Research letter

European Journal of Emergency Medicine 2021, 28:147–148

Point-of-care ultrasound to reveal hydronephrosis in the emergency department: an observational, prospective, semi-blinded single-center study

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Received 25 November 2019 Accepted 28 June 2020

Urinary tract infection (UTI) is the most common cause of urosepsis and often leads to hospitalization [1]. Different studies have investigated symptoms and patient presentations to predict the development of complicated UTIs, identifying fever and obstructive uropathy as predictors [2]. The diagnosis of hydronephrosis based on the initial clinical assessment and blood test in the emergency department (ED) is challenging, as symptoms for hydronephrosis are unspecific. No studies have investigated the prevalence of hydronephrosis in an unselected patient population in the ED suspicious to or diagnosed with UTI or elevated creatinine. The purpose of point-of-care ultrasound (POCUS) is to immediately answer focused clinical questions when examining the patient, for example, the presence of hydronephrosis. In recent study, clinical examination supplemented by POCUS increased the confidence in principal diagnosis, when considering the findings of hydronephrosis and urinary retention in a population presenting with renal colic [3].

The aim of this study was to investigate prevalence of hydronephrosis in patients presenting with symptoms of UTI or elevated creatinine in the ED.

Patients were included as a convenience sample during day and evening shift in the period 4 November 2018 to 8 April 2019. Inclusion criteria were age above 18, able to perform written consent and suspicious to kidney involvement defined as increased creatinine (from reference or 10% elevation from individual baseline) or presenting with either symptom: dysuria, polyuria, fever or positive urine sample. Patients admitted or assessed in the ED suspected for UTI or unknown infection with signs of kidney involvement were included in the project. In Denmark, patients are referred to the ED from a general practitioner or out-of-hour medical service with a tentative diagnosis [4]. The tentative diagnosis was used to screen all patients in the ED. All potentially eligible patients were examined by the research assistant with respect to inclusion criteria. Patients underwent regular clinical examination and treatment while a research assistant performed the POCUS examination to ensure execution of the POCUS examination in all included patients. POCUS results were unblinded to the clinicians after they had decided whether the conventional radiological examination was considered. Within four hours after arrival to the ED all included patients had POCUS performed by a research assistant (P.B.). For each patient, 5-s videoclips were obtained in transversal and longitudinal plan of kidneys and bladder in a swiping movement using GE S8. We defined hydronephrosis as dilation of the renal pelvis and at least one calyx. We used four grades to illustrate the severity of hydronephrosis defined as following [5]: grade I: mild dilation of renal pelvis and at least one large calyx grade II: clear dilation of renal pelvis and larger calices grade III: clear dilation of renal pelvis plus smaller and larger calyces grade IV: grade III changes and cortical thinning. The research assistant underwent 4-h e-learning [6], practical training, hands-on training and finally 35 scans supervised by a certified POCUS specialist, before performing the POCUS examinations. The aim was to make it comparable to interns and emergency physicians performing POCUS in the ED. As gold standard, all videoclips were evaluated by a radiologist specialized in urology radiology to interpret presence of hydronephrosis.

Primary outcome was prevalence of hydronephrosis in an unselected population presenting to the ED with UTI or elevated creatinine. Presence of hydronephrosis in different subgroups depending on diagnosis were examined.

All patients gave informed consent. Data were stored based on approval from the Region of Southern Denmark nr. S-20180126. Registered on ClinicalTrials.gov with registration NCT03873701. In accordance with Danish law, no permission was needed from The Regional Committees on Health Research Ethics for Southern Denmark (S-20180126).

