

# OLD AGE, DEATH AND CONVENTIONAL AUTOPSY

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## ABSTRACT

This paper reviews only some aspects of old age, death and conventional autopsy.

Old age occurs when an individual's age nears or goes beyond the life expectancy of human beings. It is the final stage of the human life cycle which ultimately ends in death. During old age, the body loses the ability to utilize ATP effectively and this heralds the events which eventually truncate the life cycle.

Death occurs when a condition creates an enabling environment. This condition could be a pathology inside the body or it could also be an external factor that can cause an extensive shock to the body. Such a condition could be referred to as a cause of death. There are many causes of death around the world. Ideally, death occurs after old age which is a final stage in the human life cycle. However, there are situations whereby death could occur before old age. It is therefore apt to subject such deaths to an investigation. Investigations of such could be done through postmortem examination. Postmortem examination reveals the details of the cause of death.

An autopsy is a postmortem examination tool that can reveal the intricacies of a particular cause of death. According to published reports, the use of autopsy is declining however its relevance is still very high in these modern times.

Even though there are new imaging techniques that are very good, an autopsy may relatively prove to be the preferred choice due to availability, transparency and easy interpretation of results. In fact, without it, the truth behind a particular cause of death could be buried with the dead especially in places of limited resources. Owing to environmental and genetic factors, a particular cause of death may be common among one group of people than the other.

According to the report put together by the WHO, cardiovascular diseases top the list of the common causes of death around the world.

## INTRODUCTION

Death is a process that can truncate the human life cycle at any stage. Sometime, it could be subtle throughout the body until a very vital organ loses the ability to function. The victim might not perceive it in times that it presents in a very subtle manner. In this case, the organ stops functioning abruptly and when this happens, it could lead to other body parts not functioning and ultimately the whole body stops functioning. Usually, this is referred to as sudden death. Owing to the manner it occurs, it begs for investigation. The widely used postmortem investigation is autopsy. It is used to reveal minor lesions which are mostly suspects in sudden deaths. The minor lesions are involved in conditions that could start from any organ but when it starts from a vital organ the fatality is very high. Organs such as the heart, lungs and the brain are vital(1). In case a critical pathological condition or trauma occurs in any of them, it is more likely to make one susceptible to death. When this unfortunate event occurs, the only option is the prevention of death. Sometimes, the organ becomes damaged beyond recovery and the only option to prevent death is a complete replacement. However, the brain can not be replaced so any critical condition that affects it so badly may ultimately end in death. Hence, brain death is often regarded as a true definition of death which affects the entire body.

During the old age stage of the human life cycle, the aforementioned

vital organs become very weak due to the high rate of death of the neurons. For the human life cycle to advance, there must be an effective use of ATP. During old age, the effective use of ATP is impaired, therefore most organs in the body become weak. As a result, it becomes easier for the truncation of the cycle. A proper criterion of death in human beings is "the permanent cessation of the circulation of blood"(2). Proper circulation is mostly created by the proper functioning of the heart, the lungs, and the kidneys. The kidneys and the heart are interrelated so, the dysfunction in one affects the other, ultimately leading to the failure of both(3). The heart plays a key role in the circulation of blood, so the heart dysfunction may lead to irregular supply of oxygen and nutrients to body tissues, ultimately leading to death.

Also, because the heart plays a key role in the circulation of blood, dysfunction of it may lead to hypoxia resulting in the downregulation of Adenosine triphosphate (ATP) production. ATP is an energy-carrying molecule found in the cells of all living things. Adenosine triphosphate (ATP) is a universal mediator of metabolism and signaling across unicellular and multicellular species(4). The heart itself is an organ with high energy demands(5). Cessation of the circulation of blood leads to very low production of ATP. Low production of ATP amounts to the depletion of energy levels in the body. As a result, the whole body ends up in a low energy state. A low energy state is a hallmark of aging (6) (font size). This could be due to the weakening of the circulatory system during aging.

Indeed, factors in the circulation have been shown to modulate aging and to rejuvenate numerous organs, including the brain(7).

