

Detective Nephron



Detective Nephron, world-renowned for expert analytic skills, trains budding physician-detectives on the diagnosis and treatment of kidney diseases. L. O. Henle, a budding nephrologist, presents a new case to the master consultant.

Nephron (angry) My assistant is late today.

L. O. Henle enters the room with excitement.

Nephron What do you want?

Henle I...I have a case for us.

Nephron You are late today.

Henle Hypomagnesemia.

Nephron (with surprise) Excellent. A good case can change my mood.

Henle (prepared) A 65-year-old man was just seen recently for fatigue and muscle weakness and found to have a serum magnesium level of 0.6 mg/dL.

Nephron This should be fun.

Henle (with a curious look) For 3 days they tried giving him magnesium replacements intravenously and via mouth, and it is improving, but they can't figure out the cause.

Nephron (confused) Ahhah! This is going to be exciting.

Henle Just some more information, if you allow it, sir.

Nephron Sure—I hope it is the information I am looking for.

Henle He really has no significant medical problems except hypertension and gastric reflux disease. His FeMg was 0.5 percent.

Nephron So it's a gastrointestinal (GI) loss. Why are you bothering me?

Henle He has no diarrhea, and no apparent GI loss can be found. He has no history of alcohol ingestion.

Nephron (very excited) Great job; let's move on. So just because there is no GI loss, it is presumed renal losses? You just told me that the kidney is doing the right thing: the urinary loss of magnesium is very minimal. If I had to guess what the urine magnesium was, it must have been very low.

Henle You are correct.

Nephron Any other electrolyte problems?

Henle (astounded) I am getting to that point. Also, hypokalemia and hypocalcemia.

Nephron (calm) Fascinating!

Henle So far he is not taking any diuretics, he was not aggressively volume expanded and not hypercalcemic, and I don't see anything on his medication list that can cause renal magnesium wasting, like a chemotherapy agent, calcineurin inhibitors, or amphotericin B.

Nephron Ridiculous! Why are you even bothered by those things when the kidney is doing the right thing! This is GI loss to me. Please go back and evaluate his medications, and make sure he is not having any GI losses.

Henle exits, and Detective Nephron resumes drinking his coffee.

Nephron (to himself) Henle seems to be very puzzled by this one. So far, the kidneys are the smarter organ here!

Before Detective Nephron can go get more coffee, Henle returns to the office.

Nephron You're back.

Henle I am puzzled. His magnesium is persistently low, and his repeat urinary FeMg percent level is appropriately low.

Nephron Good!

Henle When we have renal losses, the cause is usually medication, diuretics, certain antibiotics like gentamicin or foscarnet, or primary renal wasting from syndromes. But as you said, it is not a renal cause. He has no diarrhea or pancreatitis, no known or existing malabsorption disease. He has had no known abdominal surgery.

Nephron Great! The magnesium content of upper GI tract secretions is 15 mEq/L compared with 1 mEq/L in the lower tract, so that in general, magnesium depletion due to upper GI tract secretory loss is much more common than that due to lower GI tract disorders. You did some good work. But we still don't have a diagnosis.

Henle Yes, you are correct.

Nephron (confidently) Look at his medication list and his known diagnosis. He has hypertension and gastric reflux. What is he taking?

Henle Metoprolol and omeprazole.

Nephron (chuckling) All right, then!

Henle What?

Nephron Stop the omeprazole, and recheck the magnesium level in a week.

Henle Really?

Nephron Yes, proton pump inhibitors (PPI) can cause hypomagnesemia, especially long-term use. Hypomagnesemia in this patient's range, along with hypocalcemia, has been reported in PPI use. Usually the loss is GI, so the urinary magnesium and calcium are low. Hypomagnesemia is associated with hypocalcemia, and this is due to both decreased parathyroid hormone secretion and parathyroid hormone resistance. Hypomagnesemia-induced kaliuresis leading to hypokalemia can be seen with these patients as well. The urinary calcium and potassium in this patient?

Henle Low and high, respectively. Given the low calcium, his parathyroid hormone was checked, and it is 30 pg/mL.

Nephron So stop the PPI now!

Henle Why does this happen?

Nephron (with a smirk) It is speculated that the drug might interfere with intestinal absorption. Some data say that there might be a renal effect as well. Data from case reports suggest that a renal effect may also contribute. It is possible that the drug interferes with the maximum tubular reabsorption threshold for magnesium.

Henle This is interesting.

Nephron Let me know in a week.

Henle exits, and Detective Nephron starts reading ASN Kidney News. A few days later, as the detective is sipping away at his coffee, Henle enters the office.

Nephron Nothing is better than a cup of hot coffee! And a great case!

Henle Once we stopped the PPI and the magnesium, the patient's calcium and potassium all improved slowly. He is being discharged and is asked not to take these agents any more.

Nephron Great work, Henle. Again, my dear apprentice, from a diagnosis of hypomagnesemia, you found the culprit agent. Always, to be a good detective, observe, think, read, and apply. If it doesn't cross your mind, you will never diagnose it. Great case, Henle. The problem is not always in the kidney!

"Detective Nephron" was developed by Kenar Jhaveri, MD, assistant professor of medicine at Hofstra North Shore LIJ School of Medicine. Thanks to Dr. Rimda Wanchoo, division of nephrology, Weill Cornell Medical Center, for editorial assistance.



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