Logistical considerations of doing a different GFR protocol for patients with Oedema

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Introduction

Recent published work has highlighted that GFRs are significantly over-estimated in patients with oedema (Wickham *et al.*, 2013), with percentage errors between -10% and 125% reported. Errors are more significant for patients with low GFR or if fewer samples are taken (Wickham *et al*., 2015).

A four sample method (samples at 2,4,8,24 hours) has been validated for patients with oedema (Wickham *et al.*, 2013). However, from a systematic review of GFR techniques, a single sample GFR technique was recommended for patients **without** oedema (McMeekin *et al*., 2016a).

It is therefore becoming difficult to justify maintaining a 'one protocol fits all' approach for radionuclide GFR tests, as a single sample test on a patient with oedema carries high errors, and a four sample (2,4,8,24 hour) protocol for all patients is difficult to schedule in an outpatient setting and is inconvenient for patients.

In this work we retrospectively evaluated 200 cases to determine whether we could check if patients have oedema in advance of their GFR test

An Overview of the New Dual Protocol

This graphic summarises the change in workflow in changing our practice to align with current evidence in literature.
We would move from our existing 3 sample GFR test that is used for all patients to running two protocols depending on oedema status.

Current Workflow

Referral

"One fits all" Protocol

- Three sample slope-intercept method (SI-GFR)
- Samples taken at 2, 3, 4 hours
- **Moderate errors if patient has oedema**

Proposed Workflow

Referral

Check History for Oedema

New Standard Protocol

- Single sample method
- Time of single sample determined by expected GFR result⁺
- **Much higher errors if patient has oedema**

Oedema Protocol

- Four sample method
- Samples taken at 2, 4, 8 and 24 hours
- **Robust, but inconvenient and relies on effective screening**

⁺ Determining the eGFR will present further logistical issues, however this has not been considered in this work.

Results

We retrospectively evaluated 200 patient's imaging on PACS and their GFR worksheets for mention of oedema, ascites or excess fluid. 45 patients had mention of oedema on either available CT / Ultrasound imaging or the GFR worksheet (29 from imaging, 23 from the worksheet, 7 cases were concordant)

Of **29** patients with oedema on imaging

- **7** patients mentioned oedema when asked
- 22 patients did not.

Of **23** patients who said that they have oedema

- We knew this from imaging in **7** patients
- 16 patients did not have oedema noted on imaging, or imaging was not available

*Asking patients about oedema had a sensitivity of 24% (**7/29**)*

*Checking imaging for oedema had a sensitivity of 30% **(7/23)***

Analysis

These two sensitivities can be combined (using a method analogous to Keightley, 2014) to approximate the total number of patients with oedema in our cohort as 95 in 200 [(23*29)/7]. In real terms this represents an estimate of the total true and false positives that we would identify if all patients had relevant available imaging.

Of the estimated 95 patients with suspected oedema, we would only have known of 45 patients and hence assigned these to the 'oedema' protocol, leaving 50 patients with suspected oedema assigned to the single sample test, which carries high errors in oedematous patients.

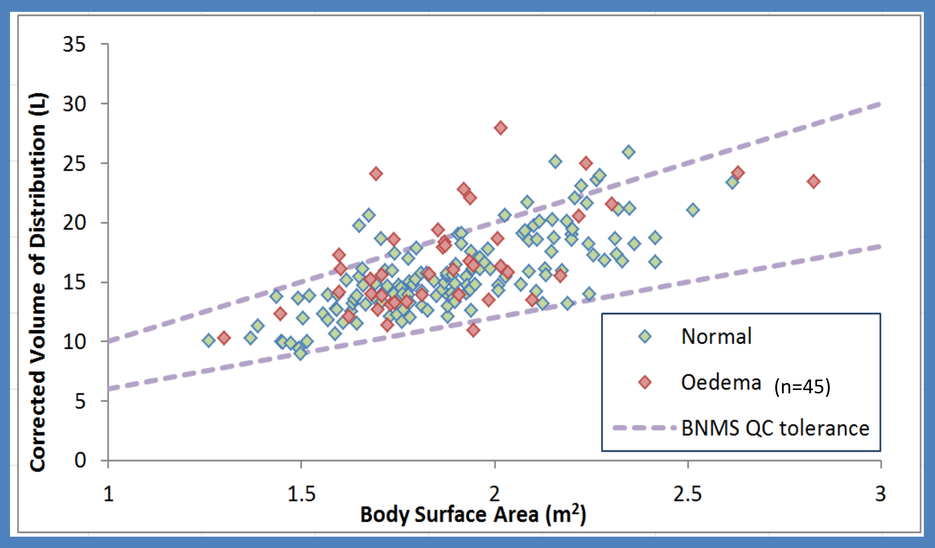

Figure 1: The volume of distributions of the "oedema" and "normal" groups

Oedema status vs Volume of Distribution

We correlated our findings with the volume of distribution (figure 1). The proportion of patients that exceeded the BNMS QC tolerance of 10*BSA was *not* significantly different between the two groups (p=0.105). This observation supports McMeekin *et al.*'s (2016b) work that established that this QC check only identifies oedema in 7% of cases with a positive predictive value of 3%.

Conclusion

1. **Running separate protocols for oedematous patients requires a robust way of checking for oedema in advance.**
2. **Checking available imaging and asking patients directly is estimated to have identified oedema in less than 50% of cases in our cohort**
3. **Volume of distribution is not a sensitive way of identifying oedema retrospectively and its value as a QC check is questionable.**

In the absence of a robust way of checking for oedema in advance, it is not possible to move to the proposed dual protocol. Further improvements to oedema detection may come from improved communication with referrers and examining the whole clinical history, not just checking available imaging for mention of oedema.

References
Keightley (2014): www.npl.co.uk/upload/pdf/20140227-rctc-keightley.pdf
McMeekin *et al.* (2016a): NMC 37(7) pp 743-755.
McMeekin *et al.* (2016b): NMC 37(7) pp 756-766.
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In relation to this presentation, I declare that there are no conflicts of interest.

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