

Haematuria: Urological work-up 2018

Hin Fan Chan MBBS FRACS (Urology)



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Learning Objectives

By the end of the session, you should be able to:

1. define the various types of haematuria
2. become familiar with the different terminology commonly used
3. appreciate the clinical significance of haematuria
4. identify the management goals
5. take appropriate initial management steps
6. arrange and interpret relevant investigation and imaging results
7. identify the indications for specialist referral
8. formulate an appropriate follow-up and on-going management plan



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Haematuria

Definition

- Presence of blood or red blood cells in urine

Causes of haematuria

Urological causes

Common

Benign prostatic hyperplasia
Cancer (bladder, kidney, prostate, ureter)
Calculus disease or nephrolithiasis
Cystitis or pyelonephritis
Prostatitis or urethritis
Schistosoma haematobium infection

Less common

Radiation cystitis
Urethral strictures
Tuberculosis
Medullary sponge kidney
Cyclophosphamide induced cystitis

Rare

Arteriovenous malformation
Renal artery thrombosis
Polycystic kidney disease
Papillary necrosis of any cause
Loin pain haematuria syndrome

Nephrological causes

Common

IgA nephropathy (Berger's disease)
Thin basement membrane disease

Less common

Acute glomerular disease:

- Postinfectious glomerulonephritis
- Rapidly progressive glomerulonephritis
- Systemic lupus nephritis
- Vasculitis
- Goodpasture's disease
- Henoch-Schönlein purpura syndrome
- Haemolytic-uraemic syndrome

Chronic primary glomerulonephritis:

- Focal segmental glomerulonephritis
- Mesangio-capillary glomerulonephritis
- Membranous nephropathy
- Mesangial proliferative glomerulonephritis

Familial causes:

- Polycystic kidney disease (autosomal dominant or recessive)
- Hereditary nephritis (Alport's syndrome)
- Fabry's disease
- Nail-patella syndrome

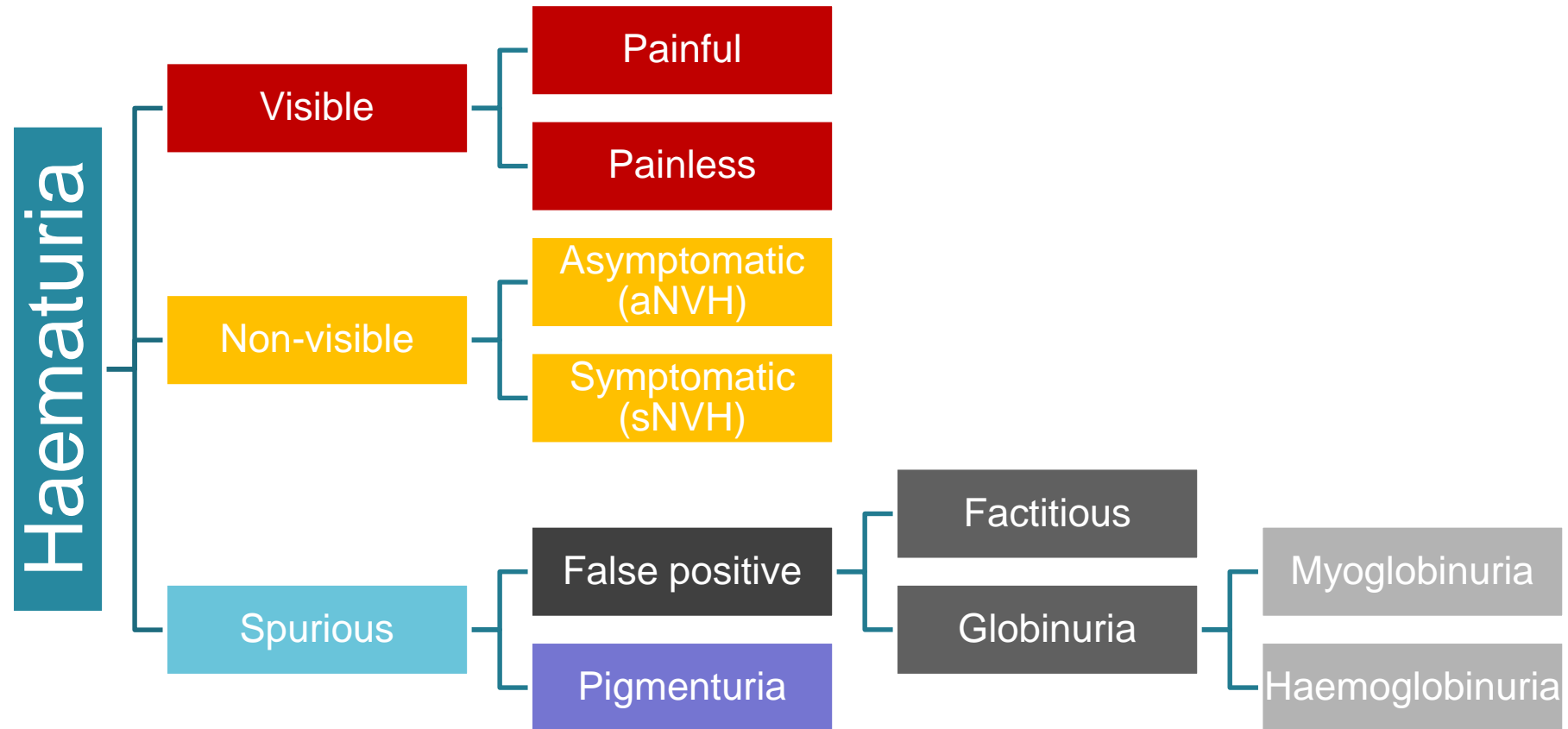


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Terminology and classification of haematuria



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Examples of discoloured urine

Pigmenturia	Blue/green	Pseudomonas infection	
		Medications	Amitriptyline, Indomethacin, promethacin, triamterene
	Orange	Medications	Phenazopyridine, laxatives/phenolphthalein, rifampin, sulfasalazine
	Dark yellow	Bilirubin	
		Food (Carrots, riboflavin, Vit A)	
		Medications	Sulfonamides, chloroquine, phenacetin
	Red	Porphyria	
		Beets, berries	
		Food coloring (Rhodamine B)	
		Medications	Phenothiazines, Phenazopyridine, Adriamycin, rifampin, Phenytoin



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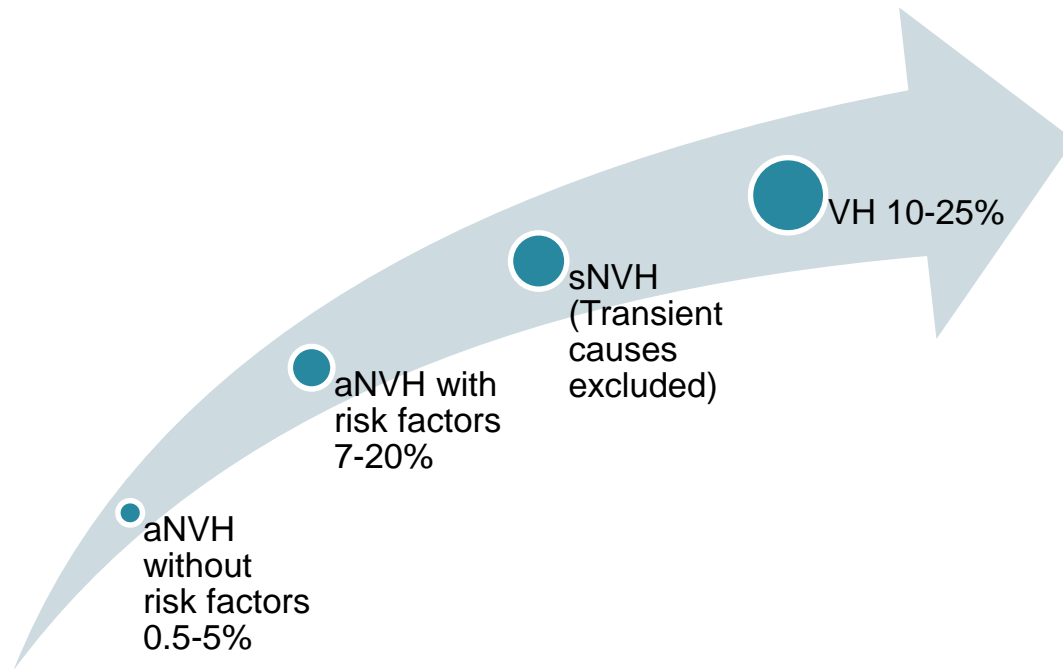
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Overall management goal

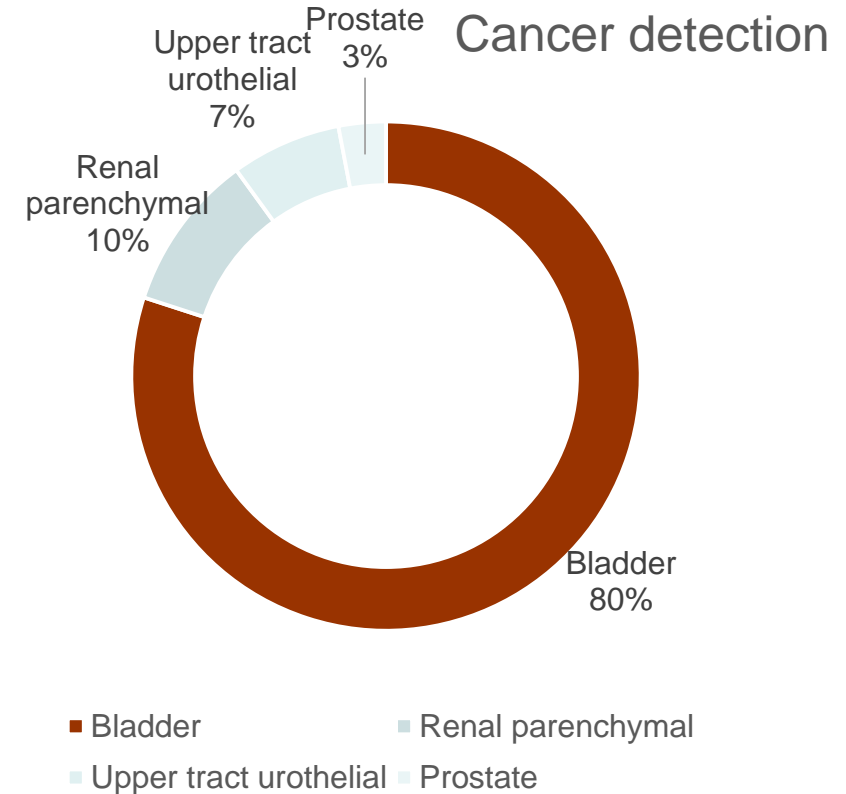
Exclusion of biologically significant underlying uro-pathology

Urological significance of haematuria



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Risk factors for bladder cancer

Risk factors
Male
Age greater than 50
Past or current smoking
Occupational or other exposure to chemicals or dyes (polycyclic aromatic hydrocarbons or aromatic amines)
Analgesic abuse (phenacetin)
Prior visible haematuria
History of urological disorder or disease
History of irritative voiding symptoms (urgency and frequency)
History of pelvic irradiation
History of chronic urinary tract infection
History of exposure to known carcinogenic agents or chemotherapy, such as alkylating agents (particularly cyclophosphamide)
History of chronic indwelling foreign body

