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ONE MINUTE CONSULT
BRIEF ANSWERS TO SPECIFIC CLINICAL QUESTIONS

Q: Does my patient need maintenance fluids?

My adult nonacutely ill patient, weighing 70 kg with a glomerular filtration rate (GFR) greater than 60 mL/min/1.73 m^2, is admitted to the general medical service. She is to receive nothing by mouth for at least the next 24 hours for testing. Do I need to provide maintenance fluids intravenously?

A: The question seems like it should have an easy answer. However, there is no consensus either on the type of fluids or the need for them at all.

Mortiz and Ayus[1] have described the role of maintenance intravenous (IV) fluids in *acutely ill* patients and made the case for isotonic saline (0.9% NaCl) to minimize the risk of hyponatremia, while acknowledging that it provides 7 to 10 g of sodium per day.

Recommendations for IV fluids for *nonacutely ill* hospitalized patients range from isotonic solutions such as 0.9% NaCl and lactated Ringer's, to hypotonic fluids such as 5% dextrose in water (D5W) in 0.45% NaCl and D5W in 0.2% NaCl.[2–5]

The 2013 guidelines of the UK National Institute for Health and Care Excellence (NICE) recommend hypotonic fluids to provide 25 to 30 mL/kg/day of water with 1 mmol/kg/day of sodium. For a 70-kg patient (body surface area 1.7 m^2), this would be 1,750 to 2,000 mL of water, with a maximum of 70 mEq/L of sodium (35 mEq/L).[5] An option would be D5W in 0.2% NaCl, which has 34 mEq/L of sodium.

When choosing maintenance IV fluids, we need to consider the following questions:

- What is my patient's volume status?
- What is the baseline serum sodium and renal function?
- Are there comorbid conditions that may affect antidiuretic hormone (ADH) status such as physiologic stimulation from volume depletion, drugs, pathologic medical conditions, or syndrome of inappropriate ADH stimulation?
- Will my patient be receiving strictly nothing by mouth?
- Are there unusual fluid losses?

SCENARIO 1: 'USUAL' MAINTENANCE

If the patient is euvolemic, with a normal serum osmolality, a GFR more than 60 mL/min/1.73 m^2, no stimuli for ADH secretion, and no unusual fluid losses, "usual" maintenance would be expected. The usual volume for this patient can be estimated by the following formulas:

- Maintenance volume: 2,550 mL (1,500 mL × 1.7 m^2 body surface area)
- Holliday-Segar method[6]: 2,500 mL (1,500 mL plus 20 mL/kg for every kilogram over 20 kg).

The usual sodium can be also estimated by the following formulas:

- 2 g Na/day = 2,000 mg/day = 87 mEq/day
- Holliday-Segar[6]: 3 mEq Na/100 mL and 2 mEq K/100 mL of maintenance fluid.

Maintenance IV fluids for our nonacutely ill adult patient could be:

- NICE guideline[5]: D5W in 0.2% NaCl with 20 mEq KCl, to run at 75 mL/hour
- Holliday-Segar method[6]: D5W in 0.2% NaCl with 20 mEq KCl, to run at 100 mL/hour.

Twenty-four hours later, assuming no unusual fluid losses or stimulation of ADH secretion, our patient would weigh the same and would have no significant change in serum osmolality.

OTHER OPTIONS

What if I provide 0.9% NaCl instead?

Each 1 L of normal saline provides 154 mEq of sodium, equivalent to 3.5 g of sodium.

The question seems like it should have an easy answer. However, there is no consensus on either the type of fluid or the need for them at all.

