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# Effect of aging on heart and ileum histology of male albino rats

**Maisa "Mohammad Amin" Al-Qudah**

*Department of Allied Medical Sciences , Zarka University College , Al-Balqa Applied University, Jordan*

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**ABSTRACT**

*Aging is considered a natural process that presents various alterations in behavioral ,physiological and neurochemical processes. The aim of this study was to evaluate the effect of aging on the histology of the ileum and heart of albino rats. Fifteen male albino rats were used. Group **A** included 5 rats of 2 months and groups **B** and **C** included 5 animals each and were continued to live up to the age of 6 and 12 months, respectively. At time of sacrifice all the animals were weighted , anaesthetized , then the ileum and heart were dissected out and specimens were processed for histological examination. Normal histological structure of heart and ileum were recorded in rats aged 2 months. The most prominent histological changes in heart of 6 and 12 months aged rats were congestion in coronary vein in comparison with congestion in the blood vessels in the ileum of rats with the same age which reached all layers of ileum in addition to disintegration of muscle fibers in muscularis. In conclusion, the results of the current study revealed that age related histological changes involved the heart and ileum , and at age 12 months the histological changes were more and obvious.*

**Keywords:** aging , histology , rats , heart , ileum

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## INTRODUCTION

Aging is the natural phenomenon, which is the process of growing old and is usually defined as the gradual biological impairment of normal function which has direct impact on the functional ability of organs and on the biological systems. These irreversible series of changes inevitably end in death. Evidence shows that physiological brain senescence, including declining cognitive and motor skills, is a significant socioeconomic problem that affects life quality of aged people (Hedden et al , 2004). Phenomenon of aging leads to changes in the brain size, vasculature, and cognition, therefore as age increases the brain shrinks and changes occur from the level of molecules to morphology (Peters , 2006 ; Dorko et al , 2009 ).

Dysfunctions of the gastrointestinal (GI) system, including dysphagia, constipation, diarrhea, and irritable bowel syndrome are more common complaints of the elderly ( Wade, 2002) . It was estimated that certain changes occur in the gastrointestinal structure and function such as reduction in gastric emptying time, and of both frequency and amplitude of the peristaltic wave in old age (Cowen, 2000 ; Sixabela et al , 2011 ; Iribhogbe et al , 2011 ) **.** The functional impairments of the aging gut suggest that particular subpopulations of myenteric neurons may be more vulnerable than others. Loss of motility may involve intrinsic excitatory cholinergic neurons (Cowen ,2000 ; Mohamed et al , 2009 ; Iweala and Obidoa, 2010 ; Iweala et al , 2011 ) .

Some researchers believe that aging is mainly a condition of insulin-like growth factors deficiency, in which mitochondrial dysfunction is one of the most relevant endpoint as an intracellular source of free radicals perpetuating oxidative cellular damage and causing ATP depletion (Melling and Nylen, 1996 ; Garcia-Fernandez et al, 2008 ; Puche et al, 2008 ; Castilla-Cortazar et al, 2011). Reports have shown that various cognitive performances

declined in aging that include processing speed ( Salthouse , 1996 ) and episodic memory (Backman et al, 2000). Declining cognitive functions in aging is a complex process that starts to become obvious during middle age in humans (35–65 years old) and rats (12–24 months old) even in the absence of any neurodegenerative disease (Kluger et al, 1997 ; Cox et al, 2008). This study was carried out to evaluate the effect of aging on the histology of the ileum and heart of male albino rats.

## MATERIALS AND METHODS

Fifteen healthy male albino rats, were obtained and housed in the Animal House of Department of Histological Sciences-Faculty of Medicine, University of Jordan, during January-October 2011 . The experiment was planned to last for 10 months. Rats were allowed the Ad libitum (AL) diet regime and subdivided into:

***Group A:*** Included 5 animals at the age of 2 months .
***Group B:*** Included 5 animals , which were continued to live to the age of 6 months.
***Group C:*** Included 5 animals , which were continued to live to the age of 12 months.

The animals were caged separately in plastic cages with open access to tap water and cubes of standard rodent diet during the whole session of experiments. The room temperature was maintained at 23 ± 2 °C. Before starting each experimental session, rats were accustomed to various handling procedures in order to avoid any stress effect. The familiarization was performed in order to nullify the psychological affliction of the environment. Also, rats body weight was recorded . The study was approved by the Institutional Review Board of the University of Jordan.