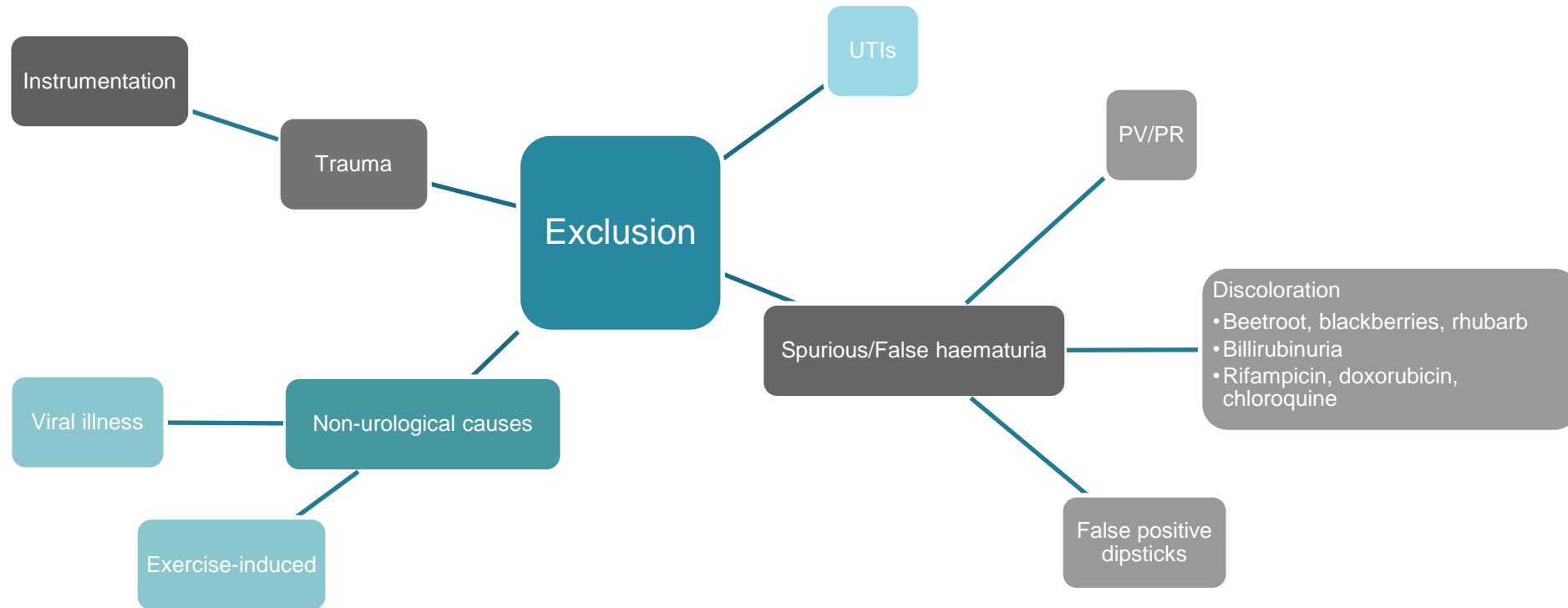


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Initial management: Exclude transient and false haematuria



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Learning objectives: End of part 1

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4

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Suggested initial GP management

History

Risk stratification
Limiting factors in likely
management (e.g.
contrast allergies)

Examination

Pulse, BP
Abdomen
+/-DRE
+/-PV

Investigations

EUC: Creatinine and
eGFR
Random urine for
albumin:creatinine ratio
Dipstick
**(MSU + red cell
morphology)*
**(Urine cytology series)*
Others: FBC,
Coagulation profile, STI
PCR, PSA



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Haematuria: Confirmation urine tests

Guidelines	Confirmation of haematuria	Imaging	Urine cytology/biomarkers
BAUS	Single freshly voided urine 1+ haem on dipstick	No current recommendation Ultrasound suggested by working group	No
NICE	Single freshly voided urine 1+ haem on dipstick	No current recommendation Ultrasound suggested by working group	No
AUA	*Urine microscopy	CTIVP	No
ACT Health (TBC)	*Urine microscopy	CTIVP	Cytologyx3 Cxbladder Triage under trial



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Case 1: 72F “I passed blood in my urine!”

How would you verify the presence of blood in the urine?



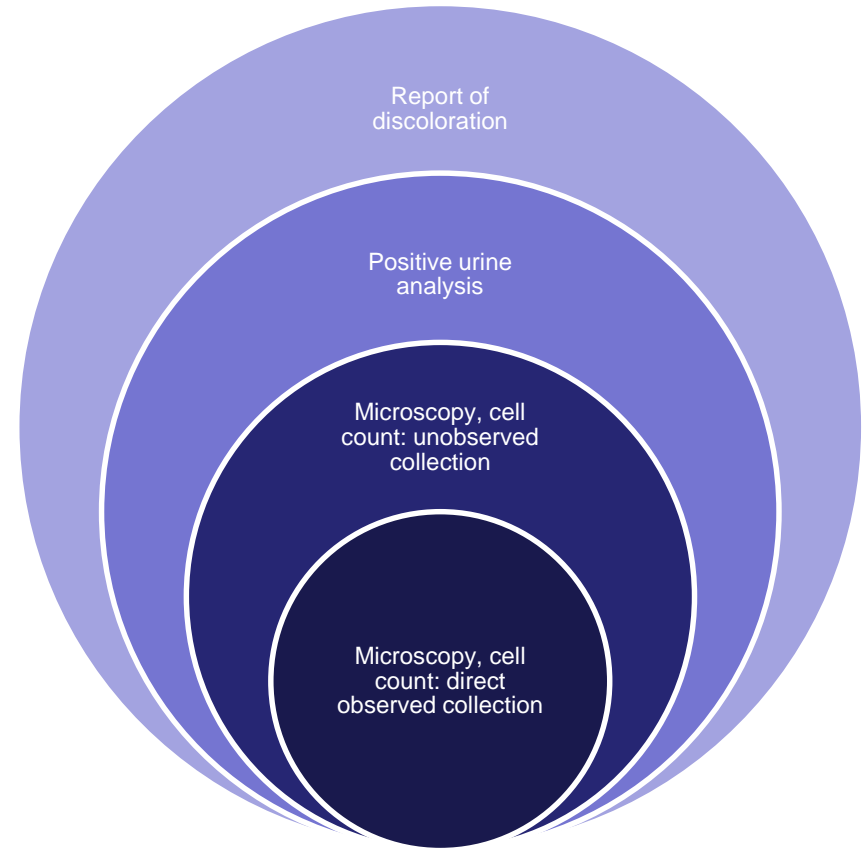
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Confirmation of haematuria: Levels of confidence

- Different levels of confidence for positivity
 - Unverified reports of discoloration
 - Bilirubinuria
 - Beeturia
 - Factitious
 - Urinalysis
 - Freshly voided
 - Dropper/syringe
 - 1+ (or more) positive haem
 - Microscopy
 - Fresh, clean-catch
 - RCPA: RBC $>10 \times 10^8/L$ (chamber count)
 - Also commonly accepted: 3 RBC/HP field (centrifuged)
 - *Check local preference



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Dipsticks

Relies on oxidation of an organic peroxide on the test strip by the peroxidase-like activity of haemoglobin.

Good overall accuracy in primary care settings:

- Single (1+ or more) positive haem in freshly voided sample

False positive

- Oxidising agents
- Bacterial peroxidase
- Bleach
- Myoglobinuria/haemoglobinuria

False negative

- Reducing agents
- Ascorbic acid

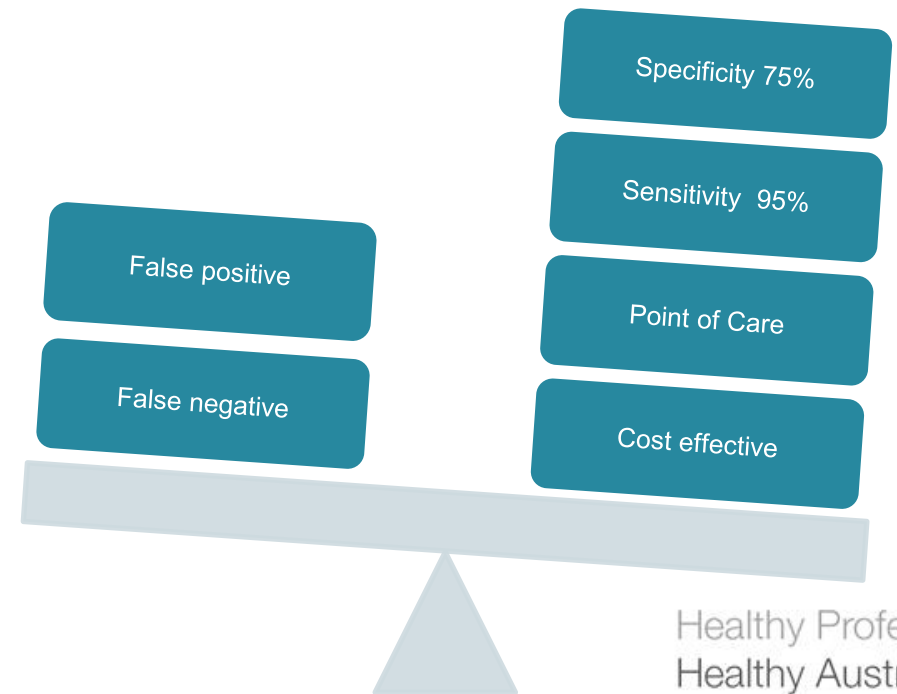


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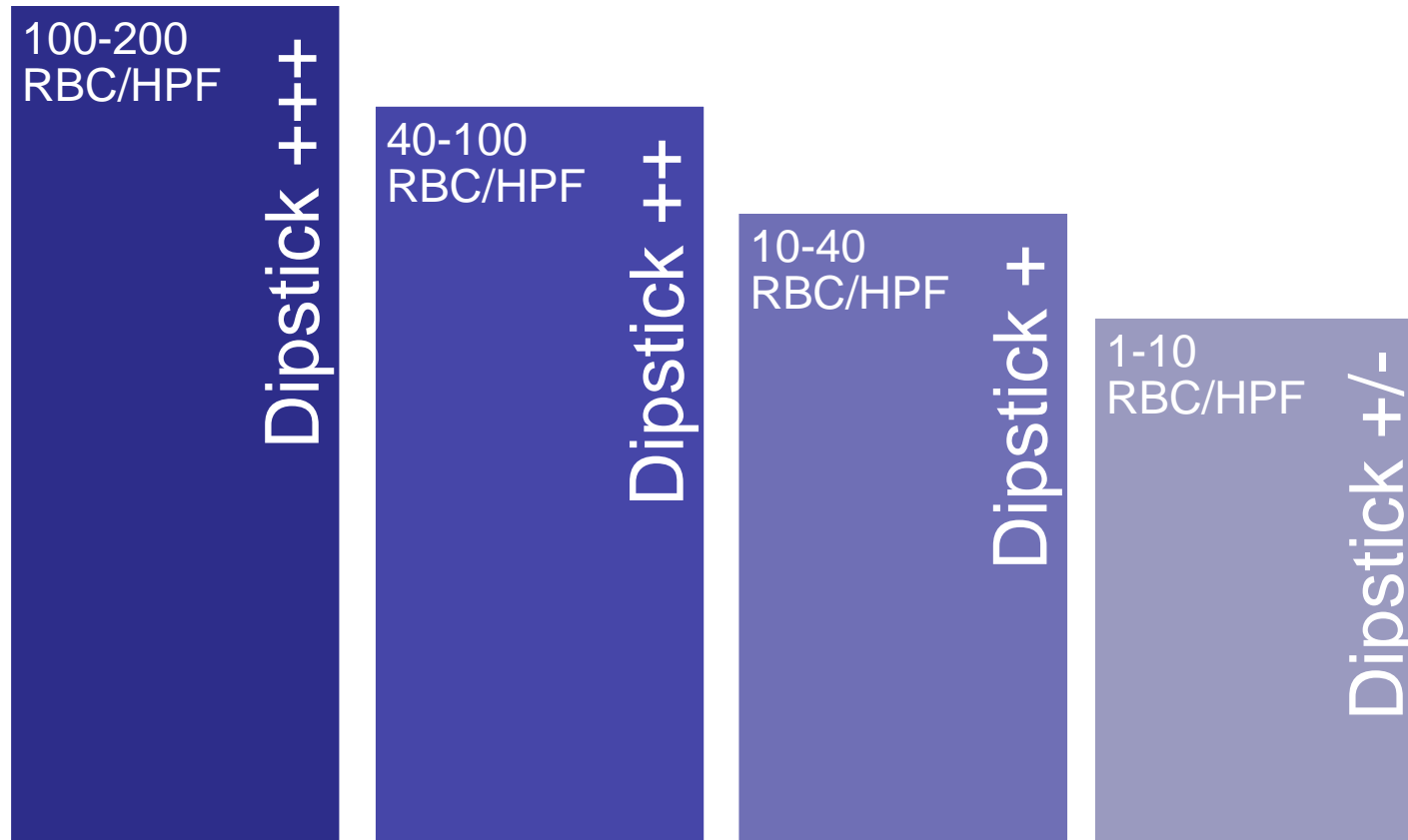
Disadvantages

