American Medical Association and the Blood Protein Research

“TRUTH IS SO OBSCURE IN THESE TIMES, AND FALSEHOOD SO ESTABLISHED, THAT, UNLESS WE LOVE THE TRUTH, WE CANNOT KNOW IT.”

~ Blaise Pascal

Release date: September 19th, 2014 / Last revised: April 1st, 2015

The most critical, scientifically documented medical research that reveals the prime cause of every degenerative disease condition has already been done.

The following revolves around the critical, revolutionary and medically documented blood protein research conducted and published between 1930 and 1963, which hasn't been taught in any college, university or even medical school in the United States, ever since the discoveries were made. This blood protein research does not relate to the protein we consume from food, but concerns the three major blood plasma proteins manufactured in the liver from amino acids and secreted into the bloodstream. These plasma proteins are the (1) albumin, (2) globulin, and (3) fibrinogen. Plasma in this context represents the colorless liquid part of blood. The plasma holds blood cells but is not made from them.

It all begins in the 1930’s with Dr. Cecil K. Drinker, M.D. (1887-1956) of Harvard Medical School.

Drinker, with the help of colleagues (notably Madeline E. Field), was the first person to challenge a fundamental tenet of Prof. Ernest H. Starling’s (1866-1927) hypothesis published in 1896 (Starling’s Hypothesis). In 1931—following numerous experiments—Drinker suggested that the blood plasma proteins did in fact leak from the bloodstream in significant quantities into the tissue spaces (aka. interstitial spaces) and that this
occurred "practically universally" throughout the body. He also suggested that these proteins could only return to the bloodstream via the lymphatic system. This was opposed to Prof. Starling's theory, since one of the fundamental tenets of this theory maintains that the blood protein particulates are too large to escape through typical or 'healthy' capillary walls in more than trace amounts, which at the time was the general conviction (as you will herein soon learn that it unfortunately still is today).

Drinker, however, did not have the sophisticated laboratory equipment available in his time to definitively prove his conclusions that the proteins were leaking from the bloodstream, and to confirm that they did not somehow originate from the cells themselves in the tissue spaces. Drinker's conclusions thus were not widely accepted and Prof. Starling's theory was maintained.

In 1948, Dr. Hymen S. Mayerson, M.D. (the father of lymphology; the study of the lymphatic system) (1900-1985) of the Tulane University School of Medicine, with the available equipment Drinker didn't have, picked up where Drinker left off and undertook an effort to clarify the following point as he states in his 1963 research article: "Teachers and writers of textbooks continued to maintain that 'healthy' blood capillaries did not leak protein. It was in an effort to clarify this point that I undertook an investigation of lymph and the lymphatics some 15 years ago [in 1948]." (See scanned page images 1a.-5a. provided in the appendix.)

Between 1948 and 1963, Dr. Mayerson proved Drinker to have been correct, when Mayerson tagged the blood plasma proteins with radioactive iodine atoms to measure the rate and quantity at which they leaked from the bloodstream with the water into the tissue spaces.

Prof. Starling's View of Net Fluid Filtration
The previous theory maintained that fluid (water) and salts (minerals) left the blood capillaries into the spaces between the cells (as illustrated by arrows), were mixed with interstitial fluid and most of it then reabsorbed into the bloodstream back through the blood capillaries; the excess fluid being drained by the lymphatic capillaries. In this scenario, Prof. Starling visualized our blood proteins as being too large for significant protein-seepage to happen across the blood capillary membrane, and this is what's still being taught all over the world today.

**Present Well-Documented Understanding of Net Fluid Filtration**

The large plasma proteins (black dots) and lipids (open circles) have been found to always accompany the fluid and salts across the capillary membrane. And while 9/10 of the fluid containing smaller constituents is near-immediately absorbed back into the bloodstream, the excess 1/10 of fluid containing molecules too large to be reabsorbed (the plasma proteins especially) is returned to the bloodstream via the lymphatic system.

He calculated that about 50 percent of the blood plasma proteins leaked from the bloodstream every twenty-four hours and if it were not for the removal of these proteins by the lymphatic vessels, he said, “The excess water around the cells would spell swift catastrophe.” (One of the primary functions of the blood plasma proteins—albumin especially—is to magnetically attract and hold water in the bloodstream; anywhere the plasma proteins go, the water will follow; i.e. “body fluids follow the blood proteins.”) Mayerson published his research in the June 1963 issue of the Scientific American journal in an article titled “The Lymphatic System” (PDF) and this research revealed the vital importance of the lymphatic system with regard to our health.
“This second circulation plays an essential role in maintaining the body’s steady state, draining from the spaces between cells fluid, protein and other substances that leak out of the blood.” ~ Dr. H. S. Mayerson, M.D., The Lymphatic System, p. 80

Additional information can be found in the July 1965 research paper titled, “Capillary Permeability to Plasma Proteins” (PDF) published by the Postgraduate Medical Journal.

In December 1964, the American Medical Association (AMA) documents Dr. Mayerson's research by publishing it in their at-the-time official journal, known as “Today's Health” (formerly “Hygeia”), in an article called 'Your Other Circulatory System' by J. D. Ratcliff (scanned article images 6a.-8a. provided in the appendix).

This would become the first and last time the AMA ever conveyed the truth about the blood proteins leaving the bloodstream and the role the lymphatic system plays in the prevention and mitigation of the resulting catastrophe, if the proteins and water in the tissue spaces weren't removed promptly.

In January 1965, Reader's Digest published a condensed version of 'Your Other Circulatory System' in an article called "Our Amazing 'White Bloodstream" (PDF) which basically said the same things as the AMA's article.

Then it all came to a full stop in the year of 1966. That year, the largest medical research project in history was pulled off by the U.S. government with the help of international military forces. The primary objective was to bring together all the top lymphologists and medical research scientists from all around the world who had researched and studied anything with relationship to blood plasma proteins and water escaping from the bloodstream into the tissue spaces, and the resulting role of the lymphatic system in rectifying this. Most of the approximately 370 gathered scientists (roughly 65 of these from the United States) were department heads of universities and medical schools.

They were gathered at Dr. Mayerson's home in New Orleans the same year, which soon resulted in the formation of the International Society of Lymphology (I.S.L.). The unification through this organization was a promising opportunity for all of its members to gather periodically to share information and research (they have since held international congresses every 2 years). But this was also where the trap was unleashed: by-laws were written and established which specified the I.S.L. as a non-pure medical society, meaning that every medical member of the society was permanently restricted from ever publishing—in medical journals—any research they had made or would make in the future. Hence all the research and discoveries regarding the blood proteins and water leaving the bloodstream resulting in disease and death at the cell level, as well as what we do to either cause or prevent these
plasma proteins from getting trapped in the interstitial spaces around the cells, was "locked" into the I.S.L. and prevented from being published in medical journals and thereby also inhibited from reaching the lay public.

For this reason, some prominent members of the society, as they were all for education, later encouraged Dr. C. Samuel West, D.N., N.D. (1932-2004)—who in light of his knowledge pertaining to much of the research was accepted as the 379th and first non-medical member of the I.S.L. on February 22nd, 1980—to start the International Academy of Lymphology which he did on January 4th, 1982, and dedicated his life to teaching people the more than 68 years of documented research that helps us understand how to prevent, reverse and eliminate degenerative disease naturally, as well as laying the foundation of all the healing arts, and to certify the lay person to teach and share this research with others under the guiding light of: "to help raise up a people regardless of race, color, or creed who can live together in peace, overcome disease and have no poor among them." Apart from Dr. West's involvement, the I.S.L.'s focus has been oriented around the treatment of lymphedema (fluid retention and swelling of tissue caused by trapped blood proteins).