At the end of the experiment, the animals were sacrificed at the appropriate age . major organs such as ileum and heart were immediately taken from each animal . Small pieces of the ileum and heart were fixed in 10% formalin and processed using a standard histological procedure. Sections of 5 µm. thickness were stained with hematoxyline and eosin. The tissue sections were then evaluated for histological changes under Zewiss compound light microscope and photomicrographs were taken using Kodak digital camera 10.3 mega pixels .

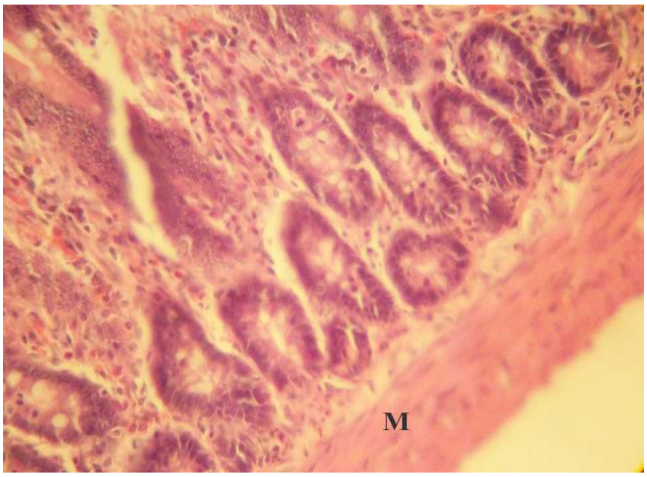


**Figure 1: Transverse section of ileum of rat aged 2 months. M: muscularis mucosa. 400X. (H&E stain)**

## RESULTS

The mean weight of the rats increased gradually from 115 ± 10 g at the age of 2 month to 260 ± 15 g at the age of 6 months and to 360 ± 20 g at the age of 12 months .

Light microscopic examination of the ileum rats at the age of 2 months stained by H&E showed the classical normal histological structure of ileum (Fig. 1 & 2). On the other hand , sever inflammation was recorded in submucosa in rats aged 6 months (Fig. 3). At age 12 months the histological changes were recorded in all layers of the ileum. The muscle fibers in muscularis were not compact to each other in different areas indicating a disintegration condition there as shown in (Fig. 4). In sub mucosa apparent increase in blood vessels was recorded (Fig. 5) and sever congestion in the blood vessels was also seen (Fig. 6).

Normal histological structure of heart was recorded in rats aged 2 months (Fig. 7 & 8). The histological changes began later on and congestion in coronary vein in the heart of rats aged 6 months was obvious as shown in (Fig.9) as well as in rats of 12 months age (Fig.10). Also, congestion in blood vessels (Fig. 11) was a prominent change at12 months age .

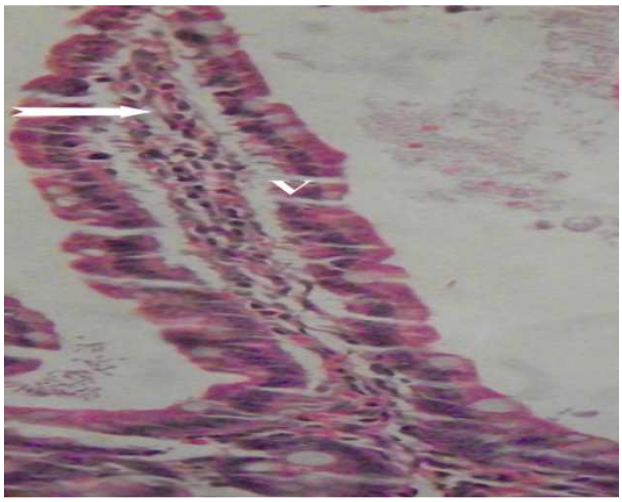


**Figure 2: Transverse section of ileum of rat aged 2 months. V: villus, → the core of the villus. 400X. (H&E stain)**

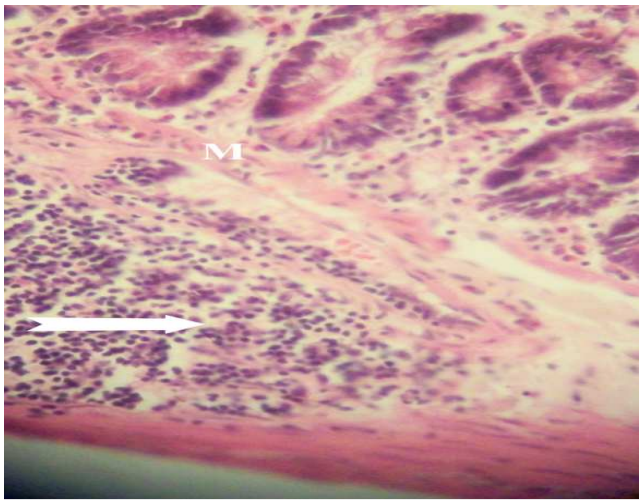


**Figure 3: Transverse section of ileum of rat aged 6 months. → sever inflamatinon in submucosa. Note the prescnce of muscularis mucosa (M) 400X. (H&E stain).**