Advantages



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Dipstick-microscopy equivalence



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Case 1: Outcome

++ dipstick

Initial MSU RC10-100 but contaminated

Repeat clean MSU negative for blood with urine microscopy

Completed negative urological investigations

Confirmed PV bleeding

Subsequent uterine cancer diagnosis treatment

Message:

- *Dipstick and urine microscopy are not equivalent*
- *Urine microscopy generally considered “Gold standard” in the urology setting*



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Confirmation of haematuria in urology

Urine microscopy

Fresh, clean-catch

RCPA: RBC $>10 \times 10^8/L$
(chamber count)

Also commonly
accepted: 3 RBC/HP
field (centrifuged)

*ACT Health referral
(TBC)



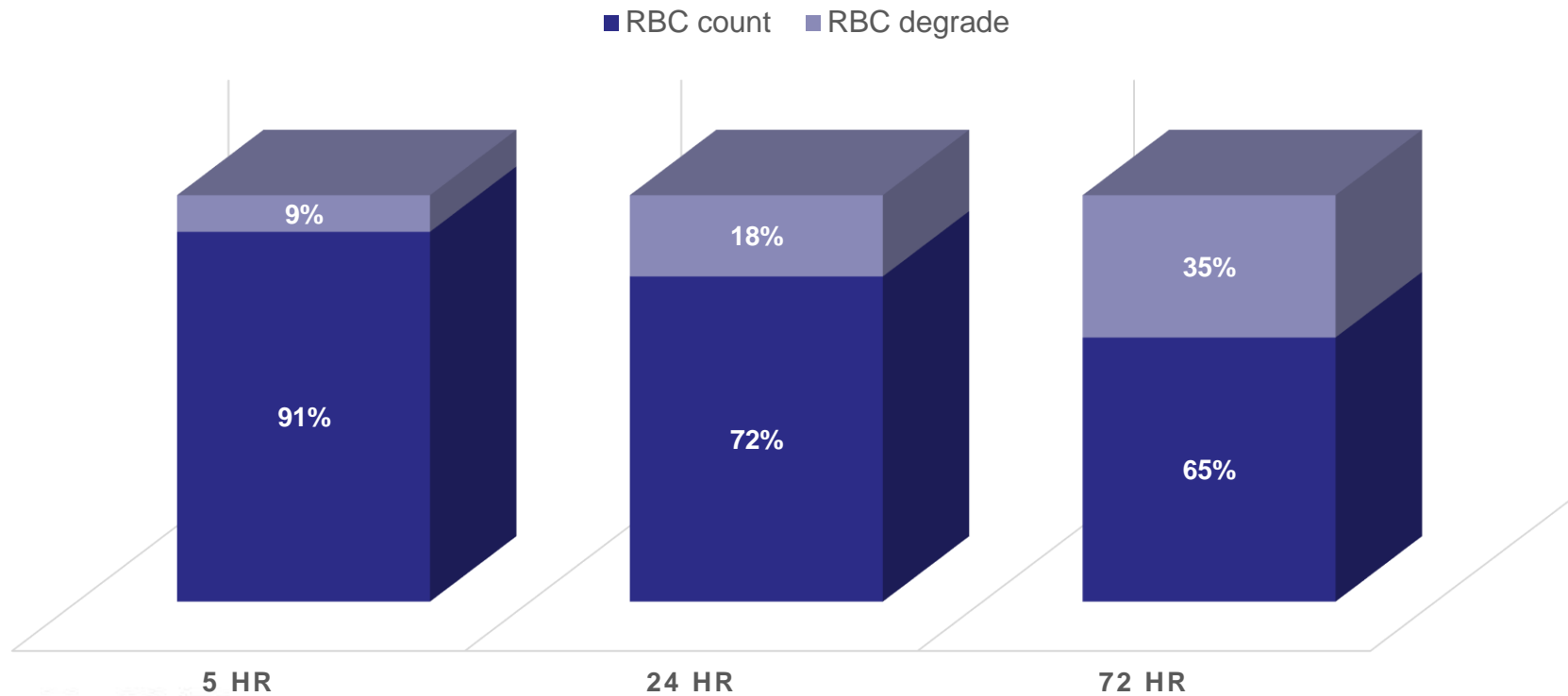
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Use freshly voided sample

DELAY IN MICROSCOPY CAUSES DECREASE IN RBC COUNT



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Haematuria: Imaging

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Case 2: 17 M recurrent visible haematuria proven on microscopy and otherwise negative laboratory investigations

How do you decide which imaging modality to use?

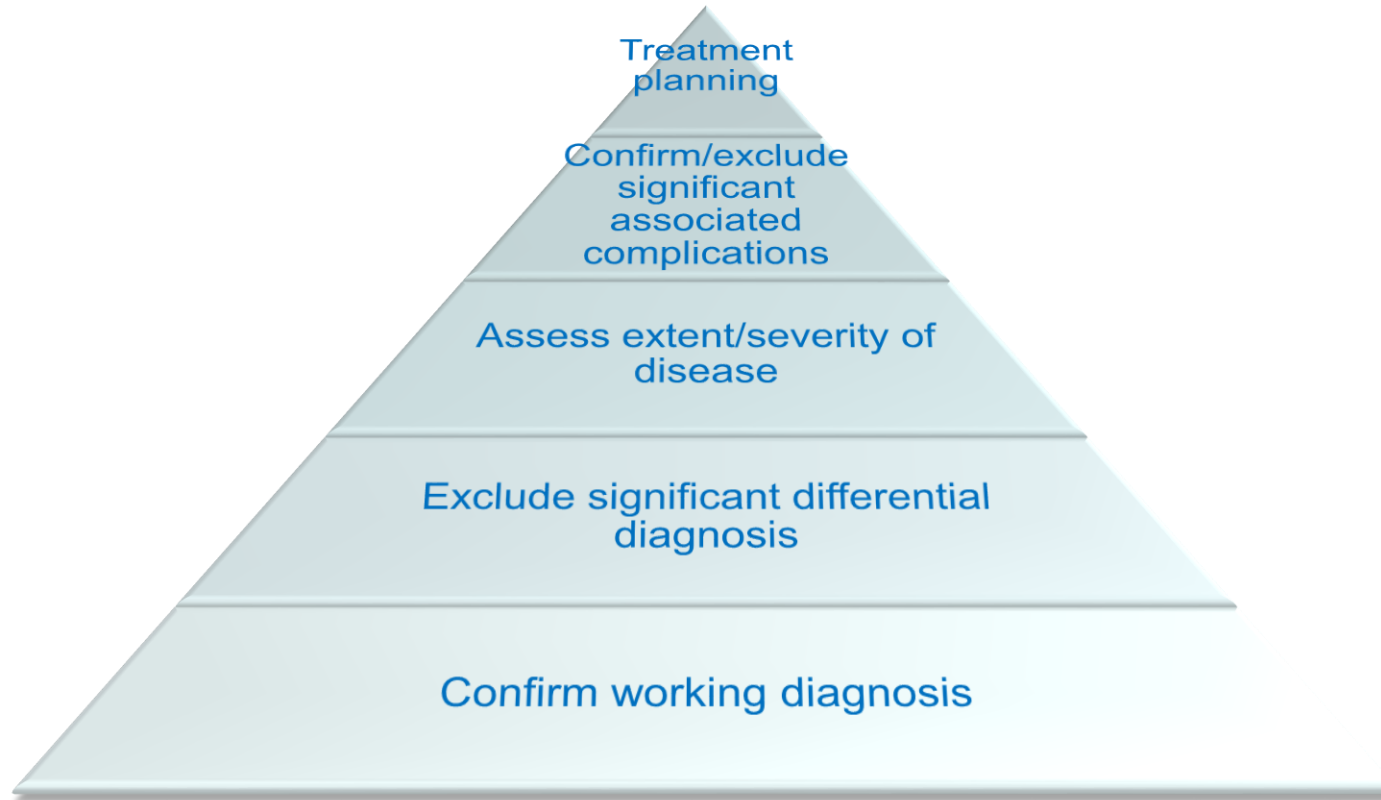


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Advantages of CTIVP/CTU



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Disadvantages of CTIVP

Risks of CTU

The risks associated with CTU are a result of radiation exposure and administration of iodinated IV contrast.

Exposure to radiation

The average radiation dose varies from 15-52mSv, whereas the radiation dose for unenhanced CT is 3-12mSv and can be further reduced to 1.4-2.1mSv ^[37-39].

Patients exposed to as little as 10mSv may have increased risk for cancer ^[40] and multiphase abdomen/pelvis CT has been associated with highest adjusted lifetime risk for cancer (4 per 1000 patients) ^[41].

Iodinated IV contrast

In addition, there is a 0.2-0.7% risk of adverse reactions due to IV contrast, including:

- hives
- bronchospasm
- laryngeal oedema
- hypovolemic shock
- rarely death
- contrast-mediated nephropathy ^[42].

Therefore, many investigators have explored the possibility of using unenhanced CT as the initial investigation. Unenhanced CT identified 58% ^[43] to 97.6% ^[44] of significant haematuria-related abnormalities.

Lisanti et al. 2014

A recent study found no additional benefit of CTU versus unenhanced CT in evaluating upper tracts with a less than 1% chance of missing an upper tract malignancy in adults younger than 50 years old with a-NVH ^[45].



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Dutch Association of Urologist

Pre-test probability for malignancy

Four points	Three points	Two points	One point
Presence of VH	Age \geq 50 years	Smoking	Exposure to chemical or occupational carcinogens
History of upper tract urothelial cancer		Persistent a-NVH	Analgesic abuse
History of bladder cancer		History of multiple UTIs	
		History of urolithiasis	
		History of pelvic irradiation	

CTU was first-line imaging for patients with a score of ≥ 7 [4].



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Case 2: Outcome

MSU confirmed haematuria, urine cytology negative

U/S bladder right-sided mass, right hydronephrotic atrophic kidney

CTIVP additional findings multiple “metastatic nodes”

History of “micturition attack”

Familial paraganglioma (extra-adrenal pheochromocytoma)

Endocrinology/endocrine surgery/radiation oncology/urology multidisciplinary management

Message:

U/S as initial imaging choice is reasonable to avoid radiation exposure in younger patient

CTIVP usually used in all cases other than aNVH



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Haematuria: Cytology and biomarkers

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Case 3: 55M microscopy confirmed painless visible haematuria with negative CTIVP

What additional urine test may be helpful?