The blood protein research disappeared out of the medical journals and has since been ignored or overlooked for 5 decades.

The AMA then reverted back to the pre-1930 "medical dark ages" as evidenced in their Home Medical Encyclopedia published in 1989, wherein they contradictorily state the following about the blood plasma proteins (see scanned page image 9a. provided in the appendix):

"The large size of the protein molecules prevents them from escaping from the blood into the tissues [...]"

When you read what the AMA stated in 1964, you'll know that the above statement constitutes complete and utter dishonesty. And this lie has been perpetuated and taught ever since hence why today—in 2015—the medical profession still holds NO definitive answers concerning the prime cause of any degenerative disease conditions. Since all of this started and ended in the United States, the rest of the world, including the countries whose governments and health care institutions may—because they truly care—actually be doing all they can in the best interest of the lay public, have all been kept in the dark. We are looking at the deliberate removal of critical pieces of a puzzle disease researchers and organizations all over the world have been trying to piece together for many decades, continually spending countless billions in the process with minor progressive outcome.
The foundational medical research has already been done, and it was buried.

“We have the authority with this [blood protein] research to stand up and tell people that all the [disease] research teams are researching for nothing. It’s money down the drain. And we speak with authority; it isn’t speaking halfway knowing. We are speaking with knowledge of the answer to every disease known to man and we’re saying that all the research [being done] is going down [the drain]. They’re doing it for nothing. They are researching for the treatment; they’re not researching for the cure.” ~ Dr. C. Samuel West, D.N., N.D., from the February 10th, 1986 presentation: “The Process of Healing the Body through the Lymphatic (Immune) System”

Excerpt from a proposed "Lymphatic Manifesto" presented at the November 1983 International Society of Lymphology Congress in Tel Aviv, Israel:

"While the lymphatic system is one of the 12-14 systems in the body, it receives almost no attention from the medical profession nor from basic scientists. In textbooks of medicine, surgery, pathology or anatomy, it rarely occupies more than one half percent of space. While this may improve with time and the efforts of people such as ourselves, the fact remains that many millions of people will suffer because of this widespread ignorance. Some will lose their lives, some will lose their limbs; many will suffer needless pain and incapacity; many research workers will get incorrect results. All of this through simple ignorance of the importance of the lymphatics." ~ Dr. John R. Casley-Smith, D. Sc., M.D. (h.c.), past president of the I.S.L. 1983-1985
So, the American Medical Association states:

In 1964 (Your Other Circulatory System)

"Calculations indicated that half of our blood protein is lost from the blood every 24 hours!"

“If the lymphatic system did not carry a large portion of the remaining seepage back to the bloodstream, we would all bleed to death internally in a matter of hours.”

“Thus this great river of mystery may well hold the key to dozens of disease riddles. That is why it is getting ever-increasing research attention. Inevitably, discoveries of vital importance to all will be made.”

In 1989 (Home Medical Encyclopedia)

“The large size of the protein molecules prevents them from escaping from the blood into the tissues [...]”

Additionally, before 1961, which was before Dr. Mayerson's research was published (in 1963), he (Mayerson) was lecturing for Dr. Arthur C. Guyton, M.D. (1919-2003) at the University of Mississippi School of Medicine, who attended his classes on the lymphatic system.

Dr. Guyton, also a lymphologist, who was the author of today’s most widely utilized medical physiology textbook in the whole of the United States (“The Textbook of Medical Physiology”; this is also the only medical textbook ever written by a lymphologist), was encouraged by Mayerson to get into the laboratory and find out all he could about the lymphatic system and blood proteins and so he did.

As a result, Guyton made a critical, game-changing discovery, which was that (1) the tissue spaces, in the healthy condition, were in a negative sub-atmospheric pressure condition, which was opposed to prior knowledge that came about using inferior testing methods, and (2) that it is the lymphatic system that maintains the sub-pressure state as one of its foremost priorities. Put differently, the lymphatic system's main function is to maintain the optimal conditions for healthy cells, where they are held tightly together and close to the blood capillaries to be within range of oxygen and nutrient irrigation. Guyton published this discovery in the appendix to the 5th chapter of the 1961 2nd edition of his Textbook of Medical Physiology and later coined this condition the “dry” state.

In chapter 5 on page 61 (appendix) of the textbook it states about the discovery:
Possibility of Negative Pressure in the Interstitial Spaces

"The principles of capillary dynamics presented in this [5th] chapter ["Interchange of Fluid through the Capillary Membrane"] are those taught in almost all physiology courses and that have now become almost classical. However, since this chapter was written, a finding has been made in our laboratory that will perhaps change many of our classical concepts of fluid exchange at the capillary membrane. This finding has been that negative pressures develop in small plastic capsules implanted in the tissues and fenestrated with many small holes so that fluid can exchange freely between the interstitial spaces and the capsules."

It is later stated that, "The Significance of negative pressure in the tissue spaces is the following: Contrary to previous beliefs, it might not be the elastic tension of the tissue fibers that keeps the interstitial spaces in their normal, non-edematous state. Instead, it might well be the negative pressures in these spaces that keep the spaces continually collapsed."

On page 62, Guyton elaborates, "Thus far, only a few observations are available that shed light on the mechanism that causes the negative pressure in the tissue spaces. The most important of these is that mechanical movement of the tissues causes the pressure to become more negative. This indicates that the lymphatic pump, which will be explained in the following chapter, pumps fluid and protein out of the interstitial fluid spaces each time the tissues are compressed or moved in any other way [this reveals an outstanding benefit to rebounding]. Loss of the protein would maintain a low tissue colloid osmotic pressure so that the plasma colloid osmotic pressure could cause osmosis of fluid out of the tissue spaces until the pressure would become negative."

The "dry" state is the cellular environment that allows for optimum oxygen, fructose/glucose and nutrient irrigation at the cell level, as well as for the prompt removal of waste products by the lymphatic system and immediate immune cell activity even in the absence of antibody- thus disease cannot manifest; in other words, if the cells are not in the dry-state, they will receive compromised levels of oxygen, fructose/glucose and nutrients; their wastes and other toxic material along with leaked proteins and fluids won’t be removed efficiently and the immune cells will not and cannot function properly.
From The Golden Seven Plus One (p. 35):

Ex Fl, Ex Na+, Lack of O2 = Excess fluid and excess sodium (Na+) results in lack of oxygen (O2)

"Dry" and Disease State Legend:

1. Blood capillaries (deliver oxygen, fructose/glucose and nutrients to the cells via the irrigation process and pick up carbon dioxide)
2. Every cell [in every part of your body] is an electrical generator (inside the cell, the potassium level must remain high and the sodium level must remain low, and this very delicate balance must be maintained; anything that will upset the sodium-potassium balance will damage or kill the cell)
3. Sodium-potassium pump (generates the electricity that gives every cell—immune cells included—the power to work)
4. Lymphatic capillaries (only lymphatic capillaries go up between the cells; the capillaries retrieve the leaked proteins and other plasma constituents from the cellular irrigation process)
5. One-way check valves (prevent lymph fluid from flowing backwards)
6. Excess fluid and excess sodium around the cells
7. Trapped plasma proteins around the cells (the blood proteins are negatively charged which attracts the positively charged single sodium ions out from the bloodstream in abundance with the water)

From The Golden Seven Plus One (p. 49):

(A.) - [Health] - "Healthy cells in the dry-state. Like a collapsed balloon the pressure is sub-atmospheric. This condition represents the dry-state of perfect health with no excess fluid around the cells, only enough [fluid] to fill the crevices around the cells and that is all."
(B.) - [Disease] - "Unhealthy cells, fluid retention, lack of oxygen and nutrients. Like a balloon blown up caused by fluid retention due to trapped blood proteins and excess sodium."

