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Caffarel J[1], Griffiths C[1], Pickard R[1], Robson W[1], Clarkson B[1], Drinnan M[1]
1. Newcastle upon Tyne Hospitals NHS Trust

A NON-CONTACT UROFLOWMETER

<u>Hypothesis / aims of study</u>

Existing flowmeters are contact instruments which interfere with the urinary stream. This not only introduces a delay in the resulting flow signal but also leads to a possible loss of information. It has been speculated that urine flow may contain further information about the state of the lower urinary tract [1], other than that already obtained by the measurement of maximum flow rate and voided volume. As the urinary stream breaks into drops shortly after leaving the meatus [2] it was thought that the development of a non-contact flowmeter would better allow further investigation of the urinary stream. This was the basis for the so-called “urinary drop spectrometer” [1]. We developed a new version of such a non-contact uroflowmeter and investigated its performance. We present the preliminary results of this test.

<u>Study design, materials and methods</u>

An improved version of an existing instrument allowing the detection of individual urine drops was constructed. This version, contrary to previous instruments [1,3], allows the recording of 2-dimensional drop information. Testing of the instrument took place in the laboratory using a calibrated flow device (500ml, constant 15ml/s). 10 flows were simultaneously recorded using the instrument and a weight-transducer uroflowmeter for comparison. Our initial measurements are reported for total volume and mean flow rate.

<u>Results</u>

Flow Test	**Volume (ml)**		**Mean flow rate (ml/s)**		**Comments**
	Weight-transducer	*Non-contact*	*Weight-transducer*	*Non-contact*	
1	495	444	15.3	13.3	Underestimation due to undetected drops
2	492	516	15.5	15.9	Reasonable estimation of flow
3	488	430	15.6	13.5	Underestimation due to undetected drops
4	493	525	15.2	15.8	Reasonable estimation of flow
5	491	518	15.6	16.1	Reasonable estimation of flow
6	498	689	15.1	20.6	Overestimation due to artefact (discussed later)
7	501	521	15.7	16.1	Reasonable estimation of flow
8	484	512	15.8	16.4	Reasonable estimation of flow
9	491	411	15.7	13.2	Underestimation due to undetected drops
10	498	529	15.4	15.7	Reasonable estimation of flow

Table 1 – Comparison of volume and flow calculations with the results obtained from the weight-transducer flowmeter.

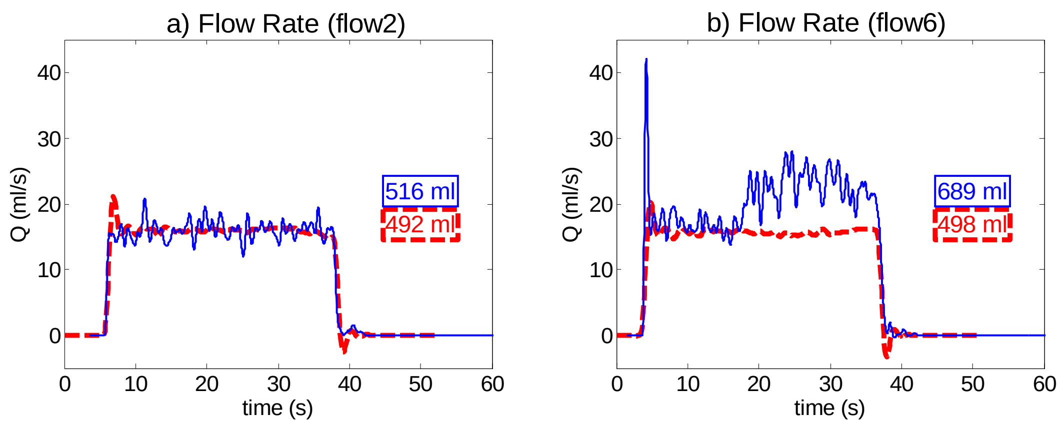

Figure 1 – a) Example of flow rate trace for which a reasonable estimation was obtained. b) Example of flow trace with overestimation. The (red) dotted line represents the flow recording with the weight-transducer flowmeter, the (blue) full line the flow calculated using our instrument.

Interpretation of results

We obtained 6 reasonable flow estimations (Table 1, Fig.1a), 3 underestimated flows and 1 overestimated flow (Table 1, Fig.1b). However, this is the first test we have performed on our device and this has enabled us to identify the key problems to solve.

The underestimation of the flows 1,3 and 9 was due to drops being undetected by our instrument. An improvement on our algorithm could either reduce the number of undetected drops and/or account for this situation. The overestimation for flow 6 was due to drops splashing onto the instrument mid-way through the flow. This can be identified by a subsequent increase in volume/flow estimation (from t=18s in Fig.1b), as the “artefact drops” are included in all subsequent volume calculations. The spike artefact observed in Fig.1b is due to the stream not immediately breaking into drops at the initiation of flow. This, due to the way we are calculating the volume, results in an overestimation of the flow at that instant. This is in contrast with the momentum artefact (spike and trough at start and end of flow) due to the use of the weight-transducer flowmeter without baffle and/or funnel. The flows were measured in this way to obtain a faster response from the flowmeter.

Concluding message

We have devised a new means of measuring flow rate without interfering with the urinary stream. This preliminary testing has enabled us to identify potential pitfalls of the instrument. However, we believe the shortcomings identified can be overcome by further improvement of our instrument and our algorithm. Work is currently in progress to address these issues and improve the performance of this instrument.

References

[1] Transactions of the IEEE (1976) 23; 266:269.
[2] Southern Medical Journal (1932) 25; 863:864.
[3] Non-Discussion Poster, ICS 2005; Abstract 374.

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