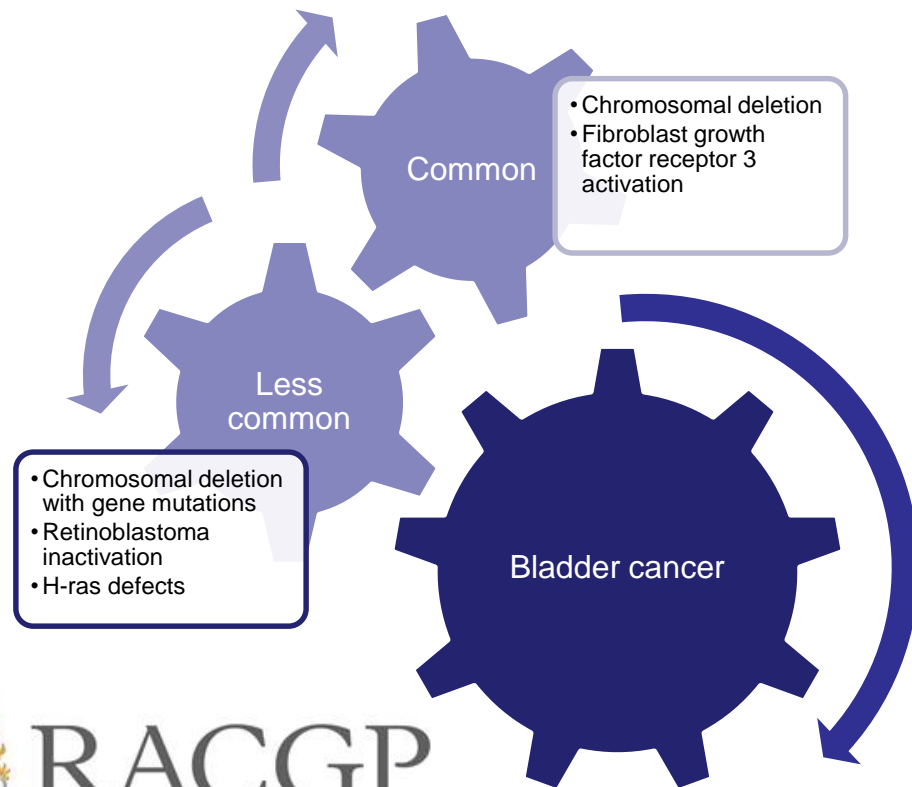
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Clinical use of biomarkers in bladder cancer detection

Molecular and genetic basis for bladder cancer



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Cxbladder Triage NPV 98.5%

Phenotype

- Age
- Gender
- Haematuria
- History of smoking/exposure

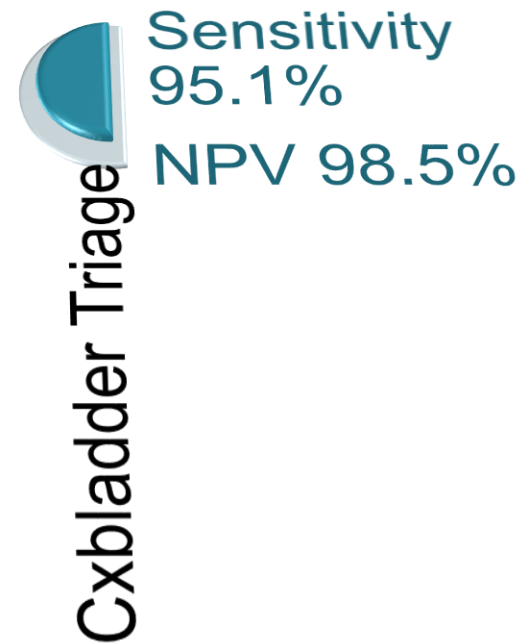
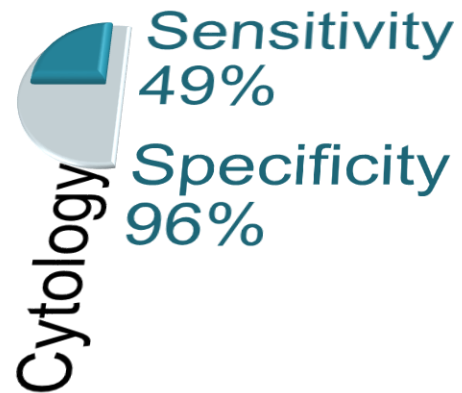
Genotype

- IGFBP5
- HOXA13
- MDK
- CDK1
- CXCR2

Cxbladder
Triage risk
assessment

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Urine cytology vs Cxbladder Triage



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Role of Cxbladder Triage in haematuria management

Positive

May be possible to by-pass flexible cystoscopy to rigid cystoscopy

Negative

Still require timely urological investigation to exclude other significant uro-pathology

Urological causes

Common

Benign prostatic hyperplasia
Cancer (bladder, kidney, prostate, ureter)
Calculus disease or nephrolithiasis
Cystitis or pyelonephritis
Prostatitis or urethritis
Schistosoma haematobium infection

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Radiation cystitis
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Rare

Arteriovenous malformation
Renal artery thrombosis
Polycystic kidney disease
Papillary necrosis of any cause
Loin pain haematuria syndrome



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Case 3: Outcome

Initially reluctant to undergo cystoscopy

Non-smoker: -ve cytology and Cxbladder Triage

Low PSA, normal DRE, -ve FHx

Cystoscopy and biopsy prostatic ductal adenocarcinoma

No other pathology

Radical surgery after completion of staging

Message:

Important to remember bladder cancer is not the only possible cancer cause



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Learning objectives: End of part 2

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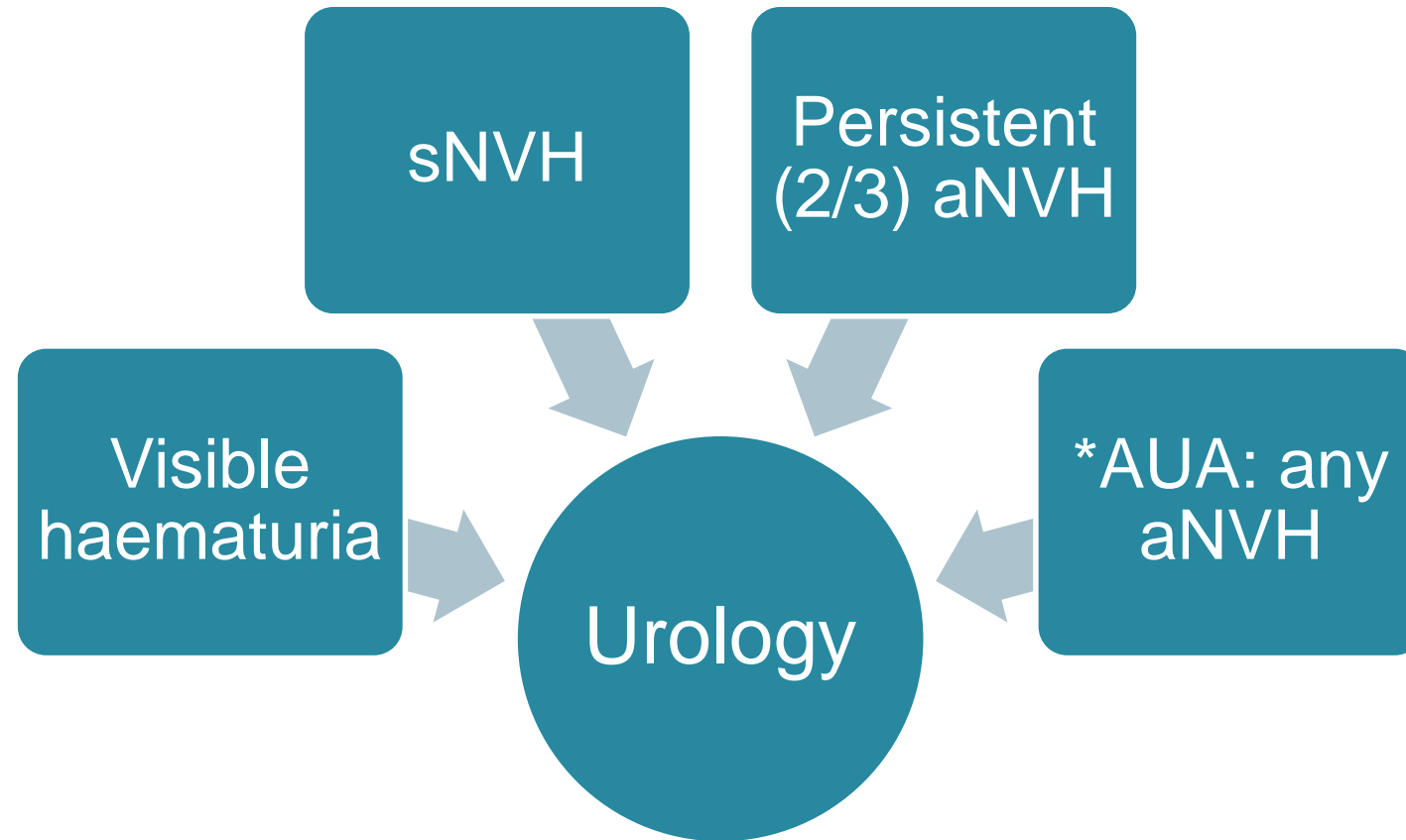


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Significant haematuria for referral



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Referral guidelines

There is currently no Australian guideline

Guidelines	VH	sNVH	aNVH
BAUS	<ul style="list-style-type: none">Refer all casesFor >45y.o. refer as suspected cancer if no transient cause	<ul style="list-style-type: none">Refer all casesFor >60y.o. refer as suspected cancer if no transient cause or has elevated WCC	<ul style="list-style-type: none">For >40y.o. refer as non-urgent
NICE	<ul style="list-style-type: none">Refer all casesFor >45y.o. refer as suspected cancer if no transient cause	<ul style="list-style-type: none">Refer all casesFor >60y.o. refer as suspected cancer if no transient cause or has elevated WCC	<ul style="list-style-type: none">For >40y.o. refer as non-urgent
AUA	<ul style="list-style-type: none">Refer all cases	<ul style="list-style-type: none">Refer all cases	<ul style="list-style-type: none">Refer all cases >35y.o<35y.o. + risk factors
ACT Health (TBC)	<ul style="list-style-type: none">Refer all cases without transient causes as suspected cancer	<ul style="list-style-type: none">Refer all casesRefer as suspected cancer if<ul style="list-style-type: none">imagine/cytology suggest canceror has risk factor for urological cancer	<ul style="list-style-type: none">Refer all cases >35y.o.Refer as suspected cancer if<ul style="list-style-type: none">imagine/cytology suggest canceror has risk factor for urological cancer



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sNVH bladder cancer risk factors: age, dysuria, WCC

Research

Sarah J Price, Elizabeth A Shephard, Sally A Stapley, Kevin Barraclough and William T Hamilton

Non-visible versus visible haematuria and bladder cancer risk:

a study of electronic records in primary care



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Table 2. PPVs for clinical features of bladder cancer in patients aged <60 years, in combination with visible or non-visible haematuria

Clinical feature	PPV (95% CI) for feature when presented with:	
	Visible haematuria	Non-visible haematuria
★ Dysuria	4.1 (2.6 to 6.3)	★ 4.5
Abdominal pain	2.3 (1.5 to 3.5)	1.7 (0.6 to 4.2)
Constipation	2.2 (1.5 to 3.4)	2.0
Urinary tract infection	2.2 (1.8 to 2.8)	1.4 (0.8 to 2.4)
★ Raised white cell count	3.7 (2.1 to 6.3)	★ 3.9
Raised inflammatory markers	3.3 (2.0 to 5.4)	1.3
Raised creatinine	2.9 (2.1 to 3.9)	1.1 (0.6 to 2.2)

PPV = positive predictive value. 95% CIs have not been calculated when any cell in the 2x2 table was <5 (invariably because too few controls had both features).