It is important to bear in mind that once there is excess water, and the proteins become trapped or clustered in the interstitial spaces around the cells, it is difficult for the lymphatic system to remove the proteins without mechanical and/or electrical assistance/stimulation. This may account for why some people—apart from emotional/psychological challenges, unaddressed continual poisoning factors (e.g. heavy metal exposure, silver amalgam fillings, electromagnetic radiation, pesticides in foods, dependent drug use, constantly inhaling toxic fumes or other harmful elements, etc.), and major negligence in adhering to getting sufficient rest and engaging basic, health-promoting activities including getting adequate full-spectrum sunlight, fresh air, making sure to breathe deeply, moving one's body and so forth—may not always be very successful through exclusive reliance on diet, botanical products and other supplements alone.

When trapped blood proteins reduce the energy field produced by the sodium-potassium pumps of the cells, this is what causes the proteins to stick together or cluster, which makes them very difficult to be retrieved by the lymphatic capillaries. However, Prof. Friedrich M. Plog, from Germany, discovered, as he shared with Dr. West in February 1980, that electricity dissipates these clustered, trapped blood proteins, making them retrievable by the lymph capillaries. Dr. Plog also informed Dr. West that, "We have known about the blood proteins for a long time in Germany."

By Dr. C. Samuel West, D.N., N.D.:

"The only substance that can interfere with the irrigation process where the cells receive oxygen and nutrients and with other life processes within the cell is the proteins that make up part of our blood plasma. The plasma proteins are the albumins, the globulins, and fibrinogens." ~ The Golden Seven Plus One, p. 31

"Due to lack of pressure in the space around the cells, the blood proteins are the only substances that cannot be immediately returned into the bloodstream [directly from the tissue spaces]. Therefore, the only substance in the body that can alter this negative pressure condition [dry-state] and produce the conditions that cause loss of energy, disease and death, is the blood proteins." ~ The Golden Seven Plus One, p. 51

Dr. Guyton, just as Drinker suggested, revealed that the only way the blood proteins could return to the bloodstream (to maintain blood volume, blood pressure and thus preventing the collapsing of blood vessels) was via the lymphatic system and stated in the 2nd edition of the Textbook of Medical Physiology (p. 69) that, "If the lymphatic drainage from any area of the body becomes blocked, more and more protein collects in the local
tissue spaces until finally the concentration of this protein may approach the concentration of protein in the [blood] plasma."

On page 190 of the 11th edition of Dr. Guyton's textbook (PDF) it states (also see scanned page image 12a. provided in the appendix):

"The lymphatic system represents an accessory route through which fluid can flow from the interstitial spaces into the blood. Most important, the lymphatics can carry proteins and large particulate matter away from the tissue spaces, neither of which can be removed by absorption directly into the blood capillaries. This return of proteins to the blood from the interstitial spaces is an essential function without which we would die within about 24 hours."

On page 401 of the 5th edition of Guyton's textbook it states:

"The importance of this function of the lymphatics cannot be stressed too strongly, for there is no other route besides the lymphatics through which excess proteins [which 'seep' out of the blood capillaries into the spaces around our cells] can return to the circulatory system."

NOTE: According to Prof. Karl J. West (current president of the International Academy of Lymphology), the 1961 2nd edition of Guyton's textbook is the best edition to acquire for teaching others about this research with respect to Guyton's discoveries and statements, as certain key statements were either revised or removed from future editions.

Dr. Mayerson's blood protein research was not the only significant, published research that has disappeared. Going back to the AMA's statement:

"If the lymphatic system did not carry a large portion of the remaining seepage back to the bloodstream, we would all bleed to death internally in a matter of hours."

The reason we would "bleed to death internally in a matter of hours," is due to shock.

Drinker, back in 1930, researched why soldiers wounded in the battlefields were dying from wounds that usually wouldn't be considered fatal. Mayerson was a member of the United States National Research Council Committee on Trauma and Shock between 1954 and 1963. Drinker's shock research, titled “Death from Shock,” was published in the early editions of the Encyclopedia Americana, while the research on trauma and surgical shock was published in the 1953, '56, and '60 editions under “Hypoalbuminemia” (i.e. low albumin plasma protein in the bloodstream). Essentially, shock and negative physical/psychological stress factors cause the blood capillary
pores to dilate, which in turn causes the albumin (smallest of the three major plasma proteins) and water to rush out of the bloodstream into the tissue spaces faster than the lymphatic system can remove them, rapidly altering the dry-state. If this process happens too fast, in extreme cases, the blood vessels will collapse, causing death. This is why blood transfusions are often a vital step in treating acute traumatic shock from serious injury.

It was therefore unveiled that shock could cause death rapidly, and that death from shock was actually death from trapped blood proteins. Stress is a mild form of shock and the resulting chemical reaction from mental stress will also cause a systemic dilation of the capillary pores (although not as quickly)—thus why long-term stress is so harmful to our health, with an estimated, according to WebMD.com, 43% of the U.S. adult population suffering adverse health effects from stress while 75-90% of all doctor's office visits are concerning stress-related ailments and complaints.

The shock research was removed from future editions of the Encyclopedia Americana and was essentially buried with the rest of the blood protein research.

"The loss of plasma from dilated and injured capillaries may be disastrous in several ways. One of these, the systemic effect is so widely appreciated as to have dominated physiological thinking in the treatment of burns almost to the exclusion of other principles very vital to efficient therapy.

There can be no doubt that reduction in plasma volume by leakage from abnormal capillaries in burned regions and possibly a slower but obstinately insidious leakage from capillaries all over the body may and often does cause surgical shock and death." ~ “The Treatment of Burns by the Closed-Plaster Method” (PDF) by William W. L. Glenn, Helen H. Gilbert and Cecil K. Drinker; J Clin Invest. 1943;22(4):609–625. doi:10.1172/JCI101433.

From all the above, we can conclude that the most critical, basic and medically documented scientific research that reveals the cause and prevention of disease and death at the cell level was conducted between 1930 and 1963 involving three major medical schools: (1) Dr. Cecil K. Drinker at Harvard Medical School, (2) Dr. H. S. Mayerson at the Tulane University School of Medicine, and (3) Dr. Arthur C. Guyton at the University of Mississippi School of Medicine.

With the newfound awareness of a prime health care association (AMA) whose supposed mission is "To promote the art and science of medicine and the betterment of public health," along with any special interest groups (pharmaceutical companies may come to mind once you realize that poisons dilate the blood capillary membrane pores and that drugs bind with blood plasma proteins, so consider what effects this can have once these plasma protein-bound drugs leave the bloodstream in large quantities and aren't
removed promptly) that may’ve been involved in this obscuration, it is for each person
to determine what they make of this, whether one sees it as "crime against humanity," "the greatest mass murder plot in history," or simply "chronic selective amnesia on the AMA's part [costing the suffering and lives of millions globally]."

"We know that in order for a prescribed drug to have a 'side reaction,' it would have to cause lack of oxygen or 'trapped' blood proteins somewhere in the body. Is this why drugs have the ability to harm or even kill those who take them? Is this why this medically documented research has been kept away from the consumer? Is this why medical doctors have specifically stated to Dr. West that if they were to teach the blood protein research, their licenses would be taken away? Is this why medical texts and literature have so little to offer on this vital subject?" ~ The International Academy of Lymphology, Introduction to the Science of Lymphology & the Art of Lymphasizing, p. 5

At this time, as of January 25th, 2015, Robert Morse, N.D. has been informed of this research and is currently investigating.

