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Strategies for Ensuring Good Hydration in the Elderly

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Dehydration is a frequent etiology of morbidity and mortality in elderly people. It causes the hospitalization of many patients and its outcome may be fatal. Indeed, dehydration is often linked to infection, and if it is overlooked, mortality may be over 50%. Older individuals have been shown to have a higher risk of developing dehydration than younger adults. Modifications in water metabolism with aging and fluid imbalance in the frail elderly are the main factors to consider in the prevention of dehydration. Particularly, a decrease in the fat free mass, which is hydrated and contains 73% water, is observed in the elderly due to losses in muscular mass, total body water, and bone mass. Since water intake is mainly stimulated by thirst, and since the thirst sensation decreases with aging, risk factors for dehydration are those that lead to a loss of autonomy or a loss of cognitive function that limit the access to beverages. The prevention of dehydration must be multidisciplinary. Caregivers and health care professionals should be constantly aware of the risk factors and signs of dehydration in elderly patients. Strategies to maintain normal hydration should comprise practical approaches to induce the elderly to drink enough. This can be accomplished by frequent encouragement to drink, by offering a wide variety of beverages, by advising to drink often rather than large amounts, and by adaptation of the environment and medications as necessary.

Key words: aging, dehydration, risk factors, prevention.

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INTRODUCTION

Water is among the most important nutrients for the maintenance of life. It is used in the body for transporting nutrients and wastes, regulating temperature, maintaining the structure of tissues, and supporting cell functions (including brain function). For a long time, it was thought that water movement occurred by simple diffusion across cell membrane layers. We now know that water crosses the membranes through water channels or aquaporins (AQP), which are made of proteins and are present in the lipid membrane in large numbers. The most expressed is AQP1, whose discovery by Peter Agre was rewarded with the Nobel Prize in Chemistry in 2003.[1] Body water is constantly renewed at a rapid rate, remaining in balance between intake and losses. Water deprivation can result in dehydration in only a few days.

CONSEQUENCES OF DEHYDRATION IN THE ELDERLY

Dehydration is a frequent etiology of morbidity and mortality in elderly people. With the increase in life expectancy, the leading causes of death have shifted from infectious diseases to non-communicable diseases and from younger to older individuals. Dehydration is one of these causes, resulting in the hospitalization of many patients and often in fatalities. Dehydration is often linked to infection and if it is overlooked, mortality may be over 50%.[2] But dehydration is not just a problem of long-term patients, it can also occur in patients in acute care.[3] Dehydration corresponding to as little as 2% loss of body weight leads to a decreased endurance and risk of heat exhaustion.[4] Maintaining hydration is important because of the close relationship between cell hydration and cell function.[5] Older individuals have been shown to have a higher risk of developing dehydration than younger adults. Modifications in water metabolism with aging[6] and fluid imbalance in the frail elderly are the main factors to consider in the prevention of dehydration.

WATER METABOLISM IN AGING: PHYSIOLOGICAL CHANGES

The human body is mainly constituted of water (63%). Fat stores are practically free of water, and the metabolically active fat free mass contains 73% water. The decrease in the fat free mass often observed in the elderly is explained by a loss in muscular mass,[7] a decrease in bone mass,[8] and a decrease in total body water.[9] Also with the aging process come physiological changes such as diminution of the sensation of thirst[10] and modifications of water metabolism, including diminution of renal urine concentration capacity, renin activity, and secretion of aldosterone, and the relative resistance of the kidney to vasopressin.[11] All of these changes help to explain the frequency and severity of dehydration in the elderly. Even in euvolemia, important variations in fluid distribution are observed.[12]

Energy reserves are present in elderly subjects, although they are reduced due to diminished muscle mass. In contrast, there are no such water reserves. Moreover, body water is difficult to measure. Evaluation of total body water is often difficult to apply routinely in the elderly, requiring methods such as deuterated water (^2H_2O) or ^{18}O-labeled water ($H_2^{18}O$) labeling.[13,14] Therefore, indirect measurements of physical (resistance, impedance) or clinical (serum concentration) parameters are usually used. Bioelectrical impedance is an ambulatory method validated for the analysis of the water compartments in elderly subjects.[15] Although total body water decreases with normal physiological aging, the proportions of the different compartments remain constant.[16] Since early diagnosis is often difficult because of the absence of the classic signs of dehydration or of their misleading appearance, prevention of dehydration must be a multidisciplinary goal.