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Age-based guidelines: who will miss out?

available at www.sciencedirect.com
journal homepage: www.europeanurology.com



Platinum Priority – Brief Correspondence
Editorial by Yair Lotan on pp. 15–16 of this issue

Who Should Be Investigated for Haematuria? Results of a Contemporary Prospective Observational Study of 3556 Patients

Wei Shen Tan^{a,b,*}, Andrew Feber^c, Rachael Sarpong^d, Prमित Khetrपाल^{a,b}, Simon Rodney^{a,c}, Rumana Jalil^d, Hugh Mostafid^e, Joanne Cresswell^f, James Hicks^g, Abhay Rane^h, Alastair Hendersonⁱ, Dawn Watson^f, Jacob Cherian^j, Norman Williams^d, Chris Brew-Graves^d, John D. Kelly^{a,b},
on behalf of DETECT I trial collaborators



Table 2 – Incidence of malignancy in male and female patients, stratified according to age groups

Age groups	Visible haematuria, n (%)					Nonvisible haematuria, n (%)				
	Total patients	All urinary tract cancers	Bladder cancer	Renal cancer	Upper tract TCC	Total patients	All urinary tract cancers	Bladder cancer	Renal cancer	Upper tract TCC
Male patients										
10–19	2	0 (0)	0 (0)	0 (0)	0 (0)	0	0 (0)	0 (0)	0 (0)	0 (0)
20–29	19	1 (5.3)	1 (5.3)	0 (0)	0 (0)	2	0 (0)	0 (0)	0 (0)	0 (0)
30–39	44	0 (0)	0 (0)	0 (0)	0 (0)	7	0 (0)	0 (0)	0 (0)	0 (0)
40–44	47	3 (6.4)	2 (4.3)	0 (0)	1 (2.1)	20	1 (5.0)	1 (5.0)	0 (0)	0 (0)
45–49	77	3 (3.9)	2 (2.6)	1 (1.3)	1 (1.3)	33	0 (0)	0 (0)	0 (0)	0 (0)
50–59	280	20 (7.1)	13 (4.6)	4 (1.4)	3 (1.1)	81	1 (1.2)	1 (1.2)	0 (0)	0 (0)
60–69	331	45 (13.6)	37 (11.2)	5 (1.5)	2 (0.6)	126	5 (4.0)	5 (4.0)	0 (0)	0 (0)
70–79	514	108 (21.0)	94 (18.3)	6 (1.2)	6 (1.2)	164	9 (5.5)	9 (5.5)	0 (0)	0 (0)
80–89	261	64 (24.5)	52 (25.2)	2 (0.8)	5 (1.9)	66	7 (10.6)	6 (9.1)	1 (1.5)	0 (0)
90–99	33	5 (15.2)	5 (15.2)	0 (0)	0 (0)	7	1 (14.3)	1 (14.3)	0 (0)	0 (0)
Total	1608	249 (15.5)	206 (12.8)	18 (1.2)	18 (1.1)	506	24 (4.8)	23 (4.6)	1 (0.2)	0 (0)
Female patients										
10–19	1	0 (0)	0 (0)	0 (0)	0 (0)	0	0 (0)	0 (0)	0 (0)	0 (0)
20–29	20	0 (0)	0 (0)	0 (0)	0 (0)	8	0 (0)	0 (0)	0 (0)	0 (0)
30–39	31	0 (0)	0 (0)	0 (0)	0 (0)	26	0 (0)	0 (0)	0 (0)	0 (0)
40–44	35	3 (8.6)	3 (8.6)	0 (0)	0 (0)	25	0 (0)	0 (0)	0 (0)	0 (0)
45–49	55	1 (1.8)	0 (0)	1 (1.8)	0 (0)	44	1 (2.3)	1 (2.3)	0 (0)	0 (0)
50–59	163	8 (4.9)	1 (0.6)	5 (3.1)	2 (1.2)	157	1 (0.6)	1 (0.6)	0 (0)	0 (0)
60–69	174	17 (9.8)	13 (7.5)	1 (0.6)	3 (1.7)	206	4 (1.9)	3 (1.5)	1 (0.5)	0 (0)
70–79	153	23 (15.0)	18 (11.8)	4 (2.6)	1 (0.7)	191	4 (2.1)	2 (1.0)	2 (1.3)	0 (0)
80–89	58	11 (19.0)	8 (13.8)	2 (3.5)	1 (1.7)	81	4 (4.9)	2 (2.5)	2 (3.4)	0 (0)
90–99	14	5 (35.7)	4 (28.6)	0 (0)	1 (7.1)	5	0 (0)	0 (0)	0 (0)	0 (0)
Total	704	68 (9.7)	47 (6.7)	13 (1.8)	8 (1.1)	743	14 (1.9)	9 (1.2)	5 (0.7)	0 (0)

TCC = transitional cell carcinoma

NICE-recommended age thresholds for haematuria investigations are shaded.



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Implications for Australia

Comment

BJUI
BJU International

Bladder cancer diagnosis during haematuria investigation – implications for practice guidelines

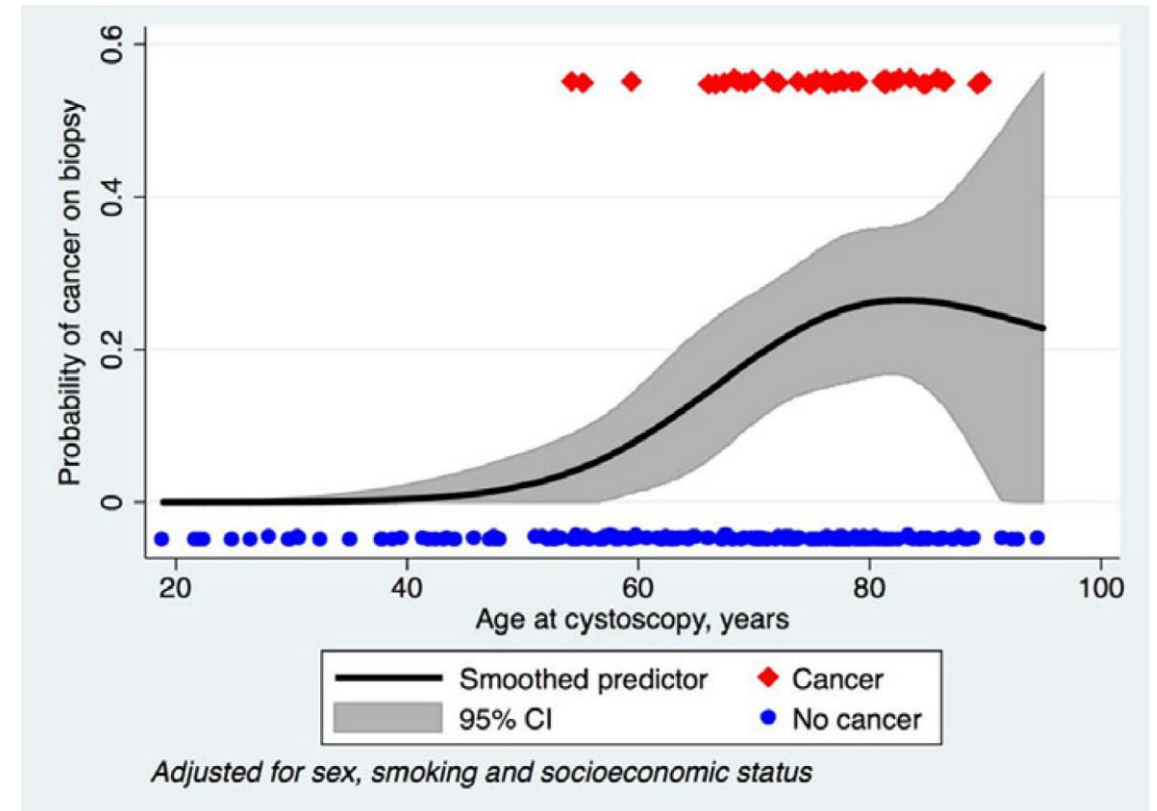
Brian Ngo, Nathan Papa, Marlon Perera, Damien Bolton and Shomik Sengupta

Department of Surgery, The University of Melbourne, Parkville, and Department of Urology, Austin Health, Heidelberg, Vic., Australia



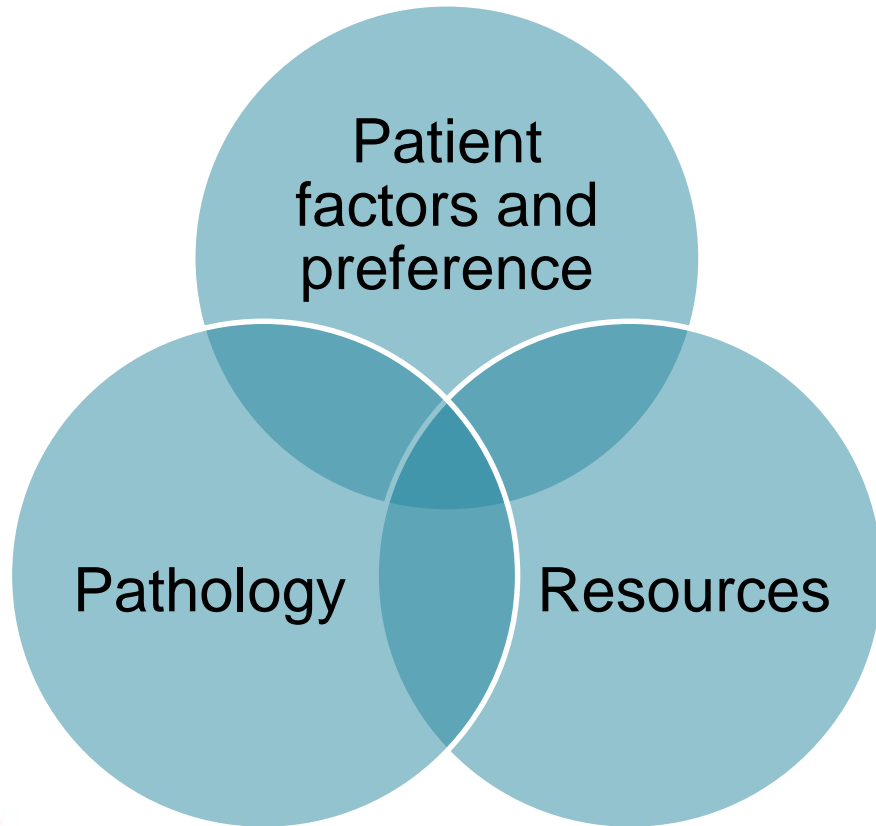
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When to refer to urologist? What to consider in real practice



- Guidelines often focus on best use of limited resources and the nature of the pathology
- Patient factors are also known to influence guideline recommendations
- Patient's preference should be addressed
- Banks J et al., Lancet Oncol 2014; 15:232-40
 - *85% patient surveyed would want a referral for investigation of symptoms attributed to have only a 1% risk of cancer*



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Learning objectives: End of part 3

Part 1

Part 2

Part 3

1.Part
4

1.define the
various types
of
haematuria

become
familiar with
the different
terminology
commonly
used

appreciate
the clinical
significance
of
haematuria

identify the
management
goals

1.take
appropriate
initial
management
steps

arrange and
interpret
relevant
investigation
and imaging
results

1.identify the
indications
for specialist
referral

1.formulate
an
appropriate
follow-up and
on-going
management
plan



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Case 4: 82M previous recurrent intermediate-risk bladder cancer on NOAG and recent development of dementia now due for regular 3-monthly check cystoscopy

What issues would you discuss with the patient, family and the urologist?