Could this research in time greatly influence and enhance our community's current understanding of the degenerative and healing processes of the human body, as well as how we can better restore the ideal conditions for life at the cell level? Quite possibly, for it may well also enhance our understanding of the processes that precede and result in what we refer to as "acidosis," what medical science refers to as "inflammation," and what others have chosen to call "hot spots," amongst other notable aspects of health. This research can advance us to a point where NO ONE can argue with the foundational science behind what we teach, because it is a scientifically well-documented (through and through), perpetual and universal truth with respect to the human physical frame.

Along with lymphologist Dr. Jack W. Shield's lymphography study in 1979 (photographing the thoracic duct using a tiny camera placed inside a volunteer and positioned at the base of the neck where the thoracic duct meets the subclavian duct—near the clavicle—and monitoring on a big screen, along with a group of other lymphologists, how the lymph fluid "shot like a geyser" into this duct at the peak of inhalation, from a deep breath, to yet again become blood plasma in the bloodstream), this research also reveals that the lymphatic system MUST return the fluid and plasma proteins back to the bloodstream one way or the other, but that the lymph fluid is purified within many of the approximately 600 lymph nodes scattered throughout the body before draining into the venous system. It is then only a question of where these toxins, poisons and waste by-products go from the lymph nodes once processed, acted upon and neutralized by lymphocytes (T cells, B cells, and NK Cells), macrophages and bacteria. We maintain that the wastes are drained into the bowels and ejected with bowel movements, sweat out through the skin, and equally as important, filtered out as
sediment via the kidneys. As a side note, Dr. Morse has once briefly mentioned that there "might be some of that going on" during a YouTube video. He was saying this in reference to whether or not lymph fluid drains into the venous system at the subclavian vein which is a concept he generally disagrees with. That was the only video where he has ever said this.

"Loss of energy or ▲EE[*] in your body is one of the first indications of trapped plasma proteins. To those who have this knowledge, the name or symptom of the problem or disease means nothing anymore. The whole body works electrically off of the energy produced by the sodium-potassium pump. Therefore, they will name the problem or disease according to [who discovered it,] where the plasma proteins get trapped and how it effects that part of the body." ~ Dr. C. Samuel West, D.N., N.D., The Golden Seven Plus One, p. 45

▲EE = any loss of energy that is produced or experienced in the body. If there is no ▲EE we could run 150-200 miles (with an upward potential of up to 400+ miles as evidenced by the Tarahumara Indians of northwest Mexico) WITHOUT REST. This is the degree of endurance Dr. Morse often talks about (e.g. Q & A 106 - 10:00; Q & A 118 - 10:08; Q & A 128 - 3:29; Q & A 151 - 46:31; Q & A 188 - 50:39) that we have the potential to tap into, once the resistance to the flows of energy—blood, nerve and lymph—has been removed or significantly reduced (moving the cellular environment closer to Dr. Guyton's “dry” state discovery).

"McDougall, neither anthropologist nor biologist, is a journalist originally given an assignment for Runner's World that morphed into a consuming fascination with feats of high mileage, particularly with that of the Mexican Tarahumara Indians, reclusive canyon dwellers reputed to be the best endurance athletes on earth. Wearing shoes fashioned from tire strips to cushion their feet, the Tarahumara cover up to 400 miles in festive, multiday events drawing runners and spectators from multiple villages. They are also the picture of health, enjoying almost total immunity to cancer and the diseases that plague modern society." ~ 'The Running Man, Revisited', Seed (magazine)
Appendix

1a. 'The Lymphatic System' (1st page) by H. S. Mayerson, published in Scientific American, June 1963 (click image to enlarge)

THE LYMPHATIC SYSTEM

This second circulation plays an essential role in maintaining the body’s steady state, draining from the spaces between cells fluid, protein and other substances that leak out of the blood

by H. S. Mayerson

Living tissue is for the most part a collection of cells bathed in a fluid medium. This interstitial fluid constitutes what the French physiologist Claude Bernard named the milieu intérieur: the internal environment of the organism that is the true environment of its cells. The interstitial fluid brings nutrients to the cells and carries away waste products, its composition varies in space and time under the control of the co-ordinated physiological processes that maintain homoestasis, the remarkably steady state that characterizes the internal environment of a healthy organism.

In the maintenance of the homoeostasis of the interstitial fluid the circulation of the blood is obviously of fundamental importance. In the higher vertebrates there is a second circulation that is equally essential: the lymphatic system. Its primary function is to recirculate the interstitial fluid to the bloodstream, thereby helping to create a proper cellular environment and to maintain the constancy of the blood itself. It also serves as a transport system, conducting specialized substances from the cells that make them into the bloodstream.

In recent years physiologists, biochemists, physicians and surgeons have been studying the lymphatic system intensively, in health and in disease. Their investigations are providing much new information on how the body functions, explaining some heretofore poorly understood clinical observations and even suggesting new forms of treatment.

The fact that the lymphatic system is an evolutionary newcomer encountered only in the higher vertebrates is significant. In lower animals there is no separation between the internal and external environments; all the cells of a jellyfish, for example, are bathed in sea water. With progression up the evolutionary scale the cells become separated from the external environment, “inside” is no longer identical with “outside” and rudimentary blood circulatory systems make their appearance to conduct the exchange of nutrients and waste products. As the organism becomes more complex the blood system becomes more specialized. The system develops increasing hydrostatic pressure until, in mammals, there is a closed, high-pressure system with conduits of diminishing thickness carrying blood to an extensive, branching bed of tiny capillaries.

At this point in evolution a snag was encountered: the high pressures made the capillaries leaky, with the result that fluid and other substances seeped out of the bloodstream. A drainage system was required and lymphatic vessels evolved (from the veins, judging by embryological evidence) to meet this need.

In man the lymphatic system is an extensive network of connective vessels resembling the veins. It arises from a fine mesh of small, thin-walled lymph capillaries that branch through most of the soft tissue of the body. Through the walls of these blind-end capillaries the interstitial fluid diffuses to become lymph, a colorless or pale yellow liquid very similar in composition to the interstitial fluid and to plasma, the liquid component of the blood. The lymphatic capillaries converge to form larger vessels that receive tributaries along their length and join to become terminal ducts emptying into large veins in the lower part of the neck. The largest of these great lymphatics, the thoracic duct, drains the lower extremities and all the organs except the heart, the lungs and the upper part of the diaphragm; these are drained by the right lymphatic duct. Smaller cervical ducts collect fluid from each side of the head and neck. All but the largest lymph vessels are fragile and difficult to trace, following different courses in different individuals and even, over a period of time, in the same individual. The larger lymphatics, like large veins, are equipped with valves to prevent backflow.

Along the larger lymphatics are numerous lymph nodes, which are of fundamental importance in protecting the body against disease and the invasion of foreign matter. The lymph nodes serve, first of all, as filtering beds that remove particulate matter from the lymph before it enters the bloodstream; they contain white cells that can ingest and destroy foreign particles, bacteria and dead tissue cells. The nodes are, moreover, centers for the proliferation and storage of lymphocytes and other antibody-manufacturing cells produced in the thymus gland; when bacteria, viruses or antigenic molecules arrive at a lymph node, they stimulate such cells to make antibodies [see “The Thymus Gland,” by Sir MacFarlane Burnet; Scientific American, November, 1962].

