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THE DIFFERENCE BETWEEN A LIVING HUMAN ORGANISM AND A DEAD HUMAN ORGANISM

Norbo‘tayeva Dinora Baxtiyorovna
1st-year student of the Faculty of Medicine,
Termez University of Economics and Service
norbotayevadinara30@gmail.com
Ruziyeva Gulsara Temirkulovna,
Termez University of Economics and Service Department of
“Natural Sciences” PhD, acting associate professor
E-mail: Ruziyeva.gulsara@gmail.com
gulsara_ruziyeva@tues.uz
https://orcid.org/0009-0009-2634-063X
Tel.:+998975327322

Annotatsiya. Ushbu maqolada tirik va o‘lik organizm o‘rtasidagi fundamental farqlar biokimyoviy jarayonlar, hujayra darajasidagi metabolizm hamda fiziologik funksiyalarning to‘xtashi nuqtayi nazaridan tahlil qilinadi. Tadqiqotda gomeostazning buzilishi va o‘limdan keyingi destruktiv o‘zgarishlarning asosiy bosqichlari ko‘rib chiqiladi.

Kalit so‘zlar: gomeostaz, metabolizm, anabolizm, katabolizm, autoliz, fiziologik funksiyalar, biologik o‘lim, klinik o‘lim, hujayra darajasi

Аннотация. В данной статье анализируются фундаментальные различия между живым и мёртвым организмом с точки зрения биохимических процессов, клеточного метаболизма и прекращения физиологических функций. В исследовании рассматриваются нарушение гомеостаза и основные этапы постмортальных деструктивных изменений.

Ключевые слова: гомеостаз, метаболизм, анаболизм, катаболизм, аутолиз, физиологические функции, биологическая смерть, клиническая смерть, клеточный уровень

Annotation. This article analyzes the fundamental differences between a living and a dead organism from the perspective of biochemical processes, cellular metabolism, and the cessation of physiological functions. The study examines the disruption of homeostasis and the main stages of postmortem destructive changes.

Key words: homeostasis, metabolism, anabolism, catabolism, autolysis, physiological functions, biological death, clinical death, cellular level

INTRODUCTION

One of the fundamental problems in biology and medicine is the study of the mechanisms by which matter loses its property of being alive. A living organism fundamentally differs from inanimate matter by its ability to exist as a system separated from the external environment, to self-regenerate, and to respond to external signals. To understand these differences, the organism should be considered as an open thermodynamic system.

Thermodynamic approach: Entropy and Negentropy. As noted by Erwin Schrödinger, a living organism exists by maintaining “negative entropy” (negentropy). A living organism absorbs energy from the environment (food, sunlight) and uses it to maintain ordered structures such as proteins and nucleic acids. This process represents a temporary resistance to the second law of thermodynamics. In contrast, in a dead organism, once the flow of energy ceases, disorder (entropy) increases sharply. The organism begins to move toward equilibrium, that is, chemical and thermal balance with the environment, ultimately leading to decomposition.

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Biochemical boundary: ATP and ion pumps. The most precise molecular indicator of life is the synthesis of adenosine triphosphate (ATP). In the living state, Na^+/K^+-ATPase pumps located in cell membranes expend energy to maintain the gradient of ion concentrations between the intracellular and extracellular environments. This gradient is essential for nerve impulse transmission and muscle contraction. After death, ATP synthesis ceases, leading to the failure of ion pumps. Sodium ions enter the cell uncontrollably, causing cellular swelling. Subsequently, lysosomal hydrolytic enzymes are released, initiating the process of autolysis (self-digestion).

Physiological integrity (Homeostasis). A living organism is an integrated system of interrelated subsystems (nervous, endocrine, and circulatory) functioning to maintain homeostasis. In a living organism, parameters such as body temperature, blood pressure, and pH are regulated within a very narrow range, a state referred to as "dynamic equilibrium." In a dead organism, this integration is lost. The organism ceases to function as a unified, regulated system and becomes merely a biological substrate. For example, postmortem cooling of the body (algor mortis) and the gravitational settling of blood in the lower parts of the body (livor mortis) indicate the loss of regulatory control.

Relevance of the Study

In modern medicine and biology, clearly defining the boundary between the concepts of "life" and "death" is of particular importance, especially in the fields of transplantology and resuscitation. Studying the mechanisms underlying the cessation of energy metabolism in cells and the initiation of irreversible processes contributes to a deeper understanding of the distinctive characteristics of living organisms.