RISK FACTORS FOR DEHYDRATION

Certain warning signs can alert health care professionals or caregivers about the risk of dehydration.[17] Two factors are involved in dehydration: diminution of liquid intakes and augmentation of liquid losses, since the quantity of water is adjustable by thirst and since the thirst sensation diminishes with aging.[10] Apart from these physiological modifications, the most frequent risk factors are all difficulties limiting access to drink:

- Diminution of functional status, with diminution of mobility;
- Visual problems;
- Confusion or other cognitive alterations that lessen communication capacities;
- Certain medications that greatly increase dehydration risk, such as diuretics, laxatives, and sedatives (which lessen vigilance and the urge to drink); and
- All acute pathologies with fever or those that cause difficulties in swallowing or provoke diarrhea and/or vomiting.

Two lesser-known etiologies must be emphasized as well. First is the decrease of dietary intakes in the elderly. Water is taken in as food water content, water produced by food oxidation, and drinking. Every decrease in the quantity of food consumed is unavoidably accompanied by a water deficit. Every limitation of dietary intake must be compensated for by an increase in water/fluid intake, even though the opposite is likely. The other etiology is the fear of incontinence, which leads some elderly people to diminish their intake of liquids to avoid being faced with the difficulty of finding a toilet or to avoid difficult or painful position changes.

Hydro-electrolytic perturbations are the consequences of these varied risk factors for dehydration in the elderly (Table 1). Intracellular dehydration, also called hypertonic dehydration, is due to a loss of water from the cells toward the hypertonic extracellular compartment. It is most often linked with global dehydration and never occurs in isolation. This kind of dehydration provokes hypernatremia (>145 mmol/L) and hyperosmolality (>300 mOsm/L). Its most frequent etiology is fever without liquid compensation. Indeed, treatment by diuretics or merely incapacity due to alterations in alertness or a diminution of mobility can result in hypertonic dehydration. Clinical signs linked to this kind of dehydration are a sensation of thirst, confusion, arterial ischemia, dryness of mucosa, and sometimes fever. Intracellular dehydration may be caused by inadequate intake, renal problems (hypercalcemia, acido-ketosis), or extrarenal losses due to vomiting, diarrhea, perspiration, or polypnea.

Extracellular dehydration, also called hypotonic hydration, is caused by a loss of sodium, leading to a proportional loss of water. Natremia is then low (<135 mmol/L), as is osmolality (<280 mOsm/L). Diuretic treatment resulting in salt loss is the main etiology. Hyponatremia is responsible for the increased morbidity and mortality associated with this type of dehydration. Among the other biological signs, increases of proteinemia and hematocrit reflect the hemoconcentration. Several clinical signs indicate the diagnosis of extracellular dehydration: arterial hypotension, orthostatic hypotension, weight loss, hypotonia of the ocular globes, a lasting skinfold, and hyperconcentration of the urine.

Extracellular dehydration is primarily due to renal problems and digestive losses. Several things lead to renal problems in the elderly: administration of diuretics, diabetes mellitus, acute renal failure, chronic renal fail-

Table 1. Clinical and Biological Signs of Hydro-electrolytic Perturbations in Dehydrated Elderly Subjects