Stirling’s Hypothesis

The present view of the lymphatic circulation as a partner of the blood system in maintaining the fluid dynamics of the body stems from the investigations early in this century by the British physiologist Ernest H. Starling. “Stirling’s hypothesis” stated that the exchange of fluid between the capillaries and the interstitial space is governed by the relation between hydrostatic pressure and osmotic pressure. Blood at the arterial end of a capillary is still under a driving pressure equivalent to some 40 millimeters of mercury; this constitutes a “filtration pressure” that tends to make plasma seep out of the capillary.
LYMPHATIC VESSELS drain the entire body, penetrating most of the tissues and carrying back to the bloodstream excess fluid from the intercellular spaces. This diagram shows only some of the larger superficial vessels (light color), which run near the surface of the body, and deep vessels (dark color), which drain the interior of the body and collect from the superficial vessels. The thoracic duct, which arises at the cisterna chyli in the abdomen, drains most of the body and empties into the left subclavian vein. The right lymph duct drains the heart, lungs, part of the diaphragm, the right upper part of the body and the right side of the head and neck, emptying into the right subclavian vein. Lymph nodes interspersed along the vessels trap foreign matter, including bacteria.
visualized the wall of the capillary as being freely permeable to plasma and all its constituents except the plasma proteins albumin, globulin and fibrinogen, which could leak through only in very small amounts. The proteins remaining in the capillary exert an osmotic pressure that tends to keep fluid in the capillary, counteracting the filtration pressure. Similar forces are operative in the tissue spaces outside the capillary. At the arterial end of the capillary the resultant of all these forces is ordinarily a positive filtration pressure; water and salts leave the capillary. At the venous end, however, the blood pressure is decreased, energy having been dissipated in pushing the blood through the capillary. Now the osmotic force exerted by the proteins is dominant. The pressure gradient is reversed; fluid, salts and the waste products of cell metabolism flow into the bloodstream (see top illustration on page 89).

It follows, Starling observed, that if the concentration of plasma proteins is decreased (as it would be in starvation), the return of fluid to the bloodstream will be diminished and edema, an excessive accumulation of fluid in the tissue spaces, will result. Similarly, if the capillaries become too permeable to protein, the osmotic pressure of the plasma decreases and that of the tissue fluid increases, again causing edema. Capillary poisons such as snake venoms have this effect. Abnormally high venous pressures also promote edema, by making it difficult for fluid to return to the capillaries; this is often one of the factors operating in congestive heart disease.

A fundamental tenet of Starling's hypothesis was that not much protein leaves the blood capillary. In the 1930's the late Cecil K. Drinker of the Harvard Medical School challenged this idea. Numerous experiments led him to conclude "that the capillaries practically universally leak protein; that this protein does not re-enter the blood vessels unless delivered by the lymphatic system; that the filtrate from the blood capillaries to the tissue spaces contains water, salts and sugars in concentrations found in blood, together with serum globulin, serum albumin and fibrinogen in low concentrations, lower probably than that of tissue fluid or lymph; that water and salts are reabsorbed by blood vessels and protein enters the lymphatics together with water and salts in the concentrations existing in the tissue fluid at the moment of lymphatic entrance." In other words, Drinker believed that protein is continuously filtering out of the blood; the plasma-protein level is maintained only because the lymphatic system picks up protein and returns it to the bloodstream.

Unfortunately Drinker had no definitive method by which to prove that the protein in lymph had leaked out of the blood and was not somehow originating in the cells. Perhaps for this reason his conclusions were not generally accepted. Teachers and the writers of textbooks continued to maintain that "healthy" blood capillaries did not leak protein. It was in an effort to clarify this point that I undertook an investigation of lymph...
4a. 'The Lymphatic System' (4th page) by H. S. Mayerson, published in Scientific American, June 1963 (click image to enlarge)
5a. 'The Lymphatic System' (5th page) by H. S. Mayerson, published in Scientific American, June 1963 (click image to enlarge)
6a. American Medical Association's official journal, 'Today's Health', December 1964 issue. In the table of contents, see second feature (Your Other Circulatory System) under 'THE WORLD OF MEDICINE' (click image to enlarge)
IT IS ONE of the world’s rivers of mystery—sluggish, largely unmapped, perhaps hundreds of miles long. A remote Amazon tributary? No. The lymphatic system of your own body.

The lymphatic system has puzzled physiologists since early Grecian times. Only now is the “white blood stream” beginning to yield its secrets—thanks to new tools and laboratory techniques. One thing becomes increasingly clear: Our health, even our lives, depend on how well this complex system functions.

In contrast to the blood stream, which operates under pressure and follows a swift-flowing closed circuit from arteries to capillaries to veins and then back to arteries, the lymphatic system flows slowly in a single direction. Its initial rivulets—microscopic in dimension—originate in intercellular spaces. Fluid gathered here passes along through ever-enlarging ducts until it reaches the lower neck region, where it empties into veins leading to the heart.

Much of the mystery surrounding the lymphatic system traces to the fact that most of its ducts are so fragile, so gossamer, that they are invisible—the smallest have walls of only one-cell thickness. And the fluid they carry is almost as clear as water (except after a fatty meal when it appears white).

Moreover, at the touch of a probe, all but the largest lymphatic vessels collapse, as they do at death. Exploring such a near-invisible stream has called for supreme ingenuity, and even now there are scores of unanswered questions about the lymphatic system’s role in health and disease. Still, the general picture is emerging.

Among the methods developed in recent years to map the lacy network of ducts, two have been particularly helpful. First, opaque dyes that cast shadows on X-ray film. Second, isotopes, which leave a track of telltale radiation.

Explorations with these and other techniques reveal fascinating insights into the “geography” of the body. In many respects the body is like a vast swamp. Its trillions of fluid-bathed cells live in aquatic life. The lymphatic network, it can now be seen, provides an all-important drainage system—one on whose function our survival depends. The reasons for this are readily apparent.

To nourish cells, blood capillaries constantly leak minerals, fats, vitamins, and sugars, along with fluid and proteins. Much excess fluid, together with cellular wastes, passes back through capillary walls to be carried away by veins. But not all. If the lymphatic system did not carry a large portion of the remaining seepage back to the blood stream, we would all “bleed” to death internally in a matter of hours.

Loss of blood proteins through capillary walls would be particularly disastrous. Recently, Dr. H.S. Mayerson of Tulane Medical School, tagged blood proteins with radioactive iodine, then measured the rate at which they passed into lymph vessels. Calculations indicated that half of our blood protein is lost from the blood every 24 hours but for the prompt retrieval of the protein by the lymphatic system this constant loss would spell swift catastrophe.

The route of return is reasonably well-known. A gathering system of minute lymph capillaries collects fluid—how they do this no one knows—and passes it along until it finally reaches the thoracic duct. This is the largest vessel in the lymphatic system:soda-straw-sized, it passes some 16 inches upward through the center of the body, finally emptying into the blood stream.

What propels this great lymphatic stream? Fish and reptiles have lymph “hearts”—pulsating tubes—to move fluid along. Man does not. Apparently—this is one of the lymphatic system’s mysteries—lymph is propelled mainly by breathing, walking, intestinal pulsations, and other muscular activity. As muscles tighten, lymph vessels are squeezed and fluid is pushed along. Backflow is prevented by flap valves.
located at regular intervals in the larger lymphatics. The infinitely complex lymphatic network has other jobs besides drainage and maintenance of fluid balance. Spaced along the channels are hundreds of nodes—bean-shaped masses of tissue that range from pinhead size up to an inch long—which serve as filters, removing dangerous impurities much as an oil filter does in a car. These lymph nodes vary in size that if one fails, another a few inches farther along is likely to do the job. This filter system traps almost anything that is potentially harmful—dead red-blood cells, chemicals, even excess tattoo dye. Lymph nodes in the lung areas of city dwellers are almost always black from a sort filtered out of murky city air.