Research Objective

The aim of this study is to conduct a comparative analysis of the processes that ensure the integrity of a living organism with the processes of decomposition (destruction) occurring in a dead organism, as well as to systematize the main distinguishing criteria between them.

Materials and Methods

The study employed biophysical and biochemical analytical methods, cytological observations, and data from forensic medical examinations. The energetic balance of a living organism was compared with postmortem changes such as body cooling (algor mortis) and muscle stiffening (rigor mortis).

Results

The main differences between a living and a dead organism are summarized in the table below:

Indicator	Living Organism	Dead Organism
Energy metabolism	ATP synthesis continues continuously.	ATP synthesis ceases, and energy reserves are depleted.
Metabolism	Balance of anabolism and catabolism (homeostasis).	Only catabolic and destructive processes (autolysis).
Information exchange	Neural and hormonal regulation is present.	Systemic regulation is lost.
Cell membrane	Selective permeability (ion pumps function).	Membrane permeability is disrupted; diffusion becomes uncontrolled.
Entropy	Low (the organism)maintains order).	High (the system tends toward disorder and decomposition).

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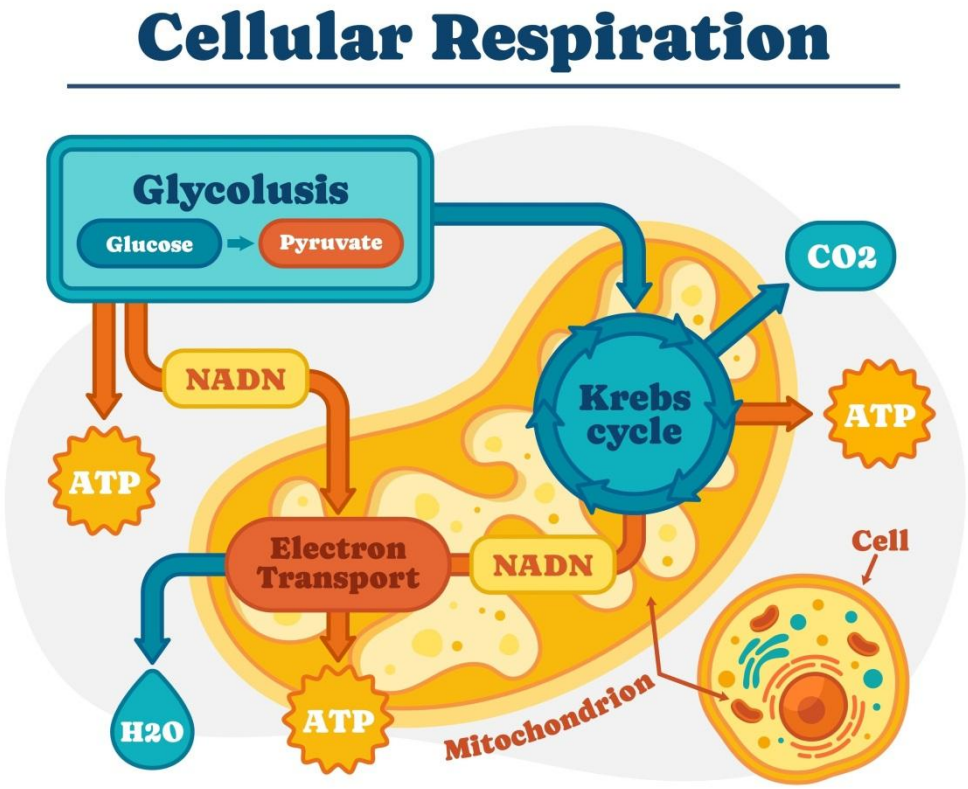

Main Biochemical Difference

In a living organism, energy is produced through the oxidation of glucose and is utilized to maintain the intracellular ionic balance. After death, membrane ion pumps (such as the Na^+/K^+ pump) cease to function. As a result, water enters the cell, enzymes are released, and the process of autolysis (self-digestion) begins.

Main Part

Body cooling (Algor mortis). After death, the human body no longer produces heat. Therefore, body temperature gradually decreases until it reaches the ambient temperature. On average, it drops by approximately 1–1.5°C per hour.