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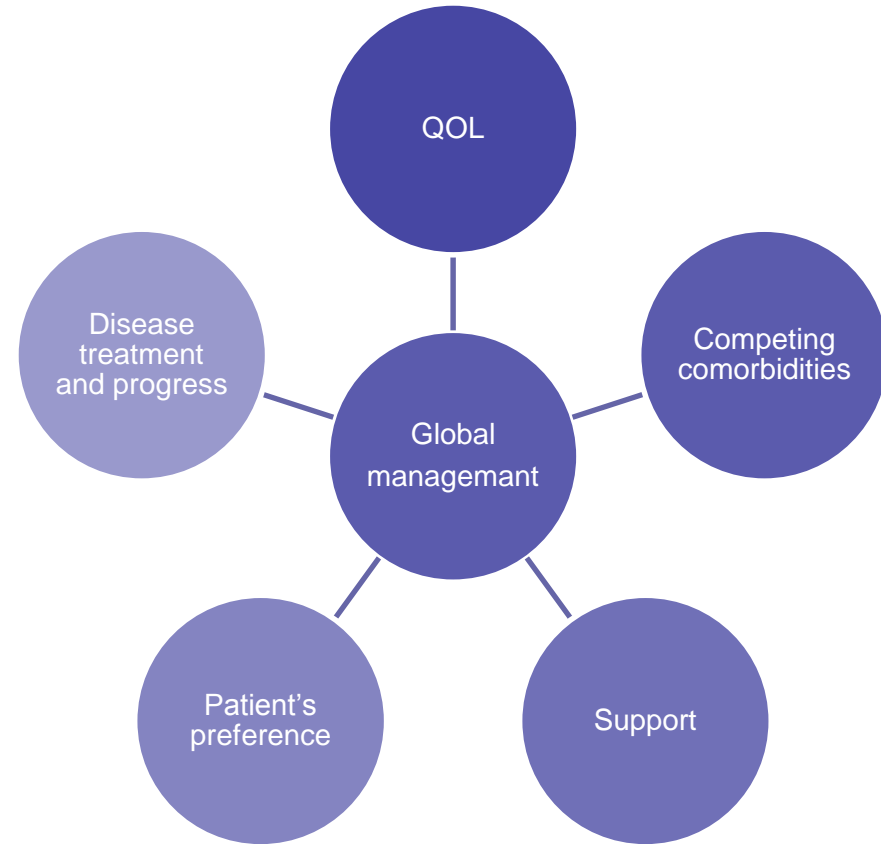
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Confirmed urological cancer diagnosis: Issues for GP consideration

Experts in seeing the big picture

Whenever appropriate, advocate for and facilitate with

- Compliance
- Additional specialist opinion
- Discontinuation of treatment/surveillance
- Advanced directive



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Case 4: Outcome

Cystoscopy surveillance was suspended indefinitely in consultation with patient, family and GP
GP monitoring with 6 monthly u/s, MSU, cytology
Accepting the chance of missing bladder cancer diagnosis ~10%

Message:

“...just because we can does not mean we should...”

GPs are often best placed to advocate for the evolving need of their patients

Case 5: 27M transient malaise and painless visible haematuria; discharged from urology service after negative urological work-up with discharge instruction “to follow-up with GP”

What exactly is “...to follow-up with GP”?



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Negative urological work-up: What now?

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BJU INTERNATIONAL

Patient-specific risk of undetected malignant disease after investigation for haematuria, based on a 4-year follow-up

Thomas J. Edwards, Andrew J. Dickinson*, Jane Gosling*, Paul D. McInerney*, Salvatore Natale* and John S. McGrath†

Departments of General Surgery and *Urology, Derriford Hospital, Plymouth, and †Department of Urology, Royal Devon and Exeter Hospital, Devon, UK

Accepted for publication 12 March 2010

The probability of missing malignant disease overall was 1.7% (95% CI, 0.95–3.04) but this rose sharply to >4% for males over 60 with macroscopic haematuria.

For those with non-visible haematuria, the percentage probability of missed malignant disease was less than 1%.

Other considerations:

- Nephrology review
- Repeat investigation after 3-5 years



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Guidelines on follow-up

Guidelines	Nephrology referral	Repeat urological investigation
BAUS/NICE	<40y.o. with <ul style="list-style-type: none">eGFR<60ACR >30HT	<ul style="list-style-type: none">VHsNVH
AUA	Dysmorphic RC, proteinuria, cell casts, renal impairment	Consider if persistent/recurrent haematuria after 3-5 years Clinician's judgement
ACT Health (TBC)	Dysmorphic RC, proteinuria/ACR>30, cell casts, renal impairment	Consider if persistent/recurrent haematuria after 3-5 years Clinician's judgement



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Case 5: Outcome

Nephrology review and subsequent biopsy proven IgA nephropathy under monitoring

Message:

End of urology management is not the end of haematuria management



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Learning objectives: End of part 4

Part 1

Part 2

Part 3

1.Part
4

1.define the
various types
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Next: Summary

QUESTIONS



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Summary

Objectives covered

1. define the various types of haematuria
2. become familiar with the different terminology commonly used
3. appreciate the clinical significance of haematuria
4. identify the management goals
5. take appropriate initial management steps
6. arrange and interpret relevant investigation and imaging results
7. identify the indications for specialist referral
8. formulate an appropriate follow-up and on-going management plan



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Take home messages

Be mindful of false haematuria

Aim to exclude biologically significant pathologies

Major UK and USA guidelines have differences and limitations

No Australian management guideline currently

ACT Health Urology Department developing referral guideline

Patients ultimately have to decide what is acceptable risks to them

Negative urological work-up common

Nephrology follow-up should be considered in some cases

Clinician's judgement for repeat urological investigations

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Hin Fan Chan MBBS FRACS (Urology)

END OF PRESENTATION



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Renal stone disease

Hin Fan Chan MBBS FRACS (Urology)



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Renal stone disease

EPIDEMIOLOGY



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Renal stone disease: Epidemiology

	Peak age	Seasonal risk	Male	Female
Estimated life time risk			1 in 10	1 in 35
Calcium oxalate stones	Peak age 50-60	Unchanged	7:3	
Uric acid stones	Peak age 60-65	+7% summer/autumn	4:1	
Infection stones	Peak age F22-55; M55-70	-10% Autumn/winter	2:3	
Predisposing co-morbidity			18%	25%

DETECT 1 showed 7.5% of haematuria cases identified renal stone disease

Around 2-5% of true renal colic has no evidence of any haematuria



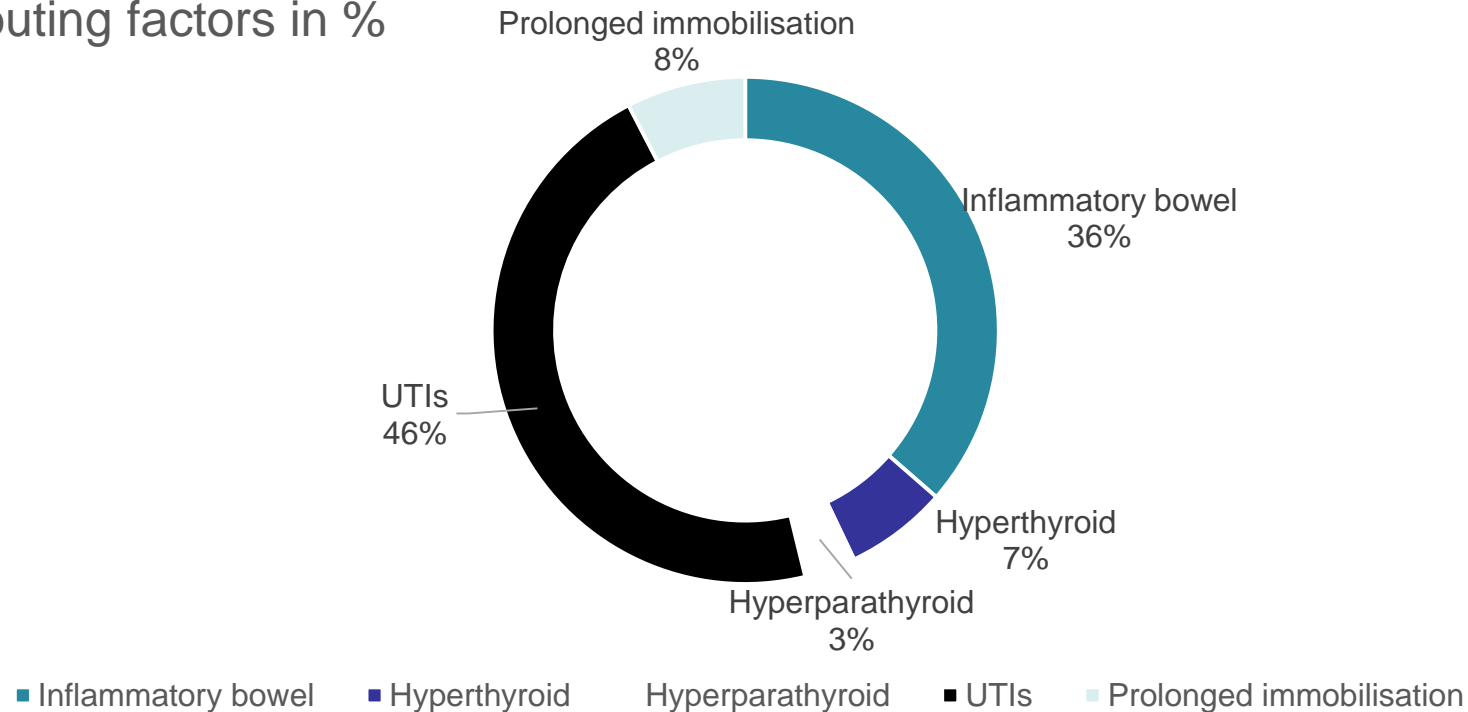
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Renal stone disease: Examples of acquired contributing factors