Suppose you cut your finger or step on a nail. Inevitably, bacteria are carried into the body. They could be lethal but for the lymph nodes that train them out, then destroy them. Generally, these filters are so efficient that the lymph they finally deliver to the blood stream is clean and safe.

Still, they can be overwhelmed—clogged as any other filter. The most dramatic example is offered by that terror of a disease, bubonic plague. Here the lymph nodes struggle valiantly to filter out and destroy the invading organisms, but it is a losing battle.

On a less dramatic scale, we have all seen evidence of lymph-node difficulties. It may seem odd, for example, that an infected finger causes pain and swelling in the armpit, or that an infected toe similarly affects the groin. But there are concentrations of lymph nodes located in these areas, and discomfort there announces that a battle royal against bacterial invaders is under way in the nodes.

While lymphatic filtering action is one of the body’s greatest protective mechanisms, it can also lead to trouble. Striving to trap and destroy anything which would be harmful in the blood stream, the ever-vigilant lymphatic nodes trap cells shed by cancer. These cancer seeds often sprout and grow in the lymphatic channels themselves; indeed, this appears to be one of the chief routes of cancer spread. This is why surgeons always pay particular attention to the lymphatic system near a primary cancer. In breast removal, for example, the greatest care is exercised to remove lymphatics and the lymph nodes in all surrounding areas, particularly the armpit.

Transport is one of the lymphatic system’s big jobs. There is mounting evidence that this is probably the route by which some of the critically important hormones are distributed through the body. Another of the system’s intriguing activities is the handling of dietary fats. Proteins and carbohydrates are absorbed directly into the blood stream along the digestive tract. Most fats are not directly absorbed—and with good reason: In heavy concentration, fats destroy red-blood cells. The lymphatic system solves this potentially deadly problem by absorbing fats from the intestine and dribbling them into the blood stream in amounts that can be safely handled.

The inordinately complex lymphatic system also produces antibodies which destroy invading bacteria, and manufactures at least one-fourth of the infection-fighting white cells that circulate in the blood stream. Whenever infection develops, the lymphatic system goes into frantic activity, producing new infection-fighting white cells by the tens of thousands and rushing them to the scene of trouble.

Inevitably, anything as complex as the lymphatic system is liable to a wide variety of trouble. Indeed, there is a great deal of evidence that this evolutionary newcomer has not yet had time to develop the wide margin of safety possessed by other organs.

At times, too, the system lacks the reserve capacity to handle jobs thrust upon it. In the lungs, for example, blood vessels may ooze fluid faster than the lymphatics can carry it away. This can happen with pneumonia, in certain types of heart disease, or when irritating chemicals damage lung tissues. The resulting pulmonary edema is among the most serious threats to life. Unless the lymphatic system can meet the challenge, the victim drowns in his own juices.

The lymphatic system usually performs so efficiently that we are hardly aware of its existence. Still, from time to time, it does announce its presence. On long plane rides and in theaters, women sometimes kick off their shoes. Reason: When the feet are inactive, fluid stops flowing and collects; feet swell, feel constricted by shoes. During surgery, lymph channels are inevitably severed. Fluid then collects in intercellular spaces and swelling follows in the surgical area, persisting until new lymph channels sprout. Children frequently suffer from "swollen glands," particularly in the neck area. This simply means that lymph nodes ("glands") are inflamed.

The lymphatic system has its own set of special disease problems. It is the chief target of lymphatic leukemia, and of Hodgkin’s disease—a cancer-like illness marked by enlargement of nodes and certain abnormalities of the white blood cells. Until lately, medical texts said that this disease was always fatal. Recent advances in radiation therapy offer some hope of changing the picture, however. High-voltage radiation appears to slow or stop overproduction of white cells. In one recently reported series of cases when therapy was begun at an early stage, two-thirds of those treated in this manner were alive at the end of five years—the usual measure of cancer cure.

Other recent work suggests a link between lymphatic difficulties and some serious forms of kidney diseases.

Thus, this great river of mystery may well hold the key to dozens of disease riddles. That is why it is getting ever-increasing research attention. Inevitably, discoveries of vital importance to all will be made.
Small blisters develop at an early stage in the rashes of the viral infectious diseases, herpes zoster (shingles), and herpes simplex; these blisters contain infectious virus particles that may spread the infection elsewhere or to another person.

**TREATMENT**

A blister is best left to heal on its own. It should not be incised, because the underlying damaged tissue could become infected. In the case of large, troublesome, or unexplained blisters, consult your physician. Bullous disorders are potentially serious and expert advice is needed.

**Bloody nose**

See Nasal congestion.

**Blocking**

Inability to express true feelings or thoughts, usually as a result of emotional or mental conflict. In Freudian-based psychotherapies, blocking is regarded as originating from the repression of painful emotions in early life. Successful treatment is thought to depend on putting patients in touch with these unconscious feelings.

A very specific form of thought blocking occurs in schizophrenia. In this disorder, trains of thought are persistently interrupted involuntarily, to be replaced by totally unrelated new ones. (See also Psychotherapy.)

**Blood**

The sticky red fluid that circulates in our veins and arteries. Its main function is to act as the body’s transport system, but it also has a major role in the defense against infection.

Blood also contains ingemous mechanisms to help repair loss from the body; it seals damaged blood vessels, protect the injury with a clot, and helps to repair the damaged vessel. (Hemostasis; Blood clotting; Wounds).

The normal adult has about 10 pints of blood. At rest, 10 pints a minute are pumped by the heart via the arteries to the lungs and all other tissues, then returned to the heart in veins, in a continuous circuit (see Circulatory system). During exercise the heart may pump blood at a rate of 40 pints or more a minute.

Almost half the volume of blood consists of red blood cells (erythrocytes), white blood cells (leukocytes), and platelets or thrombocytes (see Blood cells).

The remaining fluid is called plasma, which contains dissolved proteins, sugars, fats, and minerals.

**BLOOD CELLS**

The main function of red blood cells is to act as containers for the pigment and protein hemoglobin. Hemoglobin carries oxygen from the lungs to the tissues, where it is exchanged for the waste product carbon dioxide (see Respiration). While blood cells play an important part in the defense against infection by viruses, bacteria, fungi, and parasites, and in inflammation of any cause (see Immune system), platelets are essential to arrest bleeding and repair damaged blood vessels. They clump together to block small holes, and release chemicals that begin the process of blood clotting.

**PLASMA**

Blood plasma is a straw-colored fluid, consisting mainly of water (95 percent) with a salt content very similar to seawater. Levels of many other dissolved constituents vary from time to time. Measurements of these constituents are useful to physicians in the diagnosis of disease states (see Blood tests; Liver function tests). Important constituents of plasma include the following.

**NUTRIENTS**

These substances are transported to the tissues after absorption from the intestinal tract or following release from storage deposits such as the liver. Nutrients include sugars (principally glucose), fats, amino acids required by cells to make proteins, and various vitamins and minerals. Immediately after a meal that is rich in fats, the plasma has a milky appearance as a consequence of its high fat content.