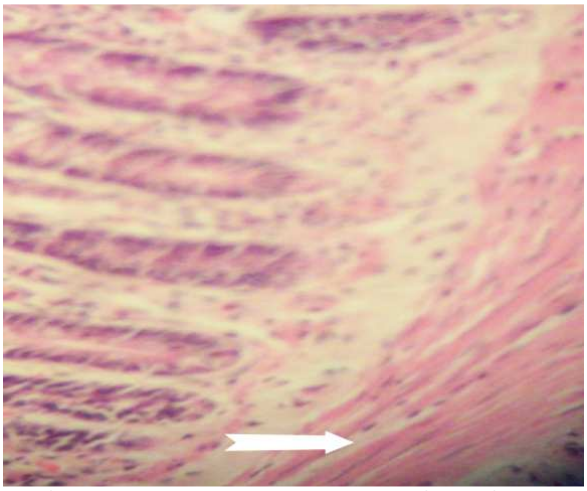

**Figure 4: Transverse section of ileum of rat aged 12 months. → smooth muscle fibers of muscularis externa showed disintegration. 400X. (H&E stain).**

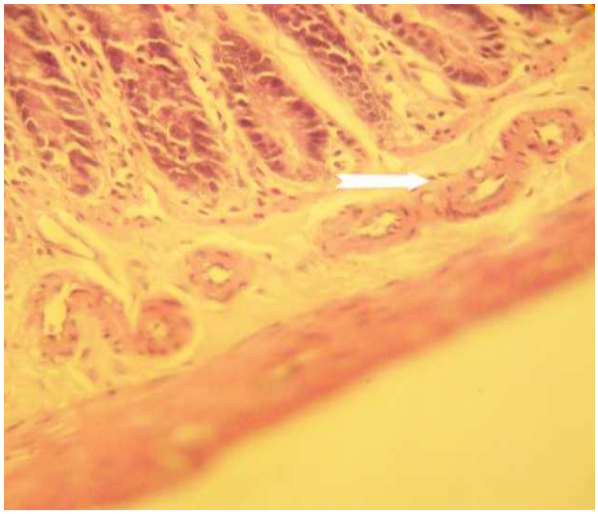

**Figure 5: Transverse section of ileum of rat aged 12 months. →apparent increase in blood vessels in submucosa. 400X. (H&E stain).**

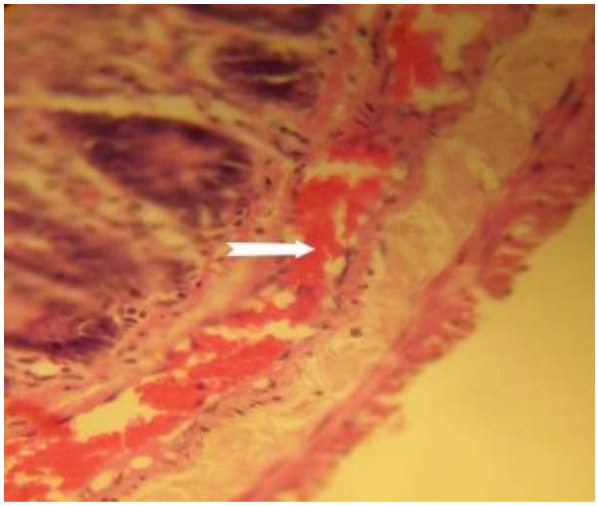

**Figure 6: Transverse section of ileum of rat aged 12 months. → sever congestion in the blood vessels. 400X. (H&E stain).**

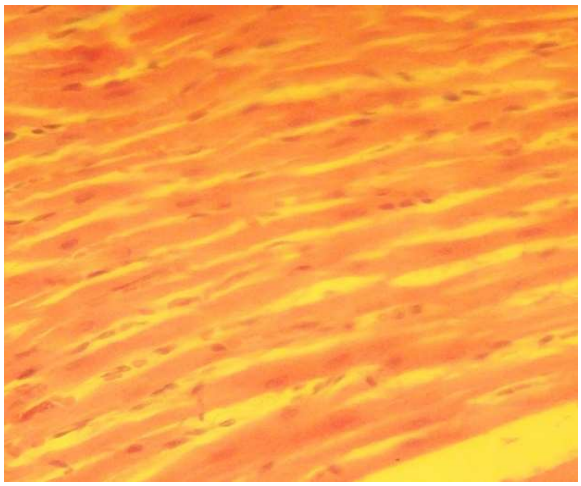

**Figure 7: Longitudinal section of heart of rat aged 2 months. Normal histological structure of cardiac muscle. 400X. (H&E stain)**

