

Übersicht / Review

Disorders of water and sodium metabolism in older patients

I. FÜSGEN

Department of Geriatrics, University of Witten-Herdecke, Germany

Summary

Disorders of water and sodium metabolism can result in serious problems for older patients. Hyponatraemia is of special significance in geriatric patients. In addition to the iatrogenic depletion of sodium, causes of hyponatraemia include comorbidity and changes associated with ageing that result in a more unstable homeostasis. Adequate fluid intake, but also the availability of needed electrolytes must be assured. A general recommendation for older, poly-pathic, patients to restrict their sodium intake must be viewed critically.

Key words

Dehydration – hyponatraemia – geriatric patient

Zusammenfassung

Störungen des Wasser- und Natriumhaushaltes bei älteren Patienten:

Störungen des Wasser- und Natriumhaushaltes können bei älteren Patienten zu einer ernsthaften Bedrohung werden. Dabei kommt der Hyponatriämie beim geriatrischen Patienten besondere Bedeutung zu. Grund dafür sind neben der iatrogenen Natriumverarmung, u.a. die Komorbidität und altersphysiologische Veränderungen, die zu einer labileren Homöostase führen. Eine ausreichende Flüssigkeitszufuhr, aber auch eine ausgleichende Elektrolytdeckung ist zu beachten. Eine generelle Empfehlung zur Natriumrestriktion bei älteren multimorbiden Patienten ist kritisch zu sehen.

Schlüsselwörter

Dehydration – Hyponatriämie – geriatrischer Patient

Disorders of fluid and electrolyte metabolism are not unusual at an advanced age. Since merely slight disturbances can lead to catastrophic decompensation and life-threatening situations, they require special attention [17]. Normally, the older organism is able to maintain the correct osmolarity of fluid volume as well as the electrolyte composition and concentration of the body fluids through the available regulatory systems. However, it is necessary to consider some special age-related factors that can elicit changed reactions: The existing age-related physiological changes, the frequently present polyphathia with use of several medications, the effect of environmental conditions, and an iatrogenic depletion of sodium.

In this context hyponatraemias with serum values below 130 mval/L have a special significance since they are en-

countered more frequently at an advanced age than high sodium levels [21]. As many as 7 % of healthy elderly individuals exhibit a significant decrease in serum sodium values [4]. Studies conducted in inpatient facilities have found that 7–12 % of the geriatric patients suffer from hyponatraemia [13, 19].

If hyponatraemia develops slowly, the clinical symptoms (tiredness, difficulty concentrating, uncertain gait) are frequently ascribed to the ageing process. In the presence of reduced osmotic pressure with outflow of fluid from the vascular system it is the peripheral oedemas, effusions in the serous cavities, and ascites that are the main clinical symptoms. With sodium values below 125 mval/L cerebral swelling also occurs and is accompanied by the clinical symp-

toms of lethargy, confusion and even coma. Therefore, hyponatraemia has always been one of the great clinical problems in geriatric patients [1, 14].

PHYSIOLOGICAL CHANGES ASSOCIATED WITH AGEING

The proportion of fluids in an organism stands in a negative relationship to age and the proportion of fat, but in a positive relationship to the proportion of muscle tissue. Total body water decreases due to the observed loss of muscle tissue with increasing age. A neonate's body weight consists of approximately 82 % fluids, while that of an adult is 60 %, and that of an individual in old age is approximately 52 %. Obesity can displace the water content of the body to the threshold of what is pathophysiological. A total body water content of only approximately 40 % is more likely the rule than the exception [8]. This decline in total body water content is partially the result of the reduced water binding capacity of the connective tissues with increasing age, but is mainly due to a decrease of the intracellular fluid. The decreased intracellular fluid is a consequence of a reduced muscular mass and a simultaneous increase of the water-poor fatty tissue. In other words, the distribution of the body water is displaced to the detriment of the intracellular space. This means that the safety mechanism for homeostasis of the water/electrolyte metabolism is impaired.

On the one hand, fluid and electrolyte homeostasis is maintained via the control of fluid intake, the plasma volume and fluid excretion and, on the other hand, via the (hormonal) regulation of the electrolyte metabolism. The latter is likewise affected by the physiological changes of ageing such as reduced thirst, decline in renal function and changes in hormone secretion (Table 1). The loss of concentrating ability is a characteristic symptom of ageing kidneys. Furthermore, increasing age is associated with salt loss because the capability of the kidneys to reabsorb sodium slowly declines. The reduction of intracellular fluid and electrolytes creates a "status quo" in fluid metabolism that falls quickly out of balance when subjected to stress.