**WASTE PRODUCTS**

The main product of tissue metabolism is urea, which is normally removed from the plasma to the kidneys; abnormally high blood urea levels occur in renal failure. The waste product from the destruction of hemoglobin is a yellowish pigment called bilirubin. This is normally removed from the plasma by the liver and turned into bile. Bilirubin levels become abnormally high in liver disease, or in hemolytic anemia, where there is excessive destruction of red blood cells. Bilirubin causes the yellow color of the skin and eyes and the dark urine in patients with jaundice.

**PROTEINS**

These include substances, such as fibrinogen, that are involved in the processes of coagulation and clotting, and others that act to inhibit coagulation (see Blood clotting). Plasma proteins, such as immunoglobulins (see also Antibodies), and complement (bacteria fighters) are part of the immune system. Another type of plasma protein is albumin. The large size of the protein molecules prevents them from escaping from the plasma into the lungs. This helps to "hold in" the water content of blood (by osmotic pressure) and thus maintain blood volume.

**HORMONES**

These are chemical messengers that affect the blood from various glands to their target organs. (See Endocrine system.)

**Blood cells**

Cells present in blood for short or part of their life span. These include red blood cells, which make up about 40 percent by volume of normal blood, and white blood cells and platelets, which make up less than 5 percent of the total volume.

All types of blood cells are formed within the bone marrow by a series of divisions from a single type of cell called a stem cell.

**RED BLOOD CELLS**

These are also called RBCs, red blood corpuscles, or erythrocytes. They carry oxygen from the lungs to the tissues, where oxygen is exchanged for carbon dioxide (see Respiration).

**FORMATION**

RBC formation from stem cells in the bone marrow takes about five days. It requires an adequate supply of nutrients, including iron, amino acids, and folic acid. The rate of RBC formation is influenced by a hormone called erythropoietin, which is produced by the kidneys.

Cells just released into the bloodstream from the marrow are called reticulocytes. Over the next four days, these develop into mature RBCs. Reticulocytes are easily recognized in blood by means of special staining techniques, and a count of their numbers aids in the diagnosis of anemia with a helpful estimate of the rate at which RBCs are being formed (see Blood count; Blood smear).

**STRUCTURE AND FUNCTION**

One cubic millimeter of blood contains about 5 million RBCs, each of which is doughnut-shaped, about 7.5 thousandths of a millimeter in diameter, and much thicker around the edge than at the center. This shape gives the cell a relatively large surface area, which assists it in absorbing and releasing oxygen molecules. The shape also allows the cell to distort and so helps it squeeze through narrow blood vessels.
INTERCHANGE OF FLUID

Effect of Low Capillary Pressure. If the mean capillary pressure falls from 25 mm. Hg down to 15 mm. Hg, this obviously results in rapid inward flow of fluid from the interstitial spaces into the plasma. The plasma volume and capillary pressure progressively increase, while the interstitial fluid volume and tissue pressure decrease. After a while these changes in pressure will cause a new state of equilibrium to be reached, and the fluid volumes will then stop changing.

Effect of Elevated Tissue Pressure. If the tissue pressure becomes greatly elevated while other forces at the capillary membrane remain normal, this obviously will cause increased fluid flow into the blood both by absorption through the capillaries and through the lymphatic system. Consequently, the plasma volume increases while the interstitial fluid volume decreases, thereby elevating the capillary pressure and decreasing the interstitial fluid pressure until the forces at the membrane reach a new state of equilibrium.

Rapidity with Which New Equilibria Are Reached. When the forces that cause inflow and outflow through the capillary membranes are thrown out of equilibrium by a transfusion, by hemorrhage, or by any other cause, equilibrium is gradually reestablished by fluid transfer through the capillary membrane. The rapidity of this reapproach to equilibrium has never been actually measured, but on the basis of filtration and absorption studies in capillaries, as well as measurements of the fluid volumes required to increase either capillary or tissue pressure, one can calculate that equilibrium should be fairly well reestablished in one to three hours. Though this seems to be a relatively slow reestablishment of equilibrium between plasma and interstitial fluid volumes, it must be recognized that severe degrees of non-equilibrium rarely develop in a short period of time. Consequently, for all practical purposes the inward forces versus the outward forces, as stated in the law of the capillaries, are rarely out of equilibrium by more than a millimeter or more of mercury at any one time.

APPENDIX

Possibility of Negative Pressure in the Interstitial Spaces

The principles of capillary dynamics presented in this chapter are those taught in almost all physiology courses and that have now become almost classical. However, since this chapter was written, a finding has been made in our laboratory that will perhaps change many of our classical concepts of fluid exchange at the capillary membrane. This finding has been that negative pressures develop in small plastic capsules implanted in the tissues and fenestrated with many small holes so that fluid can exchange freely between the interstitial spaces and the capsules. This pressure averages about \(-5\) mm. Hg inside the capsule, and it is present in all tissue areas where capsules have been implanted, though sometimes the pressure is \(-2\) to \(-3\) mm. Hg and other times as low as \(-10\) mm. Hg (particularly in the axillary spaces). Since the usual method of measuring tissue pressure (by inserting a needle into the tissue) is unsatisfactory, we believe these capsular pressures to be much more nearly the true tissue pressure than any pressures previously reported.

The significance of negative pressure in the tissue spaces is the following: Contrary to previous beliefs, it might not be the elastic tension of the tissue fibers that keeps the interstitial spaces in their normal, non-edematous state. Instead, it might well be the negative pressures in these spaces that keep the spaces continually collapsed.

There are many evidences that this is true. First, everyone is familiar with the collapse of a blister several days after it forms. Indeed, the blister is sucked so dry by the tissues that the surface of the blister actually crinkles; this could only occur if a negative pressure should develop in the blister. Second, many newborn male children have hydroceles in the scrotum. Within a few months almost all of these completely resorb even though the walls of the hydrocele during the latter stages of resorption are actually folded upon themselves so that the pressure therein could not possibly be positive. Third, measurements of pressure in nat-
GrapeGate

Page 25 of 28


urally occurring non-collapsible spaces such as the intrapleural space and the joint cavities have all been negative.

Negative pressure in the tissue spaces would almost certainly allow a far more stable control system for interstitial fluid volume than would a positive pressure system. The reason for this is that a change of only 2 mm. Hg pressure in a positive pressure system would cause a tremendous change in interstitial fluid volume, whereas in a negative pressure system the interstitial fluid spaces would be kept almost as small as possible essentially all the time regardless of changes in the degree of negativity. The fluid present in the tissue spaces in this latter instance would be only that amount held in the spaces by capillarity. Calculations of the capillary forces involved show that changes in negative pressures between the limits of minus one and minus several thousand mm. Hg would not greatly affect the volume of interstitial fluid. Therefore, with a negative pressure system, capillary interchange dynamics would have to be altered far from normal before the interstitial fluid volume would be greatly affected. Indeed, this seems to be the case, for in experimental animals severe hemorrhage, which undoubtedly reduces the capillary pressure very greatly, does not transfer significant quantities of fluid from the interstitial spaces into the blood unless the animal has been given large quantities of water to drink immediately prior to the hemorrhage. Secondly, some human beings have been discovered to have so little protein in their blood stream that their plasma colloid osmotic pressures are as low as 10 mm. Hg. Yet, at least some of these people show essentially no edema. In a negative pressure system one can readily see that the colloid osmotic pressure could be reduced a reasonable amount before the interstitial fluid pressure would become positive and cause edema. Thus, the negative pressure system provides a safety factor against the development of edema.

