nursing older people
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assessing fluid balance in older people: fluid needs

In the first of two articles about assessing fluid balance in older people, Philip Woodrow reviews physiology and how to assess fluid needs.

Sixty to 80 per cent of the human body is water. Normally, water within different parts of the body is kept within a fine balance. But ill health or impaired function of body systems (especially the kidneys) can cause fluid imbalances and complications for other systems.

distribution of body fluids

Solutes contained within body water vary. The main differences in body chemistry are between water within body cells (intracellular) and water outside body cells (extracellular). Extracellular fluid includes both fluid within the blood vessels (intravascular) and fluid between blood vessels and tissue cells (interstitial) (see Figure 1). Chemically, intravascular and interstitial fluid are virtually identical, but imbalances between them can complicate disease. This article therefore describes three fluid compartments within the body:

- intravascular
- interstitial
- intracellular.

Although the normal fluid volumes of an average healthy person are cited, wide variations occur between individuals, especially with ill health, so all figures cited are given only to illustrate trends.

Of the five litres average blood volume, about two litres are blood cells and three litres are plasma. Blood volume is important, because it:

- perfuses all body tissue (delivering oxygen and nutrients, while removing waste from cells)
- is measurable (eg blood pressure, or strength of the pulse)
- forms urine (which removes waste from the body, and is easily measurable)
- is the main route for replacing fluids (including oral fluids, which are absorbed through the gut into the bloodstream).

However, plasma contains only about 7.5 per cent of total body water (Solomon *et al* 1990). To prevent excessive loss of this relatively small volume, albumin and other plasma proteins attract water to remain in the blood vessels. Normal plasma albumin is 35-50 grams/litre, but illness often lowers plasma albumin levels, causing excessive extravasation of fluid. This causes both hypovolaemia (detected by hypotension) and oedema (see below).

Plasma moves relatively freely across capillary membranes, so intravascular concentrations of electrolytes and other solutes are similar to interstitial concentrations. However, volume of interstitial fluids is considerably larger: about 12-14 litres (Guyton and Hall 2000, Marieb 2001), or 30 per cent of total body water (Solomon *et al* 1990).

Most body water is inside cells: 25-28 litres (Guyton and Hall 2000, Marieb 2001), or 62.5 per cent of total body water (Solomon *et al* 1990). Each cell is surrounded by a membrane, which controls movement of chemicals and substances into the cell. Electrolyte concentrations of intracellular fluid are significantly different from extracellular concentrations. For example, normal extracellular (intravascular and interstitial) sodium concentration is 135-145 mmol/litre and potassium 3.5-4.5 mmol/litre. The sodium-potassium pump in cell membranes almost reverses intracellular concentrations of these electrolytes, to potassium of 140 mm/litre and sodium of 14 mmol/litre (Guyton and Hall 2000).

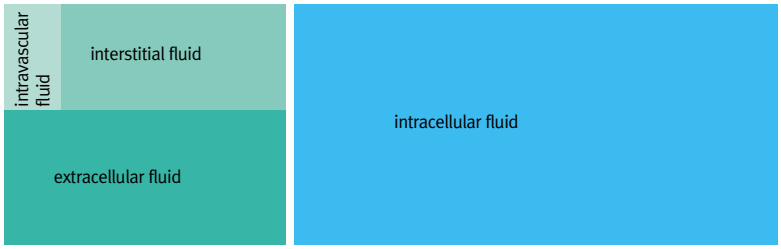
factors affecting fluid compartments

Fluids move constantly between body compartments, delivering oxygen and nutrients to tissues while removing waste products (carbon dioxide, metabolic acids). Each day 24 litres moves from capillaries into tissues – about six times total plasma volume. Most (85 per cent) of this is reabsorbed by the same capillaries, the remainder forming lymph, which eventually drains back into the cardiovascular system (Ganong 1999). So most fluid, whether a cup of tea or intravenous infusion, transfers into interstitial and then intracellular fluid compartments. Deroy (2000) suggests that only 85ml of each litre infused intravenously remains in the blood, although the amount and timing of movement varies between different fluids.

Balance between fluid compartments varies both in health and illhealth. In health, body water volume is mainly affected by the amount of body fat. Fat repels water whereas muscle contains relatively large amounts, so obese people have fewer 'stores' of water than muscular people. Observing a person's appearance, together with insights into their lifestyle, can give some indication of likely amounts of total body water.

In health, most water loss is in urine, which can be easily measured. Renal function is usually adequate provided 450ml of urine is passed daily, but most people excrete far more to remove excess body water. Increased water loss lowers the specific gravity of urine nearer to 1.0. In health, kidneys therefore increase or decrease urine volume to maintain total body fluid balance. Renal excretion of water is regulated by hormones, especially antidiuretic hormone (ADH).