Rigor mortis. Several hours after death, the muscles become stiff. This process begins with the facial muscles and then spreads to the limbs. It usually disappears gradually after approximately 24–48 hours.

Livor mortis. Due to the cessation of blood circulation, blood accumulates in the lower parts of the body under the influence of gravity. As a result, bluish or purplish discolorations appear on the skin.

Desiccation. Certain parts of the body begin to dry out, such as the lips, the mucous membranes of the eyes, and areas of thin skin.

Putrefaction. Bacterial activity begins in the internal organs, leading to tissue decomposition and gas formation. As a result, abdominal swelling, the appearance of odor, and changes in skin color are observed.

After death, a number of postmortem changes occur that may create the appearance of structural alterations in the body. Due to the loss of muscle tone, the muscles relax, and the intervertebral discs are no longer compressed, allowing them to expand slightly; as a result, the

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body may appear 1–2 cm longer. At the same time, intestinal bacteria remain active and continue to decompose residual contents, producing gases that accumulate and cause the intestines to swell and appear elongated, as well as leading to noticeable abdominal bloating. The relaxation of muscles and ligaments also results in a looser positioning of internal organs, which may make them seem larger or longer. Overall, these apparent changes are primarily associated with muscle relaxation and gas formation rather than actual growth. In general, the differences between a living human organism and a deceased body are characterized not only by biological changes but also by profound biochemical and physiological transformations, as irreversible processes begin at the cellular level immediately after death.

Metabolism and Energy Exchange

In a living organism, homeostasis (stability of the internal environment) is maintained. In a living human, ATP (energy) is continuously synthesized in cells, and the processes of anabolism (synthesis) and catabolism (breakdown) remain in balance. In contrast, after death, all synthetic processes cease, and only degradation processes such as autolysis begin. Due to the failure of membrane ion pumps, the flow of calcium and other ions becomes disrupted.

Circulation and Respiration

In a living human, the heart continuously pumps blood to the organs, while the lungs enrich the blood with oxygen and remove carbon dioxide. After death, the cessation of cardiac activity leads to the termination of blood circulation. Under the influence of gravity, blood accumulates in the lower parts of the body, resulting in the formation of livor mortis. Due to oxygen deficiency (hypoxia) in tissues, cells rapidly die.

Muscle Condition (Rigor Mortis)

In a living individual, muscles are regulated by nerve impulses and maintain a certain level of tone. In a corpse, 2–4 hours after death, rigor mortis begins due to the depletion of ATP reserves in muscle cells. Muscle fibers become locked together, causing the body to stiffen. After approximately 36–48 hours, as tissue decomposition progresses, this stiffness gradually disappears.

Structural Changes in Organs

In a dead body, organs lose their vital functions and become objects of decomposition. The main differences are presented in the table below:

Organ	Living State	Postmortem State
Brain	Electrical impulses and continuous neuronal activity are present.	The fastest decomposing organ; neurons die within 5–6 minutes without oxygen.
Gastrointestinal system	Digestive enzymes break down food.	Enzymes and bacteria begin to digest the organ itself (autolysis).
Liver	Performs detoxification and stores glycogen.	Metabolism ceases; liver tissue softens and changes color.
Skin	Elastic, pink, and warm due to blood circulation.	Becomes pale, loses elasticity, and body temperature drops to ambient levels.

Microbiological Difference

In a living human, the immune system regulates and controls billions of bacteria present in the gut and on the skin. After death, the immune system ceases to function, allowing the microbiome (internal bacteria) to spread throughout the body, thereby accelerating the process of decomposition.

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From a Transplantation Perspective

In medicine, there are two key concepts: “living donor” and “cadaveric donor.” A living donor can donate a kidney or a portion of the liver, with the organ remaining fully functional. In contrast, organs from a cadaveric donor are suitable for transplantation only if they are retrieved before biological death, specifically in the state of brain death, when the heart and lungs are artificially maintained. If biological death occurs and blood circulation stops, the organs become unsuitable for transplantation within a few minutes.

Conclusion

The fundamental difference between a living and a dead organism lies in the presence of homeostasis and the ability to resist disorder (entropy) through continuous energy expenditure. A dead organism is no longer an integrated biological system but rather a biological material subject to decomposition under the influence of the external environment. The basis of life is the maintenance of membrane potential differences and continuous biochemical regeneration within cells.

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