Just as it is important to know the right definition of death, it is equally important to know what causes it. Many causes of death have been reported but a few are very common and affect almost all the age groups and sexes. Findings from the Global Burden of Disease (GBD) Study shows that Cardiovascular diseases (CVDs) are by far the leading causes of death in the world and an estimated 17.92 million people died from CVDs in 2015. This finding may only point to the fact that these diseases are frequently concealed and discovered with surprise only at postmortem utilizing a thorough macroscopic and microscopic investigation(8). Also, CVD was thought of as a problem of the western world but has now found its way into the developing countries(9). These may be because the developing countries are fast embracing the western lifestyle. People of different ages and sexes die from CVDs. These include the elderly, young adults, children, and infants and accounts for most hospital visits. The younger population which forms the backbone of the economic development of every country accounts for the most deaths resulting from CVDs. Fortunately, most of these causes, which affect the younger population, could easily be prevented by simple lifestyle changes. Deaths that involve young people deserve an investigation to find the reason for the early demise. Autopsy, a very important method of postmortem investigation is declining according to reported literature due to certain reasons(10). However, the relevance of this investigation is very high and the most likely available tool in every major hospital. Though there are new imaging techniques such as Postmortem CT angiography which prove to be superior, an autopsy is still very relevant. Relatively, it remains the tool that may prove to provide maximum satisfaction for the concerned witnesses. Unlike the imaging techniques, artifacts found during the procedure could be seen clearly by the concerned witnesses.

## HUMAN LIFE CYCLE

To understand death, one must be able to know what life is about. Life is the ability of one to use (ATP) effectively to power the processes involved in the Human Life Cycle (HLC). The absence of this invites death which is a process that truncates the cycle. Given this, the organs that are crucial for the effective use of ATP are mostly involved in the common causes of death worldwide.

The human life cycle (HLC) includes the processes that travel from the intrauterine to old age. HLC involves many complex processes that are very important at each stage of the cycle. The main source of energy for the cycle is ATP which can be produced more when there is an availability of oxygen. This because many aspects of cell metabolism revolve around ATP production and consumption (11). The production of ATP is much greater in the presence of oxygen. This is because eukaryotic cells use oxygen for the production of biochemical energy in the form of adenosine triphosphate (ATP). Also, any condition that competes for or impairs the production and usage of ATP by the body cells nourishes the environment for death to set in. Therefore, conditions that affect the lungs and the heart are more likely to impair ATP production because of their

involvement in the distribution of oxygen throughout the body.

The following are the stages involved in the human life cycle; Intrauterine stage Infancy, Toddler, Childhood, Puberty, Adolescence, Adulthood, Middle age and old age which is the last stage of HLC. Each of these stages depends greatly on ATP to function properly. Also, the transition from one stage to another relies on the factors that affect the effective usage of ATP. The factors include the internal pathological factors which affect the normal physiology of the body such as diabetes, lung cancer, lung infection, etc. The external factors that cause the body to be in a state of shock. Examples of external factors are car accidents that cause excessive bleeding, drowning that causes impairment of oxygen usage, an animal bite which causes severe shock and so on.

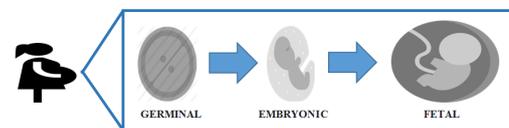


Figure 1: showing the intrauterine stage of human life.

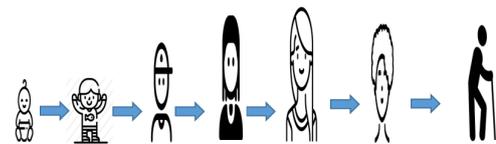


Figure 2: showing the stages of human life

## OVERVIEW OF OLD AGE

Old age is the final stage of the human life cycle which may be considered as a risk factor for many causes of death due to its debilitating effect.

From ancient literature to contemporary times, most authorities have located the beginning of old age around age sixty, although some thought it started around age forty(12). The above statement may be due to differences in life expectancy in different countries. In addition, old age may be influenced by environmental, economic and hormonal factors so numerical definition may not be entirely right. Thus, the time an individual from the same group of people born the same day reaches old age may be different from the others. Old age may rightly be defined by the time one begins to exhibit signs of old age-related changes with respect to common findings in the society in which an individual is found. Aging comes in different forms under the influence of factors such as Autonomy, Social ties and quality of life (13). In fact, education is a very good factor that could determine whether one enjoys a quality of old age or not(14). Old age is a process that starts from one organ and eventually affects the whole body. Usually, some of the signs are obvious and could be perceived by other people. Many internal and external changes characterize old age. Older people fail to adequately regulate food intake and they lose weight. Aging-associated changes in the regulation of appetite and the lack of hunger have been termed as the anorexia of aging(15). This may be a contributory factor to the holistic change during the old age.