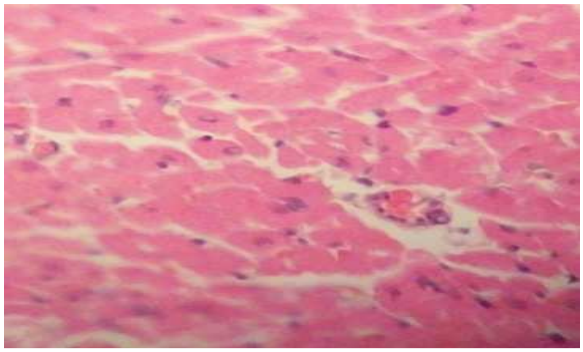

**Figure 8: Transverse section of heart of rat aged 2 months. Normal histological structure of cardiac muscle. 400X. (H&E stain)**

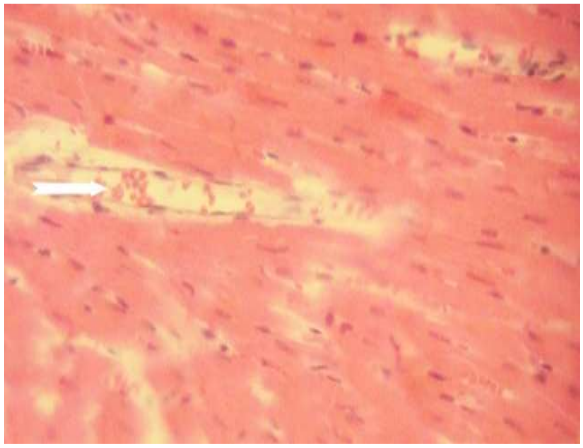

**Figure 9: Longitudinal section of heart of rat aged 6 months. → congestion in coronary vein. 400X. (H&E stain)**

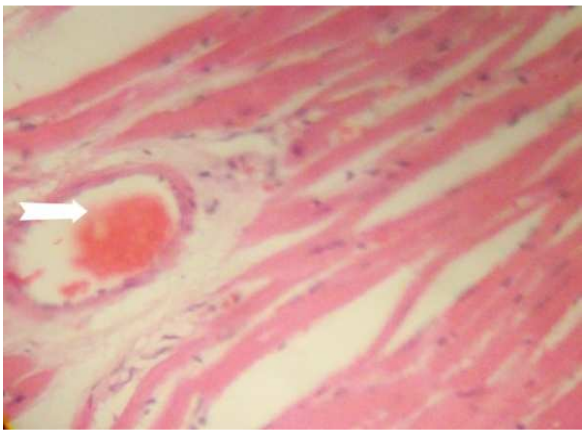

**Figure 10: Longitudinal section of heart of rat aged 12 months. → congestion of coronary vessel . 400X. (H&E stain)**

## DISCUSSION

Aging is one of the major aspects of human life and has both positive and negative effects on functional abilities of the human being as well as animals. Aging is a process that presents various alterations in behavioral , physiological, and neurochemical processes (Hedden et al, 2004 ; Peters , 2006 ; Stevens and Lowe ,2005). With aging a number of processes are affected such as memory, learning and other cognitive abilities such as; thought process, abilities to activate and focus attention. It is also reported that cognitive impairment in rodents, like other species is a consequence of advancing chronological age. Various reports have shown that as compared to young rats, aged rats perform worse on a broad range of learning and memory tasks (Okuda et al, 2004 ; Peremans et al, 2002 ; Barnes , 1990). A recent study show that aged rats exhibited a significant impairment of long-term memory. While cognitive ability was also impaired in aged rats (Haider et al, 2011).

