

Spot urine tests for proteinuria: are they accurate?

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Introduction

Under physiological conditions, protein excretion does not exceed 150 mg/day for adults or 140 mg/m² body surface area for children¹. Glomerular proteinuria is due to increased glomerular permeability to proteins and occurs in primary and secondary glomerulopathies. Dipstick and precipitation by heat (boiling test) are the commonly used methods for detecting proteinuria. Though these tests offer semi-quantitative results, the gold standard remains 24-hour urinary protein measurement².

Objectives

1. to determine how a spot urinary test for proteinuria co-relates with 24-hr urinary protein excretion
2. to determine if significant diurnal variation occurs in protein excretion, requiring early morning protein sampling
3. to compare the results of precipitation (boiling test) and urine strip methods in urinary protein analysis.

Methods

Data was obtained from 75 consecutive patients who underwent 24-hour urinary protein testing at the medical professorial unit, University of Colombo. Patients were instructed to collect three samples of urine at 0700, 1100 and 1400 hrs. Before adding this sample to the 24-hr collection, 1 cc was separated and analyzed for protein within 2 hrs

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of collection. 24 hr urinary protein samples were analyzed the next day, when collection was complete.

Precipitation method (boiling test) results were graded from 0 to 4+ as follows:

- 0 no protein
- 1 + trace
- 2 + protein present, but test tube is not opaque
- 3 + protein present, test tube opaque
- 4 + protein present with precipitation (clot)

Dipstick testing (using Bayer diagnostics multistix 10 SG code 2300) had one of 5 possible results:

- 0 no protein
- 1 10 mg% (trace) protein
- 2 30 mg%
- 3 100 mg%
- 4 300 mg% or greater

Result

Mean 24 hour urinary protein for each category (0 to 4 for precipitation method (boiling test), and 0 to 4 for dip dipstick testing) of 0700, 1100 and 1300 hrs urine samples are given in Table 1 and 2.

Table 1

Mean 24 hour urinary proteinuria for each (0700, 1100 and 1400 hr) sample of spot urinary protein using precipitation method (boiling test).

Time	0700 hrs	1100 hrs	1400 hrs
Proteinuria (mg)			
0	135	252	224
1+	389	1094	990
2+	2084	2612	2174
3+	4350	4796	4334
4+	4530	4356	4653

Table 2

Mean 24 hour urinary proteinuria for each (0700, 1100 and 1400 hr) sample of spot urinary protein using dipstick method

Time	0700 hrs	1100 hrs	1400 hrs
Dipstick result			
0	135	259	122
1 or trace (10 mg%)	202	456	430
2 or 30 mg%	350	953	678
3 or 100 mg%	1062	1028	929
4 300 mg% or greater	3915	4012	4049

(proteinuria in mg)

No significant differences were seen to suggest a diurnal variation in protein excretion.

All three precipitation method (boiling test) samples (0700, 1100, and 1400 hrs) at 1+ correspond to a proteinuria of more than 300 mg/24 hrs, which is a significant protein loss. A 2+ result in the precipitation test included proteinuria of upto 2612 mg% which is close to the nephrotic range of protein loss.

Trace results on dipstick testing included proteinuria up to 456 mg%, while at 100 mg% proteinuria on dipstick, proteinuria of > 1000 mg/24 hours was observed.

3+ and 4+ in the precipitation test and 4+ in the dipstick test were well over the nephrotic range of protein loss.

Discussion

Significant proteinuria on 24 hr testing was found even with a 1+ result on precipitation method (boiling test) and with a 10 mg% (trace) result on strip testing. A 1+ or 10 mg% proteinuria is often ignored as insignificant on spot urine analysis, and rarely will

doctors follow up such proteinuria with confirmation using 24 hr collections.

At 2+ on boiling test or 300 mg% on dipstick testing, proteinuria in excess of 2000 mg/24 hours was noted.

Based on these results quantification of proteinuria is inaccurate both by boiling or strip testing of spot urine samples. The routine use of 24-hour collection is justified in order to quantify protein loss, as single point testing is often inaccurate.

No significant diurnal variation was noted in this study. The need to collect early morning specimens, and the increased morning work load for the laboratory is not justified by our findings.

As 24 hour collection is both costly and time consuming, we recommend an alternative approach of quantification of proteinuria using a protein to creatinine ratio whenever 24 hour collection is not possible⁴.

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