Figure 1. Fluid compartments in the body showing their relative volumes



Various diseases and treatment can affect urine volume. For example, diuretics such as furosemide (frusemide) block the effect of ADH, and so increase urine volume. The high blood sugar levels of diabetes mellitus cause glycosuria, which draws additional fluid volume into urine, resulting in polyuria and hypovolaemia. Hypovolaemia causes thirst (polydipsia), the other classic symptom of diabetes.

insensible loss

Smaller but still significant amounts of body water are lost through other means, more difficult to measure. The main sources of insensible loss are:

- perspiration
- faeces
- breathing.

Normally, estimated daily insensible loss is 500ml, but other factors which may increase or decrease insensible loss include:

- pyrexia (increases perspiration)
- diarrhoea/constipation
- tachypnoea
- breathing very dry air or unhumidified oxygen.

In ill health, insensible loss may double to one litre. Although calculating insensible loss is guesswork, increased insensible loss can explain causes of dehydration.

oedema

Oedema – excessive extravascular fluid – may be interstitial or intracellular, or both. Unlike intravenous volume, neither extravascular fluid compartment can be measured directly in clinical practice.

Many acute and chronic diseases, such as heart failure, cause interstitial oedema. This often causes visible puffiness around the ankles and elsewhere, often indicating poor perfusion. Excess water significantly increases weight, so weighing patients daily indicates oedema accumulation or removal.

Intracellular oedema is not easy to detect, but causes more problems. Cell damage causes the sodium-potassium pump (see above) to fail, and so sodium moves into the cell to form more equal concentrations to extracellular fluid. Sodium draws in water, increasing intracellular fluid volume. Intracellular oedema places more pressure on the already damaged cell membrane, causing further failure, and potential cell death (necrosis). While the death of one cell is usually insignificant, cells are the functional part of any organ, so widespread cell death or damage results in organ failure.

effects of ageing

There is some age-related decline to all aspects of fluid balance, but healthy ageing is unlikely to cause problems for people. So while urine volume may decline, in the absence of disease it usually remains adequate to remove body waste. However, various factors identified above may affect body fluid balance. For example, many older people have less muscle but more fat than when they were younger, and so have fewer water 'stores'.

More often, people may respond to problems such as nocturia, frequency or incontinence by restricting their fluid intake, especially when going out or near to bedtime. Nocturia and polyuria are symptoms of an underlying problem, so restricting fluid intake may cause dehydration and further problems, such as hypotension and predisposing to urinary tract infection. Therefore, when caring for people who are reluctant to drink, nurses should explore the cause of the symptom.

Prevalence of acute and chronic diseases (for example, type 2 diabetes, COPD, chronic heart failure) in older people makes them more susceptible to fluid imbalances. Physical limitations, such as immobility or arthritis, may discourage them from getting drinks or micturating.

assessment

There are many aspects to assessing fluid balance, but all signs should be interpreted in terms of the person as a whole. Although symptoms may have other causes, key assessment questions for nurses include:

- Does the skin look or feel dry?
- Does the skin look or feel loose (subcutaneous fat or muscle wasting indicate fewer water reserves)?
- Does the skin look or feel oedematous?
- Does the skin look poorly perfused (eg discoloured white, blue or purple; ulcers)?
- Do the mouth or lips look dry?
- Does the hair look or feel dry?
- Is urine output normal?
- Are there any problems passing urine (eg incontinence)?
- Are there any other sources of fluid loss (eg stomas, surgical drains)?
- Does the person have any disease that affects water loss (eg diabetes mellitus, pyrexia)?
- Does the person have any disease or treatments that affect internal fluid balance (eg heart failure, steroids)?
- Do any treatments affect water loss (eg diuretics, dry oxygen)?
- Are there signs of hypovolaemia (eg hypotension, weak thready pulse)?

Like any assessment, potentially embarrassing issues (for example, questions about urine) or intimate aspects, such as touch, should be handled sensitively. Further multidisciplinary assessments, such as blood tests, may provide further information, so nurses may need to refer patients to other professionals.

conclusion

The healthy body maintains fluid balance through a number of mechanisms. This balance distributes water across intravascular, interstitial and intracellular fluid compartments. Acute or chronic disease can cause imbalance between the fluid compartments, resulting in many complications.

This first of two articles has described normal fluid balance and some common problems that can occur in older people. The second article will discuss the more widely used fluids that may be used for fluid replacement.

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