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WATER AND SALT METABOLISM IN THE GERIATRIC SYNDROMES

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SUMMARY:
Geriatrics has already described four syndromes of its own: confusional syndrome, incontinence (fecal and/or urinary), and gait disorders and immobility syndrome, naming them geriatric giants. This name reflects their prevalence and great importance in the elderly. Ageing process induces many changes in renal physiology such as a reduction in glomerular filtration rate (senile hyponatremia), and water and sodium reabsorbtion capability. Besides, there are particular water and salt metabolism alteration characteristics of the geriatric syndromes, such as dehydration and hypernatremia in psychiatric disturbances as well as hyponatremia in patients suffering from immobility syndrome. The geriatric giants and nephrogeriatric physiology changes, are a good example of feed-back between geriatric syndromes, clinical entities characteristics in the elderly that predispose and potentiate each other, leading to catastrophic clinical events.

Key words: Geriatric syndrome. Water. Salt

RESUMEN

PALABRAS CLAVE: Síndrome geriátrico. Agua. Sal

INTRODUCTION

Geriatrics has already described four entities of its own: confusional syndrome, incontinence (fecal and/or urinary), gait disorders and immobility syndrome, naming this geriatric syndromes as geriatric giants[1-5]. This name reflects their prevalence

and great importance in the elderly. These geriatric giants can appear as acute events or as an exacerbation of their already existing state, being often the only clinical expression of various diseases such as pneumonia, urinary infection, cardiac infarction, etc. When the previously mentioned entities appear in young people they suffer from symptoms such as fever, cough, dysuria, chest pain, etc, while when these diseases appear in old people there could be a lack of those symptoms. This situation has led to the missconception that illnesses in the elderly are oligosyntomatic when in fact their symptomatology is a very rich one but different compared to the one presented in young people[6].

Ageing process induces many changes in renal physiology which predispose old people to develop salt and water alterations. These changes consist of a reduction in glomerular filtration rate (named as senile hypofiltration), and a diminution in water and sodium reabsorbtion capability[7]. In the present review we are going to describe each of these physiological changes and their particular characteristics in the geriatric syndromes

1.- Water and salt metabolism in the elderly

Three are the main renal physiological changes which modify water and salt metabolism in the elderly [7]. As follows each of these modifications are described:

- **Decrease in glomerular filtration (senile hypofiltration)**
  In senile glomerulosclerosis, the glomeruli are replaced by fibrous tissue (glomerular obsolescence), a process that begins at approximately 30 years of age, and is present in between 1% and 30% of persons aged 50 years or older. Measurement of the glomerular filtration rate (GFR) with 51Cr EDTA confirms that the healthy elderly have a lower GFR than the young. At the third decade of life, GFR peaks at approximately 140 ml/min/ 1.73 m2, and from then on, GFR progressively declines at an approximate rate of 8 ml/min / 1.73 m2 per decade. A similar fall in creatinine clearance (Ccr) is accompanied by a concomitant decrease in creatinine production (senile sarcopenia), and consequently serum creatinine does not increase with the progressive decrease in GFR[8-10]. As clinical consequences of senile hypofiltration old people is predisposed to develop lung congestion or hyponatremia after they receive a saline or a water load respectively[10].
- **Reduced sodium reabsorption**
  The thick ascending loop of Henle sodium reabsorption is reduced in the old people compared with the young. This phenomenon has two important consequences: first, the amount of sodium loss is increased; and second, sodium interstitial concentration is reduced. The latter phenomenon leads to medulla hypotonicity which reduces the renal capacity of concentrating the urine. Thus, old subjects exhibit both an increased sodium excretion and an inability to maximally concentrate the urine (water saving). The basal plasma concentrations of renin and aldosterone and the response to their stimuli are diminished in old age, which is another mechanism of enhanced sodium loss in this population. As clinical consequences, when for therapeutic reasons or reduced appetite, salt restricted elderly can develop hyponatremia (senile sodium leakage hyponatremia), volume depletion (hypotension, hypernatremia) and even acute renal failure[10-13].
- **Altered water handling by the kidney**
  As was mentioned before medulla hypotonicity predisposes old people to reduce their water reabsorption capability. Dryness of the mouth, a decrease of taste, alteration in mental capacity or cortical cerebral dysfunction, and a reduction in the sensitivity of both osmoreceptors and baroreceptors all may contribute to this senile increased threshold for thirst. Besides, concentration of angiotensin, a powerful generator of thirst, is lower in the elderly. Urinary dilution capability is also decreased. Thus, there is a minimum urine concentration of only 92 mOsmol/kg in the elderly compared to 52 mOsmol/kg in the young. Maximum free water clearance also is reduced in the elderly from 16.2 ml/min to 5.9 ml/min. Again, the functional impairment of the diluting segment of the thick ascending limb, described above, seems to account for the decrease in the capacity to dilute urine observed in the aged. As clinical consequences elderly people may develop dehydration (hypernatremia) or volume overload (hyponatremia) under conditions of water restriction or water load respectively [10-11, 14-15].

2.- Salt and water metabolism in the Geriatric Syndromes

- **Psychiatric disturbances**
  In elderly untreated patients with psychiatric pathological changes, an alteration of the intracellular, extracellular, and total body water has been found[16]. Deterioration of verbal learning is associated with an increase in body water, intracellular and extracellular fluid, and exchangeable sodium and potassium in relation to dry body weight. The diminution in verbal ability was associated with a shift of water from the extracellular to the intracellular compartments and diminution of the interchangeable sodium in relation to lean body weight. In addition to this, there may be effects of lithium or other drugs on water and electrolyte handling. The importance of checking plasma electrolytes and urea in elderly confused individuals is mandatory. In spite of this, we did not find significantly different water metabolism in a group of demented elderly patients, although results showed a tendency towards higher body water in the group with dementia[17].