Aging is a complex multifactorial process of molecular and cellular decline that affects tissue function over time, rendering organisms frail and susceptible to disease and death(16). Another sign of old age that could affect the health of an individual is sarcopenia. Sarcopenia is defined as age-related muscle loss, diagnosed using a combination of appendicular muscle mass, muscle strength, and physical performance measures(17). Sarcopenia could be a sign that death is approaching as this is characterized by weaker grip strength and slower gait speed with an increased mortality rate(18). This could be caused by the weakening of the various body systems which usually form part of the processes which occur during the old age. The pathophysiology of sarcopenia is multifactorial, with decreased caloric intake, muscle fiber denervation, intracellular oxidative stress, hormonal decline, and enhanced myostatin signaling all thought to contribute(19). Furthermore, although old age progresses to death, death can as well occurs during any stage of the HLC. As such, death may be defined as a process that ends the life cycle of a human being or any other living organism. However, the clinical definition of death may be more difficult and different entirely from the definition above. Hard as it is to define death in the clinical sense, it may be appropriate to define it as an event that truncates the HLC at any stage.

## OVERVIEW OF DEATH

Perhaps, death is the hardest puzzle that is yet to be solved by mankind. The definition of death is as hard as death itself. It is argued that it is more ethical to allow people to choose either cessation of cardio-respiratory function or loss of entire brain function as the definition of death based on their views(20). Usually, in medical practice, brainstem death is used to diagnose death. The brainstem is a critical structure that regulates vital autonomic functions, houses the cranial nerves and their nuclei, relays motor and sensory information between the brain and spinal cord, and modulates cognition, mood, and emotions(21). Given this, the brainstem criteria seem to be apt however there is also the tendency of confusion among the medical practitioners and the lay community.

There are many causes of death but there are a few causes that have been reported more frequently than others. Causes of death may vary from one geographic area to another. This may be due to the lifestyle, economic activity or status of the people in that particular area. Besides, environmental factors in the area may play a role as to why the people in a particular locality commonly die from a certain type of condition. Therefore, in the determination of the causes of death, all factors such as nutrition, environment, medical care, injury, and diseases need to be considered(22).

Results of postmortem analysis combined with the comprehensive history of the deceased could help in the education of the general public about healthy lifestyles. Postmortem analysis could be very helpful especially in cases involving Cardiovascular disease which is currently the commonest cause of death worldwide(23).

Again, according to the World Health Organization, cardiovascular disease (CVD) remains the leading cause of death worldwide, accounting for approximately 18 million deaths per year(24).

The top 10 includes the following; ischaemic heart disease, stroke,

lower respiratory infections, COPD, tracheal and bronchial cancers, diabetes mellitus, lung, alzheimer's disease and other dementia conditions, diarrheal diseases, tuberculosis, road injury.

The incidence of the above causes of death may vary from one country to another due to factors such as environmental conditions, the lifestyle of the people, economic conditions, and so on. Cardiovascular diseases remain the first killer in Western countries(25) font size. Even though cardiovascular diseases remain the first killer in Western countries, the amount of cardiovascular disease is also increasing in developing countries together with economic growth(26). This may be the fact that economic factor plays a significant role in the development of cardiovascular diseases. This is due to the increasing urbanization and the aging population among the developing countries(27).

## OVERVIEW OF DEATH

Every death deserves an investigation to obtain any information about the cause. Ideally when one dies, the next is to subject the body to postmortem examination. When this is done, patterns of a particular pathology

or injury could be studied and saved as a guide for public information. As some clinicians are more likely to miss the cause of death, it is important to subject every death to a postmortem examination. An autopsy is a very important tool that can detect lesions that could not be detected by other tools used in clinical investigation. At any stage of the human life cycle where that death occurs, an autopsy could be used to detect the cause. Many health care providers believe that autopsy is no longer relevant in the high-technology medicine era, hence the decline in the hospital autopsy rate(28). Autopsy includes a detailed external examination as well as dissection of organs from the different body cavities – cranial, thoracic, abdominal and pelvic. The procedure is performed by using a scale, rulers, autopsy saw, scalpels, biopsy needles, camera, etc. An autopsy is a very valuable tool but the use of it is on the decline worldwide(29). There is even a much more decline in the use of it in the investigation of the causes of death among neonates(30). Even though there are new imaging techniques such as Postmortem CT angiography which prove to be superior, an autopsy is still very relevant. It is relatively cheaper and could be performed in almost every major hospital in the world. Unlike the imaging techniques, the results of the autopsy could easily be interpreted. It is easier for the witnesses of the procedure to understand and accept the results. Usually, what is considered as premature death or death with suspicion of foul play is the one that is subjected to a postmortem examination. While this is a good practice, it is also good to subject every single known death to postmortem examination as this could go a long way to strengthen the health system and also public security.

