

Urinary Creatinine-splitting Bacteria after Ileal-loop Diversion Causing Underestimate of Glomerular Filtration Rate



To the Editor:

Use of ileal intestinal segments for urinary diversion following cystectomy is common practice.

Although creatinase and creatinine deaminase are enzymes produced by gut flora, especially in patients with chronic renal failure,¹⁻³ they have not been isolated from urine. We report a patient with an ileal loop, bacteriuria, and marked underestimation of glomerular filtration rate (GFR) due to urinary creatinase.

CASE REPORT

A 50-year-old man (weight 80.0 kg, height 1.98 m) with chronic kidney disease had suffered a traumatic spinal cord injury 20 years earlier, resulting in quadriplegia, leading to neurogenic bladder, urinary tract infections, and calculi requiring cystectomy and ileal conduit. The patient's serum creatinine level was 3.0 mg/dL. The serum sodium was 140 mEq/L, potassium 6 mEq/L, bicarbonate 15 mEq/L, and chloride 110 mEq/L.

Due to concern that the serum creatinine might overestimate his true GFR because of the quadriplegia, renal clearance measurements were performed. Twenty-four-hour urine studies, collected from the loop, revealed a volume >6 L, protein excretion 5 g/day, urea clearance 3 mL/min, and a creatinine clearance of 4 mL/min, a value less than his urinary flow rate. Urine pH was 9 and a culture grew diphtheroids, *Staphylococcus*, and *Streptococcus*. Institution of hemodialysis was recommended.

The creatinine excretion rate of 175 mg per day seemed low even for his decreased muscle mass, so an inulin clearance test was performed and gave a result of 21 mL/min. Urine frozen immediately upon collection

and later tested yielded a creatinine clearance of 24 mL/min and a urea clearance of 15 mL/min. Dialysis was deferred. A rectal biopsy revealed amyloidosis.

The patient's urine mixed with 1000 mg creatinine at 20°C was sampled at 0, 6, 12, and 24 hours, and showed a time-dependent decline in creatinine levels (Figure).

DISCUSSION

Creatinine-consuming bacteria in soil and bowel are known. Colonization of the gastrointestinal tract with creatinase would cause increased extrarenal clearance and overestimations of GFR based on serum creatinine alone but would not alter urinary clearance. Urine also provides an ideal environment for creatinine-degrading bacteria. The creatinine clearance calculated from a 24-hour urine collection was 5-fold less than the real value. Creatinase in the patient's urine was demonstrated in vitro. The results of the inulin test and use of creatinine assays on frozen urine support this finding. As creatinase was first discovered in soil *Corynebacterium*,⁴ this diphtheroid may have been the source of the patient's creatinine degradation. Urease, also present in the patient's urine, artifactually decreased urea clearance.

A falsely low creatinine clearance may negatively impact medical decision-making. In patients with urinary diversions and bacteriuria, it is advised to freeze freshly collected urine samples before assay or to perform a true GFR by iothalamate or inulin clearance.

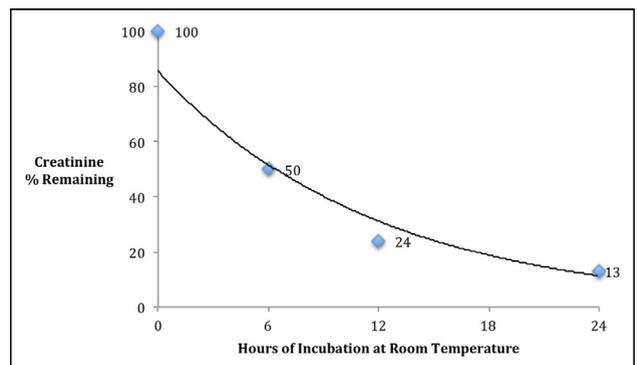


Figure Disappearance of creatinine added to patient's urine in vitro.

Funding: None.

Conflicts of Interest: None.

Authorship: The author is solely responsible for writing this manuscript.

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<http://dx.doi.org/10.1016/j.amjmed.2014.07.030>

ACKNOWLEDGEMENTS

The author wishes to acknowledge Drs. John Goffinet and Andrew Fuller for valuable discussions.

References

1. Jones JD, Burnett PC. Creatinine metabolism in humans with decreased renal function: creatinine deficit. *Clin Chem.* 1974;20(9):1204-1212.
2. Dunn SR, Gabuzda GM, Superdock KR, Kolecki RS, Schaedler RW, Simenhoff ML. Induction of creatininase activity in chronic renal failure: timing of creatinine degradation and effect of antibiotics. *Am J Kidney Dis.* 1997;29(1):72-77.
3. Jones JD, Burnett PC. Implication of creatinine and gut flora in the uremic syndrome: induction of "creatininase" in colon contents of the rat by dietary creatinine. *Clin Chem.* 1972;18(3):280-284.
4. Dubos R, Miller BF. The production of bacterial enzymes capable of decomposing creatinine. *J Biol Chem.* 1937;121(2):429-445.