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Producing urine is the process of eliminating waste products and toxic substances, to maintain fluid balance in the body (McLafferty et al., 2014). Urinalysis using a reagent test strip is an inexpensive, simple and non-invasive procedure, to assess the health status of an individual by measuring elements found in the urine such as electrolytes, hormones, or waste products of metabolism (Yates, 2016).

It is often carried out at routine medical examinations or in contact with the midwife during pregnancy.

Urine can be used in combination with other more invasive testing to identify conditions such as diabetes, acute kidney injury, chronic kidney disease, urinary tract infection, dehydration and pre-eclampsia.

Urine can be used for pre-surgical preparation, or on acute or planned hospital admission. It is routinely tested on first contact to form a baseline for future assessment (Royal College of Nursing (RCN), 2016). Frequency thereafter will depend on the rationale for urine testing and the person's general health status.

Sample collection

There are various methods of urine collection, including:

Random specimen: a randomly collected sample, suitable for the majority of screening purposes

Mid-stream urine sample: collected after the first part of the urine flow is voided, cleansing the urethra. The mid-stream is collected in a sterile pot and the final part of the urine is then voided into the toilet. This is particularly useful for bacterial culture.

24-hour urine collection: urine collected over a 24-hour period can be useful in measuring substances such as steroids, white cells and electrolytes, and in some instances, it can be useful in determining urine osmolality (Tortora and Derrickson, 2014)

First-morning specimen: the first urine void of the morning (or following 8 hours after semi recumbent positioning), this can be useful for example in pregnancy testing.

Fasting specimen: the second voided sample following a specified period of fasting which is appropriate for protein, enzyme and metabolite analysis when expressed relative to creatinine concentration.

Catheter specimen of urine: a sample of urine obtained using a sterile syringe from a catheter port (Baille and Arrowsmith, 2006) this can be useful for bacteriological examination.

For the most reliable results urinalysis should be performed immediately following voiding. If this is not possible then do so within 2 hours (Dougherty and Lister, 2015; Collie et al, 2018).

Preparation and equipment

It is vital that the health professional understands the rationale for undertaking the urinalysis, and has the competence to perform the procedure with comprehensive knowledge of the equipment required (*Table 1*).

Reagent test strip procedure

Before procedure

Discuss the procedure with the patient to optimise the quality of the specimen (where possible) (Bardsley, 2015; Nursing and Midwifery Council (NMC), 2018; Shepherd, 2017)

Obtain verbal informed consent and document a clear, accurate record of this (NMC, 2018)

Ensure privacy and dignity is maintained (Collie et al, 2018; NMC, 2018) in an appropriate environment for the patient to provide a fresh sample of urine in the sterile container provided (NB urinalysis is not an aseptic procedure)

Prepare the appropriate equipment for the procedure (*Table 1*)

Carry out good hand hygiene and apply personal protective equipment (PPE) (RCN, 2016b; RCN, 2016c) in accordance with trust policy

Decontaminate the clinical surface before testing

Check the expiry date of the reagent test strips and ensure that the container is closed again securely before use

Ensure that you have sight of a clock with a second hand

During procedure

Open the test strip container, remove the test strip, and then replace the cap securely

Dip the test strip into the urine, ensuring that all test squares are fully submerged in the urine, for the recommended time as specified by the manufacturer (*Figure 1*)

Remove the test strip gently, dispersing excess urine by running the bottom edge of the strip along the rim of the container (Roche Diagnostics, 2010)

Place the test strip on a piece of gauze and wait for the time specified by the manufacturer. Please note that some squares on the test strip for example leucocytes, require more time than others for an accurate reading.

Do not shake or blot the squares of the test strip

Hold the test strip horizontally to analyse and compare this against the colour reference grid provided. Ensure that there is no contact between the test strip and the container and that urine does not run between squares, mixing various reagents (Roche Diagnostics, 2010)

If the urine is required for further laboratory testing, accurately label the specimen container using the correct patient details. If the urine is not required, dispose of the urine into a designated sluice or toilet, and the specimen container along with the urine test strip into a clinical waste bin.