EFFECT OF POLYPATHIA

With regard to the frequently occurring polyphathia of older individuals, the impaired homeostasis of the fluid and electrolyte balance is a special problem. On the other hand, my own studies indicate that increasing polyphathia is frequently associated with an inadequate supply of sodium [6]. According to the available medical literature [1, 12, 21], it is the following diseases that are especially responsible for this polyphathia: diabetes mellitus, heart failure, chronic obstructive pulmonary disease, renal failure, cancer, myxoedema, chronic infections and febrile conditions as well as vomiting

1. Reduced thirst
2. Decline in renal function <ul style="list-style-type: none"> - Decline in glomerular filtration - Decline in tubular concentrating ability - Decline in sodium conservation - Decline in the effect of vasopressin
3. Changes in hormone secretion <ul style="list-style-type: none"> - Decline of plasma renin activity with a decline of aldosterone secretion - Increased secretion of the atrial natriuretic peptide - Increased vasopressin secretion during osmotic stress or volume loading
4. Loss of muscle tissue and increased fatty tissue

Tab. 1: Endogenous regulation of the fluid and salt balance in old age.

or chronic diarrhoea. Even extensive sweating can be the cause of hyponatraemia in the elderly, as has been shown in Swiss studies [3]. Smoking also can cause hyponatraemia [2]. These electrolyte disturbances often decisively influence the course of any existing underlying illnesses.

As far as acute diseases are concerned, diarrhoea is most directly responsible for hyponatraemia. The cause of diarrhoea can be iatrogenic (e.g., antibiotics), but it also occurs frequently when the elderly travel. 80 % of patients who are older than 80 exhibit a reduced production of stomach acid, because of atrophic gastritis that is usually not associated with any therapeutic consequences. However, the absent protection that was provided by the acid can facilitate the development of infections, especially since electrolyte losses through sweating decrease the production of stomach acid even further. The loss of sodium is unavoidably associated with the loss of water, and it is the extracellular component (i.e., the plasma) that is especially affected.

Osmotic diuresis during hyperglycaemia (diabetes mellitus), severe sweating associated with febrile conditions (infections), as well as chronic vomiting are the most frequent causes of fluid loss in association with diseases.

Fluid retention with hyponatraemia is frequently caused by the inadequate ADH syndrome (SIADH) in older patients [18]. SIADH (Syndrome of Inappropriate Antidiuretic Hormone Secretion) can be caused by a cerebral disease with irritation of the posterior pituitary gland [9], by tumour-associated substances or by medications [24]. However, old age itself can be a risk factor for SIADH [13].

Hyponatraemia due to the dilution effect of oedemas associated with heart failure is also common in old age. This "low sodium syndrome" is a complicated therapeutic situation (e.g., frequently after long-term administration of a diuretic agent). In this stage the effect of the diuretics continuously decreases while the serum sodium concentration presents severely reduced values. This results in heart fail-

ure with peripheral oedemas and venous hepatic congestion that no longer responds to medication.

CONSEQUENCES OF POLYMEDICATION

Iatrogenic causes of disorders of fluid and electrolyte balance within the scope of polymedication in older individuals are by no means rare [21]. Drugs that are the most likely candidates include those that have a direct effect on diuresis or the electrolyte metabolism. The uncontrolled intake of diuretic drugs is associated with excessive fluid loss until exsiccosis, but also with the loss of sodium and/or potassium.

Additionally, the baroreceptors in the elderly no longer respond adequately to a decrease in blood pressure. Therefore, any pharmacotherapy that even slightly reduces the amount of body water quickly can exceed the capacity of compensated regulatory mechanisms that are stretched to their limit, and can have serious consequences for the water or electrolyte balance and for the circulation.

Diuretics
ACE inhibitors
Beta blockers
SSRIs
Tricyclic antidepressants
Neuroleptics
NSAIDs
Oral antidiabetics
and others

Tab. 2: Medications possibly associated with hyponatraemia [16].

The medical literature describes a connection between hyponatraemia and an entire series of medications (Table 2).

A connection with respect to SIADH is suspected for the following drugs: propafenone, SSRIs, ACE inhibitors, MAO inhibitors, neuroleptics, carbamazepine and sulfonylurea. In this context it should not be forgotten that a series of over-the-counter drugs can cause hyponatraemia (e.g. laxatives).

HYPOTONIC AND HYPERTONIC DEHYDRATION

Dehydration (inadequate levels of fluid and salt or of fluid alone) is the most frequent disorder of fluid and electrolyte balance in older individuals [23]. The concomitant loss of salt distinguishes hyponatraemic (hypotonic) dehydration from the isotonic and the hypernatraemic (hypertonic) forms of dehydration with little or no salt loss.