Type of Dehydration*	Clinical Signs	Biological Signs
Intracellular	Altered thirst Neuropsychic symptoms (especially confusion) Arterial ischemia or phlebitis Mucosal dryness (especially hyposialia aggravated by certain treatments) Fever (occasionally)	Osmolality > 300 mOsm/L Natremia > 145–150 mmol/L
Extracellular	Cardiovascular signs: arterial hypotension (especially orthostatic hypotension), tachycardia Weight loss Hypotonia of ocular globes (sunken eyes) Concentrated urine Lasting skinfold	Osmolality < 280 mOsm/L Natremia < 135 mmol/L Increased proteinemia Increased hematocrit Blood urea/creatinine > 10/L

*Global dehydration is associated with all of the clinical and biological signs of intracellular and extracellular dehydration; the hemoconcentration and cellular dehydration persist but vary in proportion depending on the cause; natremia is often elevated but can also be normal or even low.

ure, and resumption of diuresis after the removal of a urological obstruction. Digestive losses are due to vomiting, diarrhea (especially after laxative ingestion), or digestive aspiration.

Global dehydration encompasses all of the clinical and biological signs listed above, and is indicated by hemoconcentration and cellular dehydration. Natremia is often high, but can also be normal or low. Variations in sodium balance ("bound water") lead mainly to hemodynamic disorders, and variations in "pure water" lead mainly to intracellular modifications with cellular distress and neurological disorders (confusion).

WATER REQUIREMENTS IN THE ELDERLY

The water requirement for an individual may be defined as the quantity of water necessary to maintain homeostasis of both intra- and extracellular liquid compartments. This leads to variable individual requirements as a function of age, physical activity level, etc. For this reason, recommended water intakes[19] for a given population are defined relative to daily energy expenditure as about 0.25 mL/kJ (1 mL/kcal) for adults. However, it is currently recognized that thirst is a security mechanism and not a factor in primary intake regulation. This is particularly true in the elderly, for whom the physiological decline in the sensation of thirst[10] means that thirst only occurs in cases of significant water deficit. Therefore, in the elderly, thirst could in fact be considered as a marker of the onset of dehydration. Recommendations for the consumption of water and other non-alcoholic beverages are still being determined.[20]

Despite the physiological importance of water to life, little is known about water intake and excretion patterns in free-living elderly individuals. The 1977–1978 National Food Consumption Survey (by the US Department of Agriculture) is one of the few sources of information in the United States. The US National Research Council in 1989 recommended an intake of 30 mL/kg body weight after 65 years, and 1 mL of liquid per kcal of energy intake. Healthy subjects living at home maintain normal water intake if they have access to a variety of drinks.[21] In the Euronut-Seneca study in Europe, subjects born between 1913 and 1918 and free living at home in different European countries were surveyed. The 3-day dietary questionnaire included drinks and dietary fluid supply such as dairy products. In 1995, 50% to 80% of women (depending on the country) had a fluid intake below 1700 g/d.[22] This was declared the necessary level of fluid intake by the Dutch Nutrition Board in 1995.[23] The "Apports Nutritionnels Conseillés" from France[19] recommend at least 1500 mL/d, which needs to be increased according to physical activity and/or outside temperature.

In a recent study, Schoeller et al.[20] used isotope-labeled water to measure total body water and the water turnover in 458 non-institutionalized, 40- to 79-year-old adults living in temperate climates. Water turnover was shown to be highly variable between individuals, and little of the variance (<12%) could be explained by anthropometric parameters. Moreover, they found no evidence of dehydration in the 70- to 79-year-old group despite the fact that the majority of the individuals had water intakes less than the common recommendation of 8 glasses of water per day. Furthermore, they explained that recommendations to increase fluid intake to 8 glasses of water may not be prudent in the elderly, because they have an elevated risk of overhydration due to an attenuated osmoregulatory mechanism,[25] and the typical water content of food can provide 1 L/d (Food and Nutrition Board).

The situation is different in Europe, particularly in France. Water intake recommendations are partly based on the assumption that solid foods provide 1000 mL of water daily, which is virtually impossible to achieve for the elderly. The food energy density can vary from 5.7 to 8.5 kJ/g between the high and low consumers of fruit and vegetables, which contain about 90% water. Adding water from other foods such as cheese, bread, pasta, and meat, the food water would average 600 to 700 mL/d at best.[26] Considering the number of deaths due to dehydration during the heat wave of the summer of 2003 in Europe, it would be preferable to drink a little too much rather than not enough.