When one considers that the body is made up of literally billions of capillaries and that it would be almost impossible to have precisely the same capillary pressures in all parts of the body at the same time, one can see once more that a negative pressure system would allow very wide variations in capillary pressure without this affecting interstitial fluid function. Therefore, the concept of negative pressures in the interstitial fluid spaces offers many explanations for already observed facts, though it will alter somewhat the classical principles of capillary dynamics as presented in this chapter.

Mechanism Causing the Negative Pressure in the Tissue Spaces. Thus far, only a few observations are available that shed light on the mechanism that causes the negative pressure in the tissue spaces. The most important of these is that mechanical movement of the tissues causes the pressure to become more negative. This indicates that the lymphatic pump, which will be explained in the following chapter, pumps fluid and protein out of the interstitial fluid spaces each time the tissues are compressed or moved in any other way. Loss of the protein would maintain a low tissue colloid osmotic pressure so that the plasma colloid osmotic pressure could cause osmosis of fluid out of the tissue spaces until the pressure would become negative. To do this, however, the mean capillary pressure would have to be somewhat lower than the 25 mm. Hg normally decreed in the classical mechanism. Since the capillary pressure measurements made with micropipettes have been made from the arterial and venous ends of the capillaries and since we now know that vasomotion might well cause very different pressures in the true capillaries from the pressures in the inflow and outflow tracks of the capillary beds, one could possibly explain the low capillary pressures on this basis.

Electron Microscopic Studies of Capillary Pores

Another recently discovered fact disconcerting to the classical picture of capillary dynamics has been the failure of the electron microscope to show pores in all capillary walls. Such studies have demonstrated pores only in the liver sinusoids and in the renal glomeruli. On the other hand, physiological studies are all so consistent with the idea that pores actually do exist in the capillary walls that we are presently forced to believe that the processes of tissue fixation prior to making the electron microscopic pictures have in some way obscured the presence of the pores. On the other hand, the pore size in the liver sinusoids is quite variable and can be as large as one micron. Therefore, when the truth is known, it is highly probable that the pores of the capillary wall will also be very variable in size though extremely small.

REFERENCES


Chapter 6

The Lymphatic System; Edema

THE LYMPHATIC SYSTEM

The lymphatic system represents an accessory route by which fluids can flow from the interstitial spaces into the blood. And, most important of all, the lymphatics can carry proteins and even large particulate matter away from the tissue spaces, neither of which can be removed by absorption directly into the blood capillary. We shall see that this removal of proteins from the tissue spaces is an absolutely essential function, without which we would die probably within 24 hours.

The Lymph Channels of the Body. Only a few of the tissues of the body do not have lymphatic channels. These include the superficial portions of the skin, the central nervous system, deeper portions of peripheral nerves, the endomysium of the muscles, and the bones. However, even in these structures are minute passages through which extracellular fluid can flow, and eventually this fluid flows to other areas that do have lymphatic channels or that can empty directly back into the blood.

Essentially all the lymph from the lower part of the body—even that from the legs—flows up the thoracic duct and empties into the venous system at the juncture of the left internal jugular vein and subclavian vein, as illustrated in Figure 38. However, some of the lymph from the lower part of the body can enter the veins in the inguinal region and perhaps also at various points in the abdomen.

Lymph from the left side of the head, from the left arm, and left chest region also enters the thoracic duct before it joins the venous system. Lymph from the right side of the neck and head, from the right arm, and from parts of the right thorax enters the right lymph duct, which then empties into the venous system at the juncture of the right subclavian vein and right internal jugular vein.

The lymphatics of the gastrointestinal tract pass through the mesentery to a common reservoir known as the cisterna chyli. The cisterna chyli is not a single large cistern, as its name implies, but instead is a multilocular plexus of connecting tubes that form the beginning of the thoracic duct.

The Terminal Lymphatics and Their Permeability. Most of the fluid leaving the arterial capillaries flows among the cells and finally back into the venous capillaries, but normally about one tenth of the fluid enters the terminal lymphatics. This quantity is extremely important, for substances of large molecular weight such as the proteins cannot enter the venous capillaries but can enter the lymphatics. The reason for this is that the lymphatic capillaries are far more permeable than are the blood capillaries.
Timeline Recap

- **1930’s** - Dr. Cecil K. Drinker is the first person to conclude, in 1931, that blood plasma proteins leave the bloodstream in significant quantities, "practically universally," which challenges the Starling’s Hypothesis. During this time, his findings with relation to his 'Death from Shock' research are published in the early editions of the Encyclopedia Americana.

- **1948-1963** - Dr. H. S. Mayerson picks up where Dr. Drinker left off and scientifically proves Drinker correct by tagging the proteins with radioactive iodine atoms. Before 1961, he lectures for and encourages Dr. Arthur C. Guyton to get into the laboratory to find out all he can about the lymphatic system and blood proteins. In June of 1963, Mayerson publishes his research in the Scientific American journal in an article called 'The Lymphatic System'. This research stresses the importance of a healthy-functioning lymphatic system.

- **1954-1963** - Dr. Mayerson was on the United States National Research Council Committee on Trauma and Shock. The research on trauma and surgical shock was published in the 1953, '56, and '60 editions of the Encyclopedia Americana.

- **1961** - As a result of Dr. Mayerson's encouragement, Dr. Guyton conducted research in his laboratory, which led him to discover and eventually publish his dry-state discovery in the 2nd edition of the Textbook of Medical Physiology.

- **1964** - The American Medical Association publishes and documents Dr. Mayerson's research in their official journal, 'Today's Health', in the article titled 'Your Other Circulatory System'. The last thing the AMA states with regard to this research, published 5 decades ago, is, "Thus this great river of mystery may well hold the key to dozens of disease riddles. That is why it is getting ever-increasing research attention. Inevitably, discoveries of vital importance to all will be made."

- **1965** - Reader's Digest publishes their condensed version of 'Your Other Circulatory System' in the article titled "Our Amazing 'White Bloodstream'".

- **1966** - The U.S. government, with the aid of international military forces, including the U.S. Army, gathers all the top lymphologists and medical research scientists at Dr. Mayerson's home in New Orleans, and the International Society of Lymphology (I.S.L.) is formed. All the blood protein research is put in this organization and henceforth disappears out of medical journals; the shock research is removed from future editions of the Encyclopedia Americana. The AMA reverts back to the pre-1930 research stating blood plasma proteins as being too large to escape from the bloodstream.

- **1980** - On February 22nd, Dr. C. Samuel West, D.N., N.D., the first person to ever give public lectures on the lymphatic system (starting in 1976) and who
coin...ed the term "trapped proteins" (in 1977), was accepted as the 379th and at-the-time only non-medical member of the I.S.L. on the grounds of his knowledge regarding the lymphatic system, Dr. Guyton's dry-state discovery (which Dr. West learned about in 1974) and the blood protein research. (Dr. West learned about the I.S.L. when he met Dr. Mayerson for the first time in 1978; they quickly became friends and Mayerson told him the whole story about what happened.)

- **1982** - On January 4th, Dr. West starts the International Academy of Lymphology with supportive encouragement from some of the top lymphologists and medical doctors of the I.S.L., with the aim of bringing the blood protein research to the lay public.

- **1989-2015** - Contradicting the entire process behind what they published in 1964, the AMA dishonestly states in their Home Medical Encyclopedia that, "The large size of the protein molecules prevents them from escaping from the blood into the tissues." The medical profession has - as a result - made no revolutionizing advancements in this area since 1961 (the dry-state discovery). Coupled with the neglect of lymphological orientation within medical and educational institutions, the profession's progress has been severely hampered and may well have come to an end, until it embraces this research and grants the lymphatic (immune) system the spotlight it sorely deserves.