In our study, 153 patients were included. We identified 20 (13.1%) [95% confidence interval, (8.2–19.5)] patients

Table 1 Hydronephrosis in study population

Hydronephrosis in study population distributed on grades	*N* (%)
Total hydronephrosis	20 (13.1)
Grade I	11 (7.2)
Grade II	4 (2.1)
Grade III	4 (2.1)
Grade IV	1 (0.7)

with hydronephrosis. 11 (7.2%) patients presented with grade I, four (2.6%) with grade II or III and one (0.7%) with grade IV (Table 1). Distribution of hydronephrosis using the International Classification of Diseases-10 revealed 10 cases finally diagnosed with UTI (eight with cystitis, one with pyelonephritis and one with urosepsis), one with urolithiasis, four with urinary retention and four with dehydration. The prevalence of hydronephrosis depending on final diagnosis were 14.1% of patients with UTI, 14.3% with urolithiasis, 50.0% with urinary retention and 18.2% with dehydration. Clinicians decided to refer 71 out of the 153 patients to conventional ultrasound, independent of the study. Among patients not referred to as conventional radiology after clinical assessment, POCUS revealed hydronephrosis in nine patients (11.5%).

It is well known that some types of pyelonephritis progress more severely, a recognized risk factor for this is hydronephrosis [7]. In our study, we did not register treatment or hospitalization days as a measure of severity or illness in the patients. Thus, our study does not examine the relation between hydronephrosis and mortality or hospitalization. When classifying final diagnosis discharge summary was used, this might have caused an overrepresentation of simple cystitis because pyelonephritis is a clinical diagnosis. Our results suggest hydronephrosis to be considered generally in patients suspicious for UTI or with elevated creatinine with clinical signs of kidney involvement. POCUS is performed by the treating physician, and there is no delay, in comparison to radiological ultrasound. POCUS could assist treating physicians to reveal high-risk patients.

We had eight false-negative cases compared to our gold standard, no severe hydronephrosis (grades III–IV) were missed. No false-positive hydronephrosis was found. In general, all hydronephrosis was classified as one grade lower by POCUS compared to radiological evaluation.

Our study included patients presenting in the ED suspicious to kidney involvement presenting a wide range of severity. Due to the Danish healthcare system, patients are referred through a general practitioner (GP) who treats mild cases and referred patients often require further treatment. Thus, patients not referred from a GP to the hospital could not be included in the study.

Hydronephrosis was present in 13.1% of adult patients in the ED presenting with symptoms of UTI.

Acknowledgements

The study was supported by Lilly and Herbert Hansens foundation.

Conflicts of interest

There are no conflicts of interest.

References

1 Sabih A, Leslie SW. *Complicated Urinary Tract Infections*. StatPearls. Treasure Island (FL): StatPearls Publishing; 2019.
2 Jorgensen S, Zurayk M, Yeung S, Terry J, Dunn M, Nieberg P, Wong-Beringer A. Risk factors for early return visits to the emergency department in patients with urinary tract infection. *Am J Emerg Med* 2018; **36**:12–17.
3 Nixon G, Blattner K, Muirhead J, Kerse N. Rural point-of-care ultrasound of the kidney and bladder: quality and effect on patient management. *J Prim Health Care* 2018; **10**:324–330.
4 Danish authorities. The National Association of Municipalities and Regions of Denmark; Life in Denmark. 2012. https://lifeindenmark.borger.dk/Living-in-Denmark/Emergencies. [Accessed 24 November 2019].
5 Leo MM, Langlois BK, Pare JR, Mitchell P, Linden J, Nelson KP, *et al*. Ultrasound vs. computed tomography for severity of hydronephrosis and its importance in renal colic. *West J Emerg Med* 2017; **18**:559–568.
6 Laursen CB GO, Davidsen JR, Kristensen MS, Tiwald G, Bolvig L, *et al*. Basal og klinisk ultralydsdiagnostik. Munksgaard; 2017. Available at: http://basal-klinisk-ultralydsdiagnostik.munksgaard.dk/. [Accessed 1 September 2018].
7 Gibbons R, Leonard N, Magee M, Zanaboni A, Patterson J, Costantino T. Xanthogranulomatous pyelonephritis: a complicated febrile urinary tract infection detected by point-of-care ultrasound in the emergency department. *J Emerg Med* 2018; **55**:e1–e4.

DOI: 10.1097/MEJ.0000000000000742