INDICATORS OF HYDRATION

Change in weight is the simplest indicator of changes in total body water. However, it is essential to know the initial body weight, which is not always the case, in particular for the elderly. The clinical signs of dehydration are very weak in the elderly and are often simply functional modifications (blood pressure decreases, orthostatic hypotension, declines in diuresis, increased concentration of urine, etc.). As shown in Table 1, one of the most constant and yet the least known signs is confusion due to the decrease in the cerebral intracellular volume. Another is muscle cramps and fatigue, with declines in performance caused by decreases in the muscular intracellular volume. Asthenia and concentrated urine are two other warning signs.

STRATEGIES FOR MAINTAINING GOOD HYDRATION IN THE ELDERLY

To prevent the consequences of dehydration in the elderly, as described above, it is necessary to detect the patients at risk. Elderly people have multiple risks of increasing water losses (diabetes, vomiting, diarrhea, fever). Furthermore, their environment frequently does not allow them access to drinking, even though we know that they poorly resist water deficit and thermal stress because they increase their liquid intakes less than younger people. Every loss of physical and mental autonomy can reduce the capacity to drink. This is the classical case of hemiplegic patients and tremoric, Parkinson's-like patients. Therefore, it is very important when faced with an acute or chronic disease, especially if it is infectious and febrile, to remember to increase liquid intake. Swallowing disorders or simple dysphagia are frequent and need more attention to ensure adequate fluid intake. Fear of incontinence leads to a decrease in fluid intake, and it is necessary to adapt the environment to prevent this. Anorexia is a frequent symptom in elderly people and increases the risk of dehydration. All fevers with tachypnea, diarrhea, or vomiting need to be quickly treated. The necessity of some medications such as sedatives and diuretics should be reconsidered (particularly in the summertime), especially when the patient has difficulties drinking without assistance (Table 2).

PRACTICAL APPROACHES TO INDUCE ELDERLY PATIENTS TO DRINK MORE

It is necessary to inform elderly people about the necessity to drink enough, even if they think it is not necessary because of decreases in thirst with aging. They have to drink without being thirsty, just like athletes must. The water requirement is 1.5 L/d, which is increased when the outside temperature increases, when the inside temperature is overheated (central heating), or when the patient has a fever. In the latter case, 500 mL more liquid per degree of fever above 38°C is recommended.

Elderly people should be informed about the wide variety of beverages available in addition to water; for example, tea, fruit juices, infusions, milk, and soup. They can also be instructed to increase fluid intake by consuming water-containing foods such as fresh vegetables, fruit, fresh cheese, and yogurt. The elderly should be advised to drink often more rather than drinking large amounts at one time, since gastric distension quickly decreases the sensation of thirst. In cases of swallowing or dysphagia problems, flavored gelatin is an option.

When the elderly person is dependent, the role of caregivers and health care professionals is extremely important. It is more difficult when the person lives alone. The main problem, at home as in the hospital, is to have access to water for patients who have poor mobility or altered cognitive status. In the recent SOLINUT study (Ferry M, unpublished paper), the relationship between loneliness and nutritional status in people over 75 years of age was investigated, and 77% of the subjects, despite

Table 2. Dehydration Risk Factors in the Elderly

- Age > 85 years
- Thirst reduction
- Problems with access to drink
- Communication problems
- Cognitive disorders
- Swallowing malfunction
- Reduced appetite
- Medications (e.g., diuretics, laxatives, sedatives)
- Acute pathology (e.g., fever, vomiting, diarrhea)
- Lack of attention from caregivers

Table 3. Steps to Prevent Dehydration in the Elderly

- Make information and educational programs available to caregivers and health care professionals
- Teach elderly persons to drink when they are not thirsty
- Identify at-risk elderly persons
- Make sure elderly persons have access to drinks
- Encourage elderly persons to drink
- Evaluate chronic medications for possible dehydrating effects
- Identify anorexia
- Check environmental factors for obstacles to drinking

having some difficulty in carrying heavy items, preferred to buy and transport bottled water, potentially limiting water intake, when tap water is safe and may be used instead.