After procedure

Decontaminate the work area and remove and dispose of PPE, in accordance with local policy.

Carry out effective hand hygiene, to prevent cross-infection (RCN, 2016c).

Document all results accurately and discuss the findings with the patient, as well as further action, which may be required (NMC, 2018).

Inform the relevant practitioner of any abnormal results (NMC, 2018).

Interpreting results

It is important to examine the urine for odour, colour and clarity before undertaking urinalysis with the test strip and this can provide indications of patient's health status prior to testing (Yates, 2016) (*Table 2*).

Interpreting the results requires an understanding of the clinical implications of the individual reagent squares. Urinalysis using a reagent strip can be subjective given that, some squares may present with a colour between the negative and the lowest positive and individual interpretation of this may be distinctively different (Newson, 2016).

Leucocytes

Leucocyte esterase is produced by neutrophils and may be a sign of pyuria associated with a urinary tract infection, but sometimes may indicate a more severe renal problem (Steggall, 2007; Bardsley, 2015).

Nitrites

These are not typically present in urine, they can be associated with the presence of bacteria that can convert nitrate into nitrite, suggesting a potential urinary tract infection. However, the absence of nitrites does not always rule out a urinary tract infection, as there is the potential for a false negative result (Deville et al, 2004).

Bilirubin and Urobilinogen

Bilirubin is a chemical produced when red blood cells are broken down. In the gut, bilirubin is broken down to urobilinogen, which is excreted in urine. (RCN, 2016). Thus, the presence of bilirubin can indicate liver damage. Whilst higher than normal levels of urobilinogen may suggest liver disease and lower than normal might indicate gallstones.

Protein

Urine does not routinely contain a level of protein detectable on a urine reagent strip (in a healthy individual). Damage or disease to the glomerular filtration barrier, hypertension, kidney damage, diabetes mellitus and pre-eclampsia (in pregnancy) can cause proteinuria (Mulyan, 2011).

pH

All urine will give a pH reading on analysis and it is usually slightly acidic. A range of 4.5-8.0 is considered normal (RCN, 2016). Extremes of acidity may indicate formation of urinary stones, while alkaline urine may indicate a urinary tract infection with certain types of bacteria, such as *Proteus mirabilis*, *Klebsiella* or *Pseudomonas* (Higgins, 2007). However, diet and medication can also alter pH.

Blood

The urine reagent strips do not normally detect blood; it can enter the urine via damage to the filtration barrier in the kidneys (Yates, 2016). Haematuria can be detected in the presence of kidney disease, kidney stones,

tumours, infections, trauma (RCN, 2016a), or as a consequence of cross contamination, for example, vaginal bleeding during menstruation.

Specific Gravity

This identifies hydration—a well-hydrated individual will have diluted urine whereas dehydration will produce a concentrated urine. The normal range of specific gravity is 1.001-1.035 (Yates, 2016).

Ketones

Not normally present in the urine, they form during the abnormal breakdown of fat, instead of glucose for energy (NHS website, 2016). This can be caused by prolonged vomiting, such as pregnant women with hyperemesis gravidarum, or fasting and starvation (NHS website, 2016). However, they can also be detected during dieting, episodes of diarrhoea, or as a sign of raised blood glucose, such as in poorly controlled diabetes, which can result in diabetic ketoacidosis (increased acidity of the blood) (RCN, 2016).

Glucose

May be detected in pregnancy (as a consequence of a reduced renal threshold and increased renal blood flow) (Newson, 2016) or for patients who take corticosteroids (Yates, 2016). Glycosuria is not normal and can be indicative of endocrine abnormality such as diabetes mellitus (or gestational diabetes mellitus); however, urinalysis alone will not be diagnostic.

Conclusion

Urinalysis is common practice and as such, health professionals must have the necessary skills to competently collect the specimen and carry out the procedure limiting the risk of contamination by using the test strips accurately. Whilst possessing the skills to interpret findings in combination with the presentation and clinical history of the patient. Often requiring further testing to provide a more definitive diagnosis. **BJN**

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