Contributing factors in %



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Renal stone disease

STONE FORMATION THEORIES

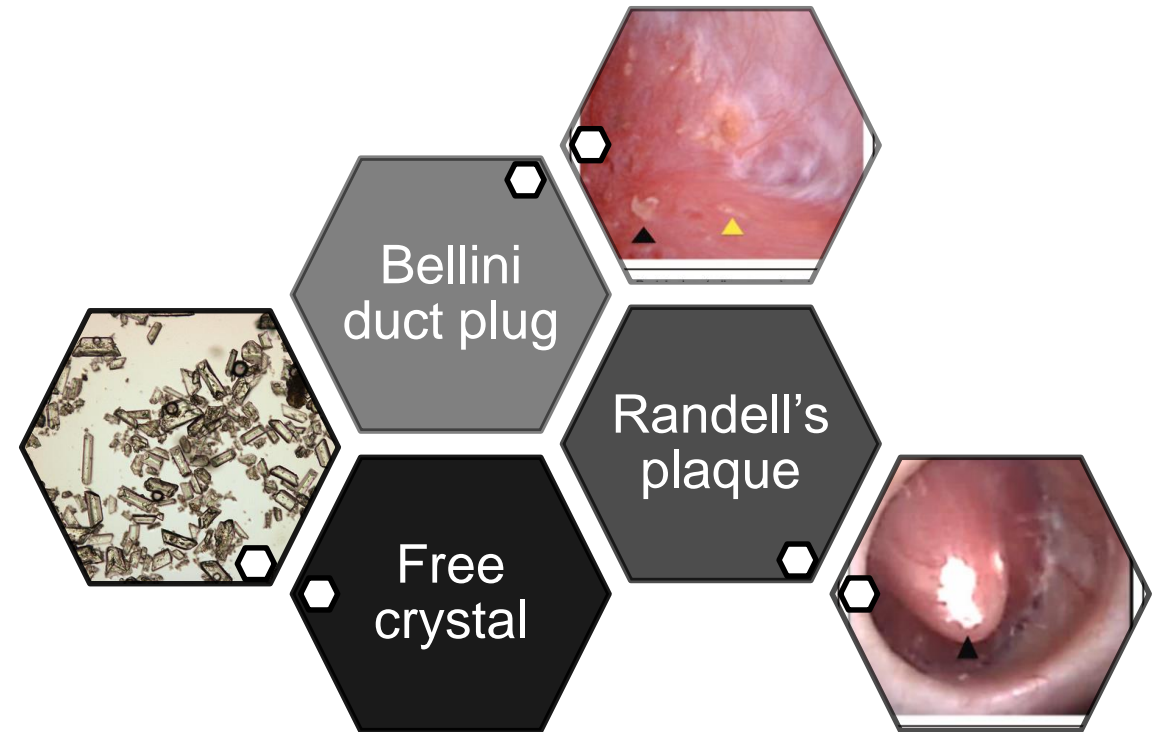
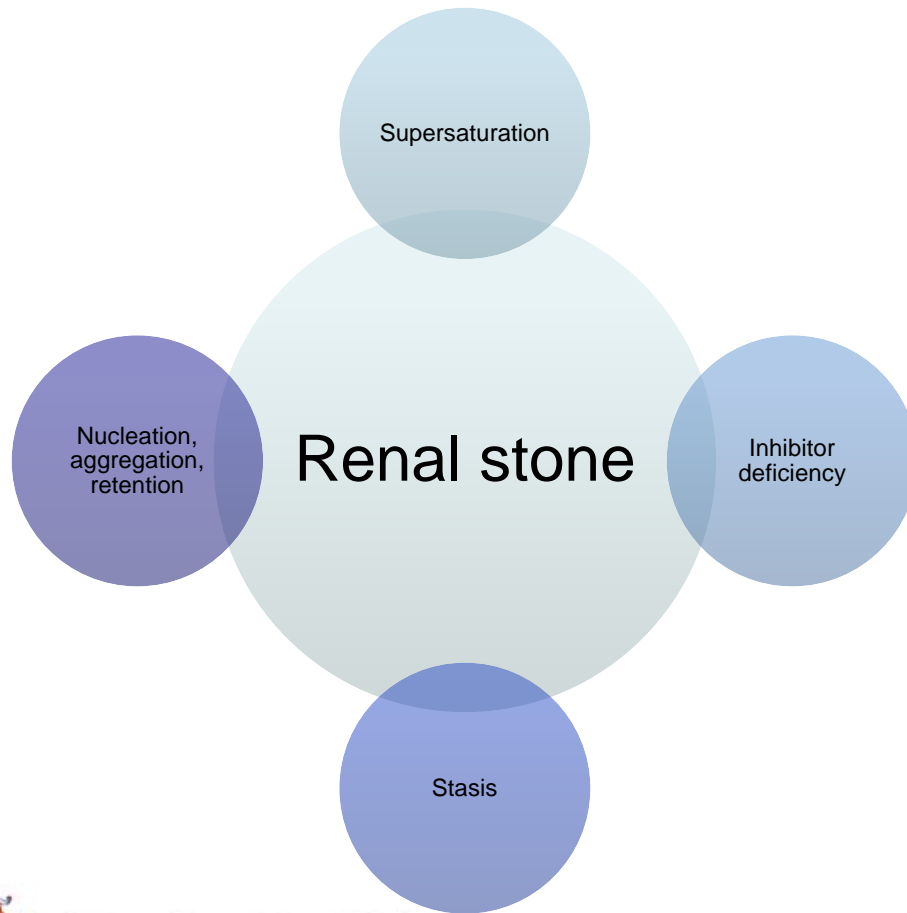


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Pathways of stone formation



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Stone formation: New insights

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BJU International

Translational Science

The origins of urinary stone disease: upstream mineral formations initiate downstream Randall's plaque

Ryan S. Hsi^{*}, Krishna Ramaswamy^{*}, Sunita P. Ho[†] and Marshall L. Stoller^{*}

^{}Department of Urology, and [†]Division of Biomaterials and Bioengineering, Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California San Francisco, San Francisco, CA, USA*

S.P.H. and M.L.S contributed equally to this work as co-senior authors.

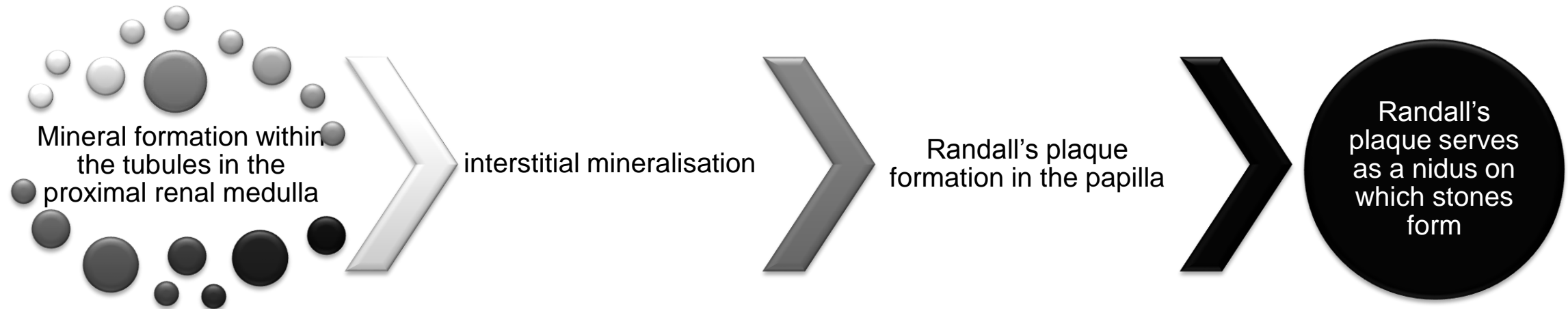


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Stone formation pathway: Overview

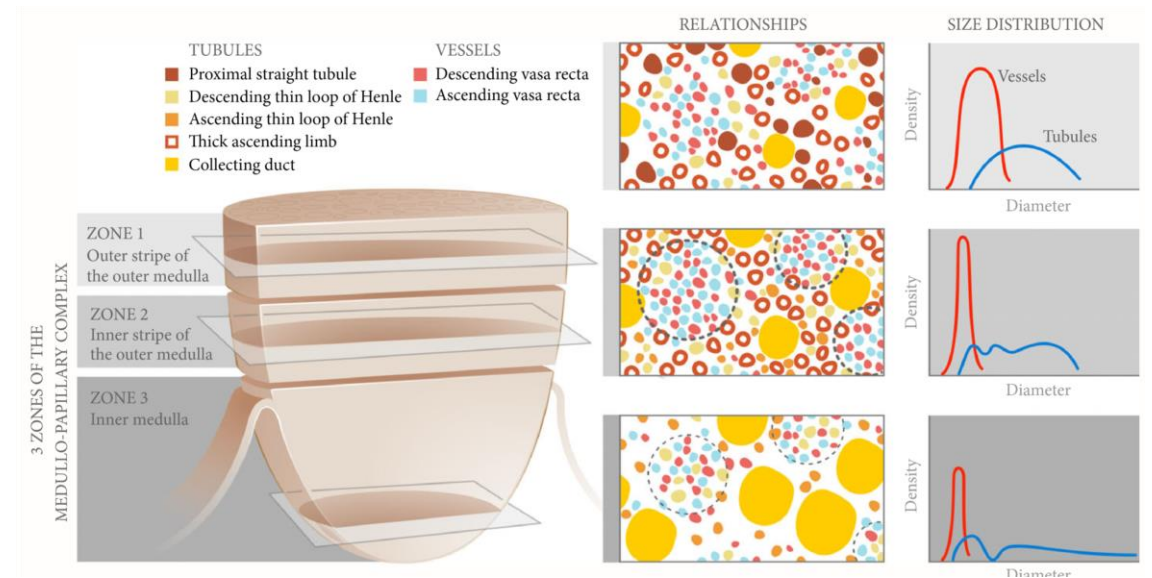
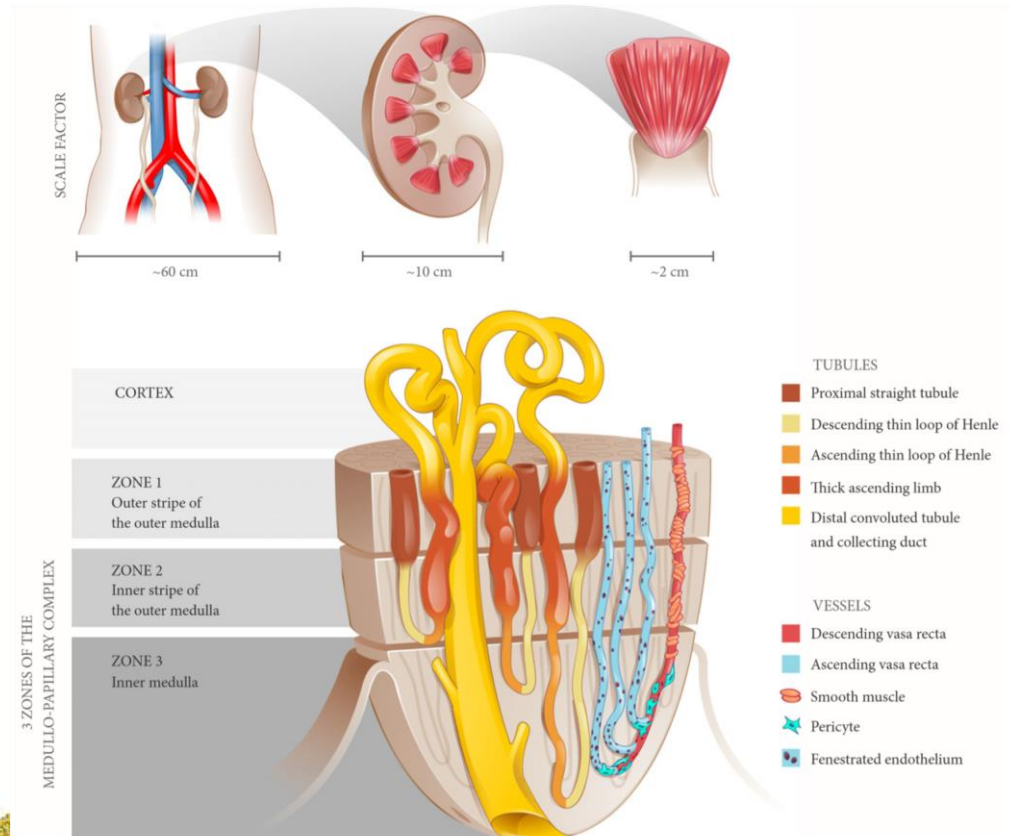


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Medulla-papilla complex: Structures