In the hospital or nursing home, the role of the medical staff is very important and consists of preventing dehydration by giving water and food regularly and increasing the amounts given as soon as an event occurs that could be a dehydration risk factor.

Treatments and the environment of the elderly patient both at home and in an institution must be adapted often. Beverages should be offered as often as possible to achieve the necessary liquid intake. For example, drinks should be offered during all activities. Those at risk for dehydration must drink abundantly, meaning that he or she must therefore be conscious and cooperative. Furthermore, the decrease of thirst perception and a thirst more quickly quenched often make it difficult to achieve sufficient liquid intake. It is therefore necessary to stimulate drinking using either low-osmolarity drinks such as water, broth, or sport drinks or high-osmolarity drinks such as carbonated, sugared drinks or fruit juices.

In spite of efforts to encourage the elderly to drink and to adapt to the person's needs, it can still be impossible to achieve sufficient fluid intake. The same problem is encountered with food and appetite dysfunction.[27] Hypodermoclysis can be used to prevent dehydration.[28] This subcutaneous route is useful for restless or agitated patients, since it does not need immobilization. A nocturnal infusion is best, especially when the needle is inserted in the subscapular area. Deperfusion reduces the need for supervision and can be used at home.

CONCLUSIONS

Water is the most important substance for the body, although it is the least studied, and this is particular so in the elderly. Adequate information must be given regularly, not only to all elderly people, but also to their families, caregivers, and health care professionals. It should be emphasized that thirst declines with aging, whereas hydration needs do not, rendering the maintenance of homeostasis more difficult. All means must be employed in order to maintain adequate fluid intake. Reminders to drink must be even more frequent during hot months, as illustrated by the heat wave in Europe during the summer of 2003, which killed not only those elderly already frail or ill, but also many otherwise healthy elderly people.

PANEL DISCUSSION

Antonio Dal Canton: I would raise two points. The first is drinking without thirst. I take your point and I agree with you, most elderly people are in danger of losing water. But on the other hand, with increasing age, everyone also loses renal function. Most people at 80 years of age lose approximately 60% to 70% of GFR. This means that the capacity of the kidney to dilute concentrated urine is much reduced. So, if you force water intake, you may also precipitate old people into water intoxication because of their reduced capacity to dilute urine. Simple blood examinations such as serum creatinine are no longer valid tools to understand renal function in elderly people, because muscle mass, on which serum creatinine depends, decreases and levels of serum creatinine may be normal but still correspond to very low levels of GFR. On the other hand, you said that many people admitted to the hospital during the heat wave in Europe in August 2003 in fact had low serum sodium concentration, which may be interpreted as an excessive intake of water. The other point is that I would use a word of caution in taking low sodium concentration as an index of low extracellular fluid volume. In fact, many clinical conditions that are characterized by a huge expansion of extracellular fluid volume, for example, congestive cardiac failure or nephrotic syndrome, are associated with edema and very low levels of plasma sodium. What in fact is an index of depletion of extracellular fluid volume is the content of sodium in the body, not the concentration of sodium in plasma.