Hyponatraemic dehydration has special significance because it occurs very frequently and is often the cause of a tendency to fall in the elderly. The clinical presentation is that of disturbed orthostatic blood pressure regulation, tachycardia and reduced skin turgor. It is relatively difficult to treat because correcting the lack of salt cannot be undertaken quickly and completely, but requires that the serum sodium be increased gradually in increments of 10–15 mval/L.

INADEQUATE INTAKE

The changed circumstances of life (all forms of isolation) accompanying old age can result in unbalanced nutrition that can lead to deficiencies ranging from dehydration [23] to hyponatraemia [13] and all the way to severe protein deficiency or vitamin and trace element deficiencies. The further context of the circumstances of life must also include laxative abuse that can lead to fluid loss, but especially to hyponatraemia and hypokalaemia. More than 60 % of the elderly feel constipated.

IMPROVING FLUID INTAKE

In many elderly individuals it may – for different reasons – prove necessary to follow a “drinking schedule” to maintain an adequate fluid intake. Apart from the quantity of fluid ingested, its quality is important with regard to any existing illnesses. For example, in the case of a catheterised individual the intake of acidic juices (e.g. currant juice) or medicinal acidification through the oral administration of L-methionine [7] is important. The manner in which the fluid is offered is also important: Who enjoys drinking from a “feeding cup”, even if the person in question requires nursing care?

AVOID RESTRICTING SODIUM

Because of the physiological changes associated with ageing and the frequently existing polyphathia, many elderly individuals suffer from a latent deficit in their fluid and also their mineral salt balances (including sodium chloride). Therefore, the most frequent cause of sodium depletion in the elderly is very likely iatrogenic in nature (i.e. it can be traced to a restriction of sodium chloride). Many of the elderly avoid consuming any salt, because salt supposedly increases the arterial blood pressure. Additionally, the reabsorption of sodium through the kidneys is less efficient in old age.

The medical literature has for some time repeatedly indicated the minimal importance of salt consumption for hypertension [15]. A meta-analysis published in 1998 [10] summarised the results from a total of 114 studies on salt reduction conducted during the last 3 decades. The result was a moderate reduction of the blood pressure values (SBP/DBP -3.9/1.9 mmHg) in hypertensive individuals; the results for normotensive individuals were marginal (-1.2/0.26 mmHg). An additional meta-analysis that was published during the past year in the renowned British Medical Journal [11] documents that the long-term effects (13–60 months) of switching to a low-salt diet are marginal: a decrease of 1.1 in the systolic blood pressure, and of 0.6 mmHg in the diastolic blood pressure. Apparently, there was no connection between the extent of salt restriction and the resulting decrease in blood pressure.

Most recently, therefore, the recommendation given to elderly hypertensive individuals to follow a low-salt diet has clearly lost its credibility. The effects are minimal; even in cases of massive salt reduction the blood pressure in the majority of patients only decreases by a few mmHg [22]. *Stumpe* [20] even shows that a low-salt diet can lead to detectable cognitive deficits when compared with a high-salt diet.

It appears that weight reduction, increased physical activity, and reduced consumption of alcohol are more important than a reduction of sodium chloride [22].

SODIUM CHLORIDE SUBSTITUTION

The average consumption of table salt in Western industrialised nations is indicated as being 12 g (4.8 g sodium) per day. However, these numbers are mainly based on surveys and sales data. In contrast, some experimental investigations concerning salt intake partially at significantly lower values that lie in the range of 7–8 g/d. The nutritional associations of Switzerland, Austria and Germany recommend a daily table salt intake of 6 g [5]. Therefore, neither a general salt restriction nor sodium chloride substitution is necessary in most elderly patients.

CONCLUSIONS

Because of the physiological changes associated with ageing, the elderly person is increasingly susceptible to disorders of electrolyte and water balance. Dehydration and sodium depletion play a special role in this regard. Illnesses that occur in old age, medications and changed circumstances of life frequently have a special effect on this.

In this context, an adequate fluid intake and a balanced supply of electrolytes are of special importance. The need for electrolytes depends on the individual circumstances of life. However, the available studies clearly indicate that a certain daily requirement of electrolytes is indispensable. In this context a general sodium restriction in elderly patients gives cause for concern. This changes nothing about the fact that a restricted intake of electrolytes must be accepted in certain diseases. However, this must be seen in context with other dietary measures.

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PROF. DR. MED. INGO FÜSGEN,
UNIVERSITY OF WITTEN-HERDECKE,
KLINIKEN ST. ANTONIUS,
CARNAPERSTRASSE 60,
42283 WUPPERTAL.
E-MAIL: PROF.FUESGEN@ANTONIUS.DE

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