5] In a centrifuge, the centrifugal force pushes the contents of each tube to the bottom. Since forces pull harder on objects that are denser, the more dense contents get pushed to the bottom first. In the case of blood, the red blood cells (average relative density is 1.095 g/mL and it makes up 44% of the blood volume) get pushed to the bottom of the centrifuge tube with the platelets (average relative density of 1.080 g/mL, and is 1% of the total volume of blood) above them, while the lighter plasma and proteins float near the top, creating distinct layers that can be separated out. As a reminder, plasma has an average relative density of 1.027 g/mL and is 55% of the blood volume.

The density of normal human blood is 1.0621 g/mL. From there, the samples can be decontaminated, treated with antibiotics, diluted with saline, sealed, packed, and shipped overseas.

[6] Dr. Drew's work separating plasma from blood made it possible to store blood for a week — before this, blood could only be stored for a few days. He also discovered that transfusions could be performed with plasma alone, broadening the scope and reach of who could be treated. By the time he received his doctorate in 1940, he had developed a technique for long-term plasma storage, leading to his nickname, "Father of the Blood Bank." Drew introduced the use of mobile collection units (later called "bloodmobiles.") while working with the Red Cross.

[7] "His work with the Red Cross, however, was short-lived. Later that year, Dr. Drew took a moral stand when the Red Cross announced it would segregate the blood of white and Black donors. He denounced the decision on both moral and scientific grounds and resigned in protest." (Reed, 2019)

Retrieved from: Becoming "the Father of the Blood Bank," 1938-1941 | Charles R. Drew, Black History Month: Part 1—Charles Drew, Father of the Blood Bank & Dr. Charles Drew Revolutionized Blood Storage and Transfusions on 11/12/21

Reference List

Becoming "the Father of the Blood Bank," 1938-1941. (2019, March 12). National Library of Medicine Charles R. Drew - Profiles in Science. https://profiles.nlm.nih.gov/spotlight/bg/feature/blood

Reed, J. (2019, February 20). *It Happened Here: Dr. Charles Drew*. NewYork-Presbyterian; NewYork-Presbyterian. https://healthmatters.nyp.org/it-happened-here-dr-charles-drew/

Analysis Questions

1. Reading of the article. Then, consider the question –

What is the purpose of this story?

2. Now, read the article again, looking for the answers to the following questions:

a. What variables affect the shelf-life of stored blood?
b. Why is plasma better for blood transfusion than whole blood?

c. In paragraphs 4-5, the story describes the method used by Dr. Charles Drew to separate plasma from whole blood. Create a series (multiple drawings) of macroscopic models (Sketch with labels and descriptions) and explain the method he used.
d. What are the independent, dependent, and constant variables and control groups in Dr. Drew's separation method?
independent variable:
dependent variable:
constant variables:
control group:
f. What is the principle behind centrifugation? Write your answer in two complete sentences.

Mathematical Model: Density is defined as mass per unit volume of a substance.

Use the density formula D = mass/volume to solve the density problems. Solve each problem. Show all work.

1) One unit of whole blood has a mass of 530g. What is the density of 500 mL of one unit of whole blood?
2) Rush visited a blood bank to donate a pint of blood; the density was 1.11 g/mL. He was told that the blood he donated had a mass of 523g. What is the volume of blood Rush donated?
3) A nurse took blood samples from a patient. The test tube was filled with blood until it reached a volume of 3.0 mL. After testing the blood samples, there was 1.2 mL remaining in the test tube. Knowing this, what is the mass of the blood taken, given that blood's density is 1.06 g/mL?
4) Considering the variables that impact the shelf life of blood from clotting. Explain the importance of safety in the blood processing industry, such as blood banks.