  Since hyponatremia is an electrolyte disorder which can be induced by body salt reduction, urinary sodium loss is normally increased in the aged population, and dependent demented patients are usually nourished by tube feeding solutions which are low in sodium content, they can develop a sort of hyponatremia secondary to sodium loss known as senile sodium leakage hyponatremia[13].

- **Immobility syndrome**
  The immobility syndrome (IS) consists of a reduction in the capability to perform daily activities due to a motor function deterioration that leads to characteristic body structural and physiological changes. The prevalence of this syndrome is

linked to people longevity and their environment. In non institutionalized people older than 64 years of age, the immobility prevalence is around 12% while in those older than 79 years it is about 27 %. Moreover, in the institutionalized old people the IS reaches 30 % of prevalence[18].

Among the body physiology alterations described in people suffering from the IS there are: reduced muscle mass and strength, joint contractures, diminished lung tidal volumes and maximal breathing capacity, decline cardiac output, ortostatism, capillary leak, increased daily nitrogen loss, hypercalciuria, lower bowel peristaltism, and decreased intellectual capacity[18-19].

It was found a reduced glomerular filtration rate as shown by the lower creatinine clearance in the IS group. Since this reduced glomerular filtration ran with a low fractional excretion of sodium, it supports the hypothesis of a pre-renal state that could be explained by the afore mentioned reduced cardiac out-put and capillary leak that immobile people usually present.

It was documented a trend to free water retention status in the IS group as shown by the increased body water content and lower plasma sodium and osmolality that was in the immobile group. Even though plasma vasopressin was not significantly different between the groups, it was found that the IS group had a relatively higher vasopressin level regarding its serum osmolality level, enabling this hormonal excess to explain the free water retention state found in this group. It could be hypothesized that the above mentioned pre-renal state could induce the documented vasopressin hormone relative excess found in the immobile old people[20].

- **Interdependency between the geriatric syndromes and the senile renal functional changes**
  The geriatric syndromes (geriatric giant) and the senile renal function changes (nephrogeriatric physiology) are clinical entities characteristics in the elderly that predispose and potentiate each other, leading to catastrophic events. Two examples based on clinical cases may clarify this concept[21]:

  An old person develops urosepsis and because of that he develops a confusional syndrome. The accompanying fever, lead him to lose water and also to reduce his water intake because of his confusion. Since old people have an already reduced water reabsobtion ability, he develops severe dehydration and hypernatremia that worsen the confusional state giving place to a catastrophic clinical event. This case represents an example of a geriatric giant (confusional syndrome) that is worsened by a nephrogeriatric physiology characteristic (reduced water reabsorbtion capacity).

  Also, a nephrogeriatric physiology can potentiate a geriatric syndrome leading to a catastrophic clinical event. Thus, an old person under the effect of a very hot weather loses water (via sweating), and since old people suffer hypodipsia and a low salt and water reabsorbtion capacity, this patient develops hypotension that causes dizziness, and an altered gait and fall. This situation worsens his salt and water intake leading him further to a severe volume contraction and acute renal failure. This is an example of a nephrogeriatric physiology characteristic (reduced water intake and reabsorbtion) that is worsened by a geriatric giant (fall).

Both cases described above are an example of what is named the feed-back between geriatric syndromes. The roots of this phenomenon are in the ageing process, since it consist of loss of complexity. An organism is a system that is constituted by other small ones (cardiovascular, respiratory, etc) which are named microsystem since they comform a bigger one: the organism or macrosystem. Then, complexity means all this microsystems working harmoniously. An organism functions due to a coordination among their multiple microsystems. This coordination of systems or complexity makes the organism flexible and capable to overcome enviromental changes. The senescence process weakens these microsystems and their coordination between them undermining complexity and making the person frail. They function normally under basal conditions but they can not handle extreme enviromental changes, and therefore otherwise insignificant event such as a hot weather or a urinary tract infection can lead an old people to severe compromise or death[22-24]. Good strategies to avoid or minimize clinical catastrophic events in the elderly are: rehabilitation of deteriorated functions (gait rehabilitation, etc), avoidance of risky situations (exposition to hot weather, etc), close observation for diagnosis of early problems and their treatment[6].

CONCLUSION:

Since there is a tight relationship between geriatric syndromes and aged renal physiology changes, geriatrician should handle this information for having an adequate management of their aged patients.

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Se trata de una revisión narrativa que analiza la relación entre los muy frecuentes síndromes geriátricos: confusional, de incontinencia, alteraciones en la deambulación y síndrome de inmovilidad; con los cambios en la fisiología renal de los ancianos que determinan trastornos del metabolismo del agua/sodio, implicados en la génesis de dichos síndromes.

La información obtenida del estudio es clara, descriptiva y oportuna para el planteamiento de la comprensión y manejo de determinados aspectos en dichas situaciones.

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En nuestro medio con un porcentaje cada vez mayor de pacientes mayores que acuden a la consulta de Atención Primaria, tiene una gran importancia el conocimiento exhaustivo de los cambios de la fisiologia renal asociados a la edad.

En estos pacientes la presencia de síntomas por procesos intercurrentes está minimizada y conlleva a una atención mayor por parte el médico de los trastornos hidroelectrolíticos. Por tanto, es mandatorio el análisis de los electrolitos y la determinación de urea en ancianos con cuadros confusionales.

La relevancia de estos cambios aconseja la instauración de medidas preventivas como la rehabilitación de la marcha y evitar las situaciones de riesgo que puedan provocar deshidratación en el anciano.

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