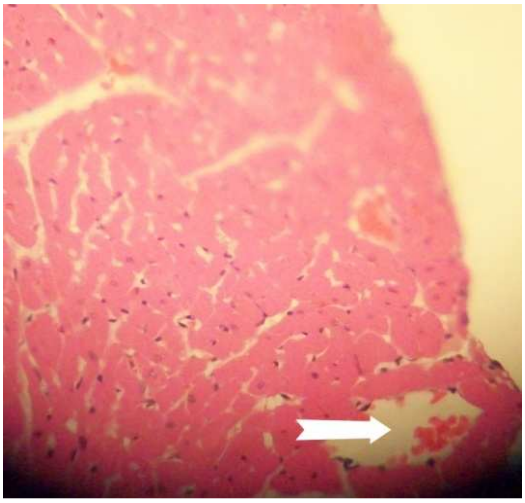

**Figure 11: Transverse section of heart of rat aged 12 months. → congestion of blood vessel . 400X. (H&E stain)**

The aging process results in an accelerated decline of functional capacity, but the mechanisms behind this decline are unclear (Persson , 2002). The free radical theory of aging proposes that mitochondrial production of reactive oxygen species causes an increase in cellular damage with age (Harman, 1998 ). This theory has gained strong support because it is consistent with many of the processes and degenerative diseases observed with aging (Harman, 1998 ; Julian and Leeuwenburgh , 2004).

The most evident and well-understood age-related effects on skeletal muscle and heart are loss of muscle mass (or sarcopenia) and a significant hypertrophy, respectively (Cheitlin, 2003 ; Narici et al, 2004 ; Ridzwan et al, 2002). On the other hand, there are few studies concerning the effects of aging on intestinal smooth muscle, despite recurring complaints of gastrointestinal motility disorders and chronic functional constipation by elderly people ( Holt, 2003 ). Most studies focus mainly on the dysfunctions of intestinal mucosa absorption ( Drozdowski et al, 2005 ; Woudstra and Thomson, 2002 ). Deleterious effects of aging on human, guinea pig, rat, and mouse intestine have been associated with specific loss of cholinergic neurons from the myentheric plexus, leading to impaired motility and muscular layer thickening ( Lofgren et al, 2002 ; Rosa et al, 2005) .

Studies in aged rodent models have shown that left ventricular mass increases and individual ventricular myocytes are hypertrophied across various species. The total number of ventricular myocytes decreases with age in the rat heart, likely as a result of an increase in necrotic and apoptotic cell death. Contractile function also appears to change with age in animal models (Hacker et al, 2006 ; Dibb et al, 2004 ; Fares and Howlett, 2009) .

A number of studies in rats and mice have examined the changes in the morphology of the small intestine with advancing age. Hohn et al, (1978) observed that, in 30 month old rats, the mucosa of the duodenum and jejunum appeared atrophic compared with the same area of the small intestine in 4 month old rats. Villi height was approximately 20% - 25% lower in the older rats compared with their younger counterparts. However, no age-related changes were observed in the ileum. In addition, they observed lower acid and alkaline phosphatase in aged than young rats, which they attributed to a reduction in enterocytes associated with atrophy in the older rats . In contrast, Moog (1977 ) observed taller villi in the small intestine from 2 year old than 6 month old mice, but found similar alkaline phosphatase-, maltase-, and sucrase-specific activities in both age groups. However, since the total intestinal weight in the older mice was greater than in young animals, total enzyme activity was calculated to be higher in the older mice (Majumdar et al, 1997). In their study, Raul et al, (1988 ) observed that small intestinal mass and protein content were higher in 29 month old rats than in their 3 and 12 month-old counterparts. In addition, villus height in the duodenum, jejunum, and proximal ileum were significantly lower in 12 and 29 month old rats than in 3 month old animals, whereas in the distal ileum they were found to increase with advancing age. In addition, specific activities of intestinal disaccharidases and aminopeptidase were also found to be higher in aged than in young rats , which could partly be due to altered cellular maturation along the villi in the proximal small intestine.

Other study by Holt et al, (1985) observed a decrease in small intestinal hydrolases in 27 month old rats compared with 4 to 5 month-old rats, and have attributed this to an increase in the proportion of relatively undifferentiated villus epithelial cells in the older animals, which translated into delayed enzyme expression. Such delayed enzyme expression could lead to impaired nutrient absorption with aging, independent of any age-related structural changes.

Further, studies by Holt and Yeh, (1989 ) found that crypt cell proliferation rates in all segments of the small intestine were greater in 26 to 28 month old rats compared with their 4 to 5 month-old counterparts, and suggested that this increase in cell production resulted from a greater number of crypt cells undergoing cell division.

## CONCLUSION

Aging has a significant effect on histological structures of heart and ileum as well as on both behavioral and neurochemical aspects of life. From the current study it is concluded that , as age advances in rats, a significant histological changes involved the heart and ileum and at age 12 months the histological changes were more and obvious.

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