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TABLE 1

Scenario 1: 24 hours without fluids

	Total body			Intracellular			Extracellular		
	Volume	Osm/L	Total osmoles	Volume	Osm/L	Total osmoles	Volume	Osm/L	Total osmoles
Baseline	42.0 L	280.0	11,760	28.0 L	280.0	7,840	14.0 L	280.0	3,920
Losses	–2.5 L		–166						–166
New state	39.5 L	293.5	11,594	26.7 L	293.5	7,840	12.8 L	293.5	3,764

Thus, for the 24 hours, with administration of 2 to 2.5 L, the patient would receive a sodium load of 7 to 8.75 g. The consequences of this can be debated, but for 24 hours, more than likely, nothing will happen or be noticeable. The kidneys have a wonderful ability to "dump" excess sodium ingested in the diet, as evidenced by the average Western diet with a sodium load in the range of 4 g per day.[7,8]

What if I provide 0.45% NaCl instead?

Each liter provides 50% of the sodium load of 0.9% NaCl. With the 24-hour administration of 2 to 2.5 L of D5W in 0.45% NaCl, the sodium load would be 3.5 to 4.8 g, and the kidneys would dump the excess sodium.

Heart failure and renal disease put the patient at risk of either hyponatremia or sodium overload

What if I provide 'catch-up' fluids after 24 hours, not maintenance fluids?

Assuming only usual losses and no unusual ADH stimulation except for the physiologic stimuli from volume depletion for 24 hours, our patient would lose 2 kg (1 L fluid loss = 1 kg weight loss) and 87 mEq of sodium. This is approximately 4.5% dehydration; thus, other than increased thirst, no physical findings of volume depletion would be clinically evident.

However, serum osmolality and sodium would increase. After 24 hours of nothing by mouth with usual fluid losses, there would be a rise in serum osmolality of 13.5 mOsm/L (a rise in sodium of 6 to 7 mEq/L), which would stimulate ADH in an attempt to minimize further urinary losses. There would be an intracellular volume loss of 1.3 L (**Table 1**). Clinically, just as with the administration of 0.9% sodium, these changes would not likely be of any clinical consequence in the first 24 hours.

SCENARIO 2: IMPAIRED WATER EXCRETION, AND FLUIDS GIVEN

If the patient is euvolemic but has or is at risk for ADH stimulation,[1,9] providing maintenance IV fluids according to the NICE or Holliday-Segar recommendations (a total of 2 L of 0.2% NaCl = 34 mEq Na/L = 68 mOsm/L) would result in an excess of free water, as an increase in ADH secretion impairs free water clearance. A potential scenario with impaired water excretion is shown in **Table 2**.

After 24 hours, the patient's serum osmolality would drop by about 7 mOsm/L, and the serum sodium would decrease by 3 or 4 mEq. The consequence of the intracellular fluid shift would be seen by the expansion of the intracellular volume from 28 to 28.7 L.

If this patient were to have received 2 L of 0.9% NaCl (308 mOsm/L × 2 L = 616 Osm) as suggested by Moritz and Ayus,[1] the result would be a serum osmolality of 284 mOsm/L, thus avoiding hyponatremia and intracellular fluid shifts.

THE BOTTOM LINE

Know your patient, answer the clinical questions noted above, and decide.

For a euvolemic patient with normal serum sodium, GFR greater than 60 mL/1.73 m^2, and no ADH stimulation, for 24 hours it probably doesn't matter that much, but a daily reassessment of the continued need for and type of intravenous fluids is critical.

For patients not meeting the criteria noted above such as a patient with systolic or diastolic heart failure, advanced or end-stage renal disease puts the patient at risk for early potential complications of either hyponatremia or sodi-

TABLE 2

Scenario 2: Antidiuretic hormone stimulation and 2L of 0.2% NaCl in 24 hours

	Total body			Intracellular			Extracellular		
	Volume	Osm/L	Total osmoles	Volume	Osm/L	Total osmoles	Volume	Osm/L	Total osmoles
Baseline	42.0 L	280	11,760	28.0 L	280.0	7,840	14.0 L	280.0	3,920
Losses	–1.0 L		–166						–166
Fluids given	+2.0 L		+136						+136
New state	43.0 L	272.7	11,730	28.7 L	272.7	7,840	14.3 L	272.7	3,890

um overload. For these patients, maintenance intravenous fluids need to be chosen wisely. Daily weights, examinations, and laboratory testing will let you know if something is not right and will allow for early detection and treatment.

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