Monique Ferry: I agree with you on those points, but as I stated, we recommend minimum water intakes from beverages of 700 to 800 mL/d. It's not more than that because when we talked with elderly people, some of them drink less than three glasses a day and this is not enough. And as they have difficulty in concentrating urine, they also have difficulty retaining urine. So we have a different level of homeostasis that is normalized at a different level than that in younger adults. I agree with you on the problem of renal capacity; we found, however, in a long study with the elderly, that only one-third of them had major problems with renal function, one-third had decreases in renal function capacity, and one-third had a normal function, even at 90 years of age. That is difficult to manage, and I think that you are completely right when you speak about the cardiac problems. This is one of the reasons that we had a lot of deaths during the heat wave in the summer 2003, not so much in frail or sick people that were already in health care institutions, but in apparently normal healthy people, often those living alone at home, who were subsequently hospitalized for dehydration. So we had to think about that and we discovered through a survey that when they had a disease, and when general practitioners and geriatricians changed their medication in order to limit the risk and cardiac output, we had a problem with that because it is really difficult sometimes to have the right amount of water to be just under the risk of dehydration and under the risk of pulmonary edema. This was our problem daily; we had a lot of hyponatremia due to diuretics in these people. And that's why it was so difficult to cure them, because when you stop the diuretics, it takes longer in the elderly to recover the normal level of hydration than in younger people. So in our group, when we discuss nutrition for elderly people, we recommend at least 700 mL/d from beverages, because below this level it is not possible to maintain normal hydration. A minimum of 700 to 800 mL/d seems adequate for elderly people, and even that level is often difficult to reach. This is why we try to teach them to drink before becoming thirsty.

Friedrich Manz: The experience of summer 2003 in France is highly interesting. What was the pathophysiology? You added salt, as you assumed that there was a salt deficit. Where does the deficit come from? Perhaps in the long run, it is due to the use of diuretics. Sweating could be an additional source of salt loss. Salt losses may result in hyponatremia due to non-osmotic vasopressin stimulation. If the water intake is unusually high, the subject is in a dangerous situation. Due to the high vasopressin level, the kidney is not able to dilute the urine adequately; serum sodium level decreases further, increasing the risk of cerebral edema, convulsions, and death. Could you differentiate between the different sources of salt loss with the information you have?

Monique Ferry: Yes, there is really a decrease in sweat loss.

Friedrich Manz: Yes, but it was hot and the patients suffered from hyperthermia. Perhaps the sweating rate was higher under this stress.

Monique Ferry: No, but in elderly people it is decreased.

Friedrich Manz: Yes, in everyday life it is decreased, but it may have been substantial in this exceptional situation.

Monique Ferry: They had a small amount. Normally, they had nothing, which is why we add one spoon of salt in order to avoid this problem. In those patients we had difficulty due to the fact that they also had some neurological impairment, and it was difficult to communicate with them. The first indicator of dehydration and poor physical and mental condition was confusion, and with their cognitive impairment, it was difficult to discuss with them and to understand exactly what their antecedents were. When they arrived at the hospital they were completely dehydrated and exhibiting behavioral problems; they developed bed sores in 5 to 6 hours due to local vasoconstriction. But I still think that it is necessary when we give subcutaneous fluids to also add salt, because water and glucose alone are not enough to compensate for minimum salt losses.

Friedrich Manz: In our study in adults over 55 years of age, we calculated adequate total water intake values of 2944 mL/d in men and 2292 mL/d in women. When food and metabolic water are subtracted, the recommended water intakes for drinking water and beverages are 1877 mL/d in men and 1306 mL/d in women, ensuring euhydration in 97% of these seniors. Thus, in men the recommendations of 8 glasses per day in Europe and 8 times 8 ounces in America seem to have an empirical basis. In women the recommended fluid intake is much lower.

Monique Ferry: Perhaps the subjects were not really old in your survey.

Friedrich Manz: They were 55 to 88 years old.

Monique Ferry: I think that we lack data about the really old (or, as I call them, the "TGV" for "très grand vieux"), because their situation is completely different. When we see some of them that are completely healthy and normal with adequate capacity to do everything and they are 90 or 95, and the same people are completely different when they are just 85. As we discussed earlier for optimal hydration, what is successful or optimal aging? I don't know what it is exactly and how to achieve that, but I am quite sure that hydration has a large part to do with it. And I think that we have to think about the fact, as Dr. Ritz explained, that we also have a problem with mitochondrial functioning when hydration level is low. In elderly people, a large part of their quality of life is linked to their capacity to do something or not, and thus to have their right level of ATP. So I think that we have a really, really huge task in front of us here.