## DISCUSSION

Perhaps, the societal definition of old age is difficult because humans live in different environments and therefore face different conditions brought about by these environments. Chronological age used by society to determine whether one has reached an old age may not be appropriate because there could be people who are chronologically perceived to have reached old age but are

healthier than those who are considered to be chronologically younger. Sometimes, factors like pathology, hunger and harsh environmental conditions may make one who is chronologically young to exhibit physical features of old age. Again, individuals of the same chronological age may not phenotypically reach old age at the same time. Hence the biological definition of old age may be more appropriate by considering factors such as the environment, economic situation, culture and social influence than just using a numerical value. Also, one may argue that, given the commonality in the appearance of the phenotypic features with that of the chronological age, it is still better the society sticks with the later which has stood the test of time. One lives long to reach far in the Human Life Cycle. Every stage of the cycle has its phenotypic features, which many times seems to correlate with the societally accepted chronological age.

Aging may be defined as a multifactorial biological process that involves an accumulation of physical and psychological changes as one goes through the Human Life Cycle. Aging affects most of the tissues and organs of the body.

Aging is a process that ultimately leads to death.

Death may be very excruciating especially when the deceased has not reached the last stage of the Human Life Cycle (HLC). These deaths which are not in the last stage of the HLC could be referred to as premature death. Premature deaths could be caused by many factors such as diseases, accidents, homicide, and suicide. In cases where these factors affect the organs which are very crucial in powering the body to produce and utilize ATP effectively, the only likely expectation is death. As a result, caregivers work around the clock to prevent death.

Eventually, when the organ stops functioning, death begins to ensue. To prevent premature death in the case of a young patient or suspend death in an older patient, caregivers and relatives may search for the options available.

Thankfully, organ transplantation has evolved and could be used to postpone death in patients with completely damaged vital organs. Postponement of death only means the continuous use of ATP by the body.

Continuous use of ATP by the body relies on the fact that the organ involved can power that process. It becomes very imperative if the organ involved is crucial in the effective production and usage of ATP. So far, out of the three crucial organs, only the heart and the lung could be transplanted successfully either from a deceased or a living being.

There are numerous causes of death worldwide which are attributable to various diseases, homicide, accidents, and suicide induced injuries. There are many causes of death according to research by the WHO. Cardiovascular disease is the number one cause of death worldwide. The cardiovascular system plays a crucial role in the distribution of oxygen and other important substances throughout the body. In view of this, any condition that affects the physiology of this system negatively creates an enabling environment for death to set in.

Ordinarily, the causes of death could be determined by the use

of conventional autopsy. New methods like a minimally invasive autopsy for some reasons such as preservation of the corpse for a funeral ceremony. Though conventional autopsy and minimally invasive autopsy have a similar strength of performance, the later has a higher yield of diagnosis according to literature by © RSNA, 2018. Most of the minimally invasive methods are imaging techniques. Though the imaging methods are increasingly progressing, the conventional autopsy has remained a basic and essential diagnostic tool in forensic medicine(31).

Autopsy also acts as a tool that links forensic medicine to pathology. It provides new information for clinical medicine and further research. Even though an autopsy is a very good tool, it is affected negatively by societal misconceptions that stem from culture and religious beliefs. In addition, a negative attitude toward autopsy could also be due to a lack of knowledge and misinformation.

Evidence suggests that new information is obtained from autopsies, therefore it will be a grave disservice to medicine if social and cultural misconceptions succeed in erasing the existence of them.

## Conclusion

Death, however excruciating it may be, is an inevitable process that occurs to truncate the human life cycle when the processes involved in the production or usage of ATP stops. Usually, it occurs at the end of old age but it could also occur in any event which deprives the body of producing and using ATP effectively. These events may occur at any stage of the human life cycle. The result of ATP deprivation is a low energy state which may eventually lead to death. When it occurs in any of the stages of HLC other than old age, it's mostly referred to as premature death. Owing to environmental and genetic factors, a particular cause of death may be common among one group of people than the other.

Autopsy which is one of the methodologies of postmortem investigation is still very relevant and can reveal the intricacies of how the impairment or cessation of ATP usage occurred. It helps to inform proper public health policy formulation. Usually, when premature death occurs, an autopsy is used to ascertain the intricacies of the cause of death.

Old age, although inevitably ends in death, it is important to subject bodies from such deaths to autopsy to find pathological patterns which may be novel for studies.

Though there are new methodologies that prove to be superior in the practice of postmortem examination, autopsy proves to be the likely preferred choice because it is cheaper and the results could easily be accepted by all those concerned.

There are many causes of death worldwide but some have been found to very common. Data from the WHO show that cardiovascular disease is the number one cause of death worldwide. Though cardiovascular disease used to be more common among developed countries while the less developed countries recorded a lower number of cases, recent research shows that cases are rising in the less developed countries.

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