Larry Armstrong: The exertion heat stroke and the classic heat stroke literature, body temperature above 40°C, indicate that hyperthermia is the problem in death and in the classic heat stroke literature. In St. Louis and Chicago in 1995 and 1999, those deaths were due to hyperthermia. In Chicago, the 100 deaths that occurred there during the heat wave were verified hyperthermia. I wonder if you have any records on how many of these deaths were due to hyperthermia, which is what the literature would show as the primary cause of death during a heat wave?

Monique Ferry: We had very high hyperthermia, and about one-third of the people died directly from it. Surely it was sudden hyperthermia and, as in the Chicago studies, it was more for lonely people and what they called "exclus-reclus" (excluded and reclusive) in the downtown area, and unfortunately we had the same results in downtown Paris and Valence. I don't have an explanation for the fact that we had for the same age range hyperthermia in some people, hyponatremia, or not rapid hyperthermia in the same kind of people. I don't know why. When they arrived at the hospital, they had no psychiatric symptoms and they had hyperthermia, but not hyperthermia above 41°C.

Larry Armstrong: It is not easy to find in the literature the degree of dehydration when someone dies of dehydration. Adolph published 15% to 20% as a range of dehydration that causes death, so do you think that these people were actually 15% or 20% dehydrated?

Monique Ferry: 15% or 20%, yes.

Michael Sawka: When you look at heat injury and dehydration helping to mediate it, it's not as simple as picking out a temperature, because one of the things we know is that as tissue gets older, it's more susceptible to a given thermal stress; there would be more damage done and also there are certain dietary components that may impact on that. So it's very possible that you might see a lower temperature and still have a heat stroke or a heat injury. But the question I wanted to ask was, how low were the sodium levels in the patients who died?

Monique Ferry: Less than 120. That's why they died.

Patrick Ritz: Going back to clinical practice, imagine I am a junior doctor and I call you in the ward, and we are examining an old person, confused and with cognitive impairment. How would you rate it, and what would be your hierarchy, in terms of the way in which you would address the hydration status of this person, to determine "this is dehydration." What would you rate first? Natremia? Weight loss? What would you say from experience-based clinical practice?

Monique Ferry: It's difficult because the first question is to know if the patient had cognitive impairment before he arrived at the hospital or not. It's the first point and it is not so easy to know. If someone is accompanying the patient it's not a problem, but often they're alone. And during the summer holidays of 2003, many elderly were alone. Then, if we know that he/she had cognitive impairment before hospitalization, we don't have the same hierarchy items, because cognitive impairment worsens with dehydration, so we have time to do something. But if you have cognitive impairment due only to dehydration in a patient who was normal before becoming dehydrated, we have very little time to do something before he/she dies. So we are obliged to try to have the essential data, and I think that natremia is extremely important. But I agree with you that we don't use blood urea creatinine. I included it because it is normally accepted in a lot of publications. But we have no time to do that because we would have to compare creatinine and non-creatinine clearance and we just don't have enough time. Natremia, proteinemia, urograms, and hematocrit are important and useful to achieve a clinical view of the patient. When you see a dehydrated person, you make a clinical diagnosis that you confirm with laboratory results. But you do something before having the results; otherwise the patient is no longer alive when you get to him.

Irwin Rosenberg: Drs. Armstrong and Sawka are going to talk about assessment and requirements. I hope that you will be sure to address the issue of whether age is a factor in how hydration should be assessed and how requirements are calculated. I know that those are issues that have been considered, and what we have heard here is that dehydration is not only a problem, but certainly potentially a lethal problem in the elderly and especially in the frail elderly. But one of the things I think we need to try to cover is the question of whether age is a factor in how we go about assessing hydration and how we go about judging requirements.

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