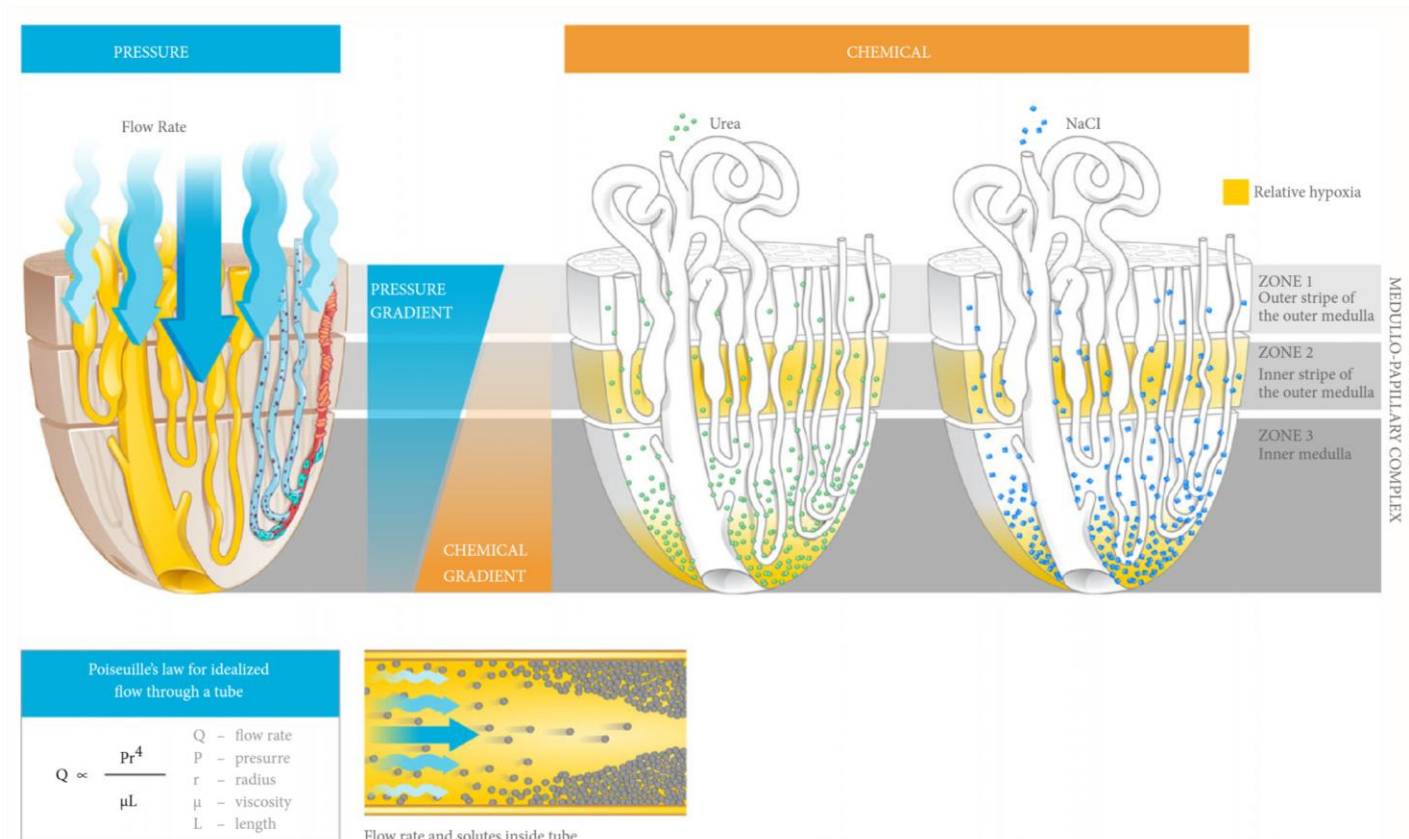


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Medulla-papilla complex: Gradients and functions



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Medulla-papilla complex: Mineralisation

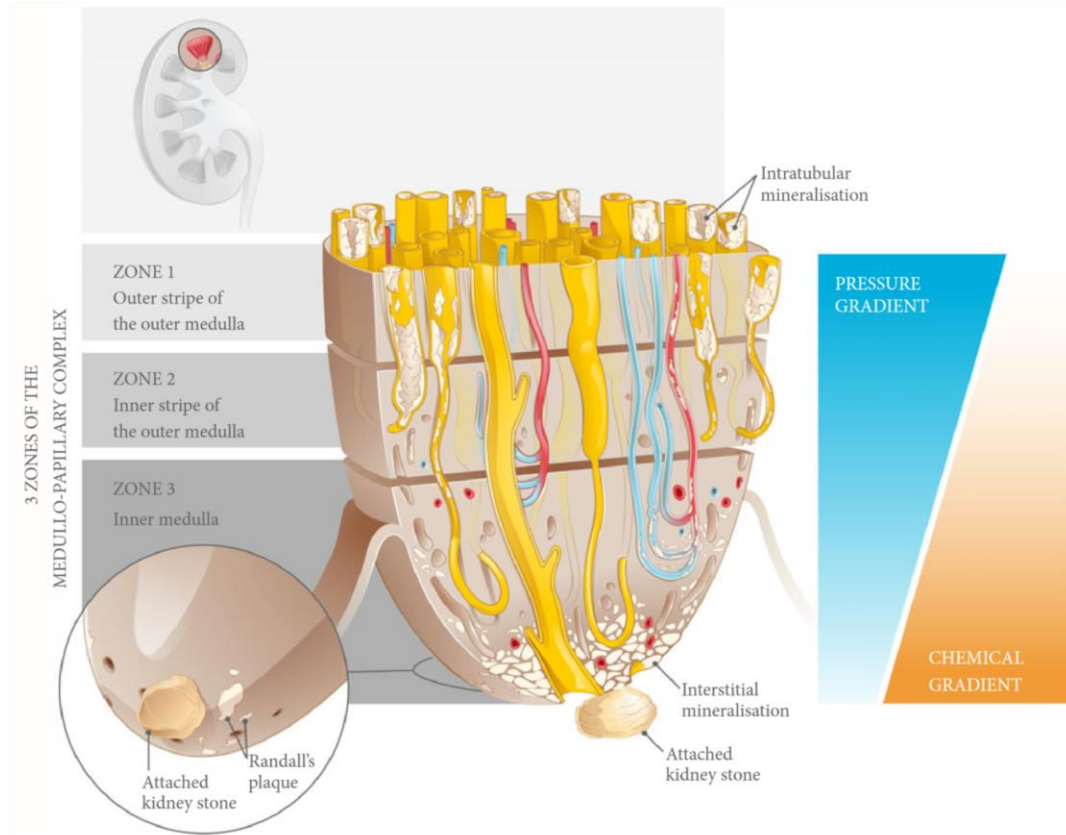
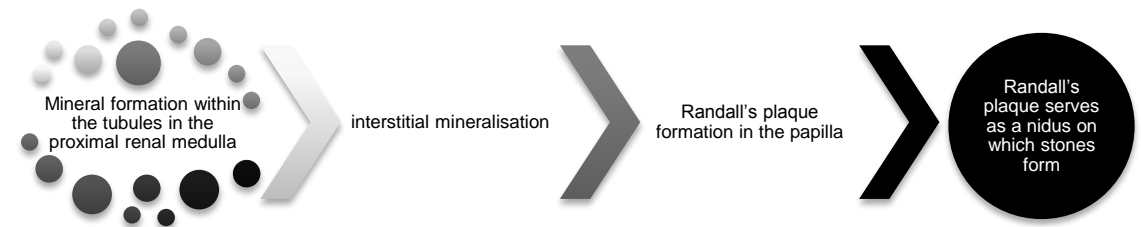
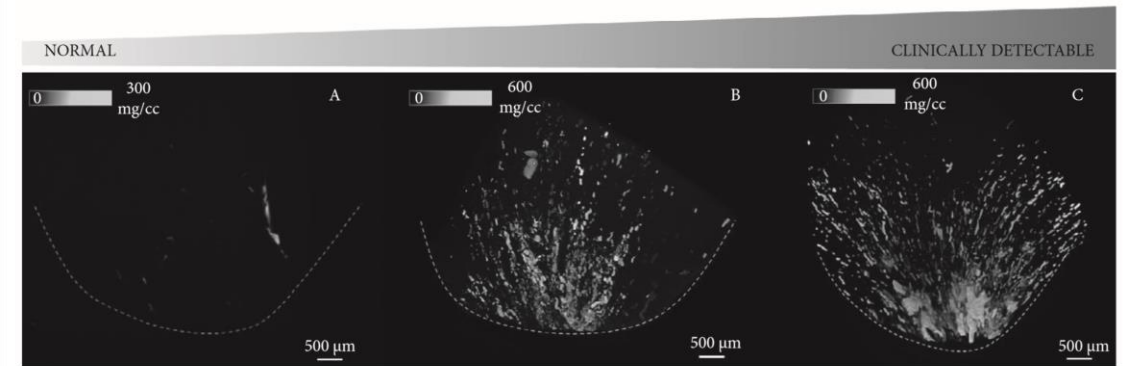


Fig. 5 Micro-CT of human medullo-papillary complex. From left to right, a comparison of increasing mineralisation is detectable in three subjects. Streaks and aggregates of mineralised regions in Zones 1 and 2 are predominantly intratubular in location. With greater proximal mineralisation, distal interstitial mineralisation becomes apparent. Upper scale bars represent gradients in mineral densities within the medullo-papillary complex.



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Renal stone disease

INITIAL MANAGEMENT IN GENERAL PRACTICE

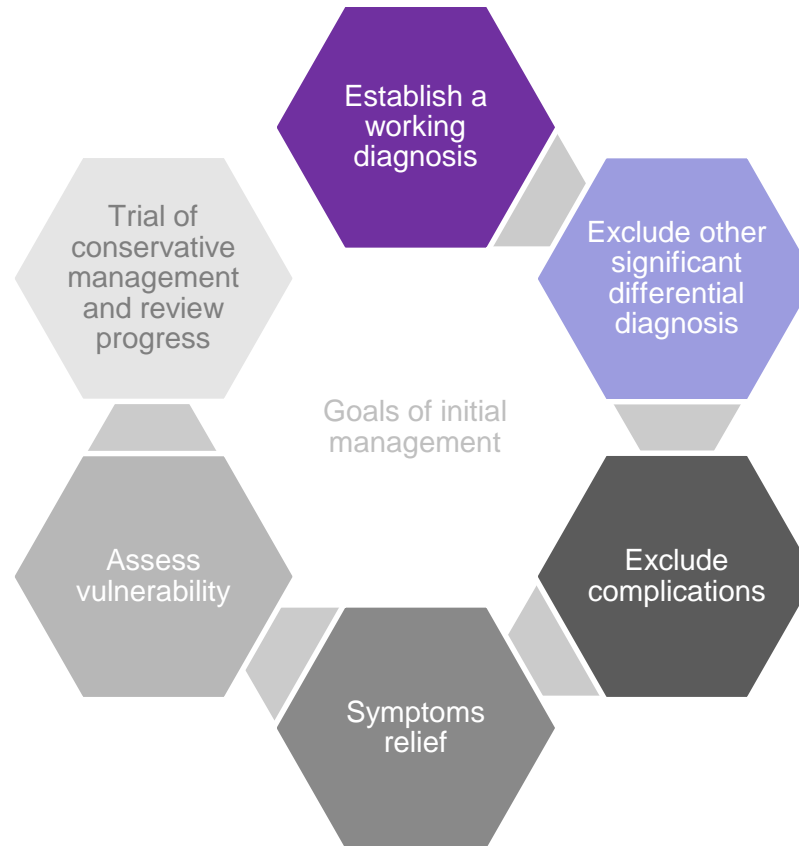


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Renal stone disease: Initial management principles



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Renal colic: diagnostic accuracy

CT 95% sensitivity; 95% specificity

- CT features of obstruction
 - Hydronephrosis 80% sensitivity.
 - Hydroureter 80%
 - PN stranding 50%
 - Renal swelling 60%
 - Periureteric rim 60%

IVP 80% sensitivity; 90% specificity

Haematuria 60% PPV; 85% sensitivity

Flank pain 40-70% PPV

USS 50% sensitivity

Plain film 50% sensitivity all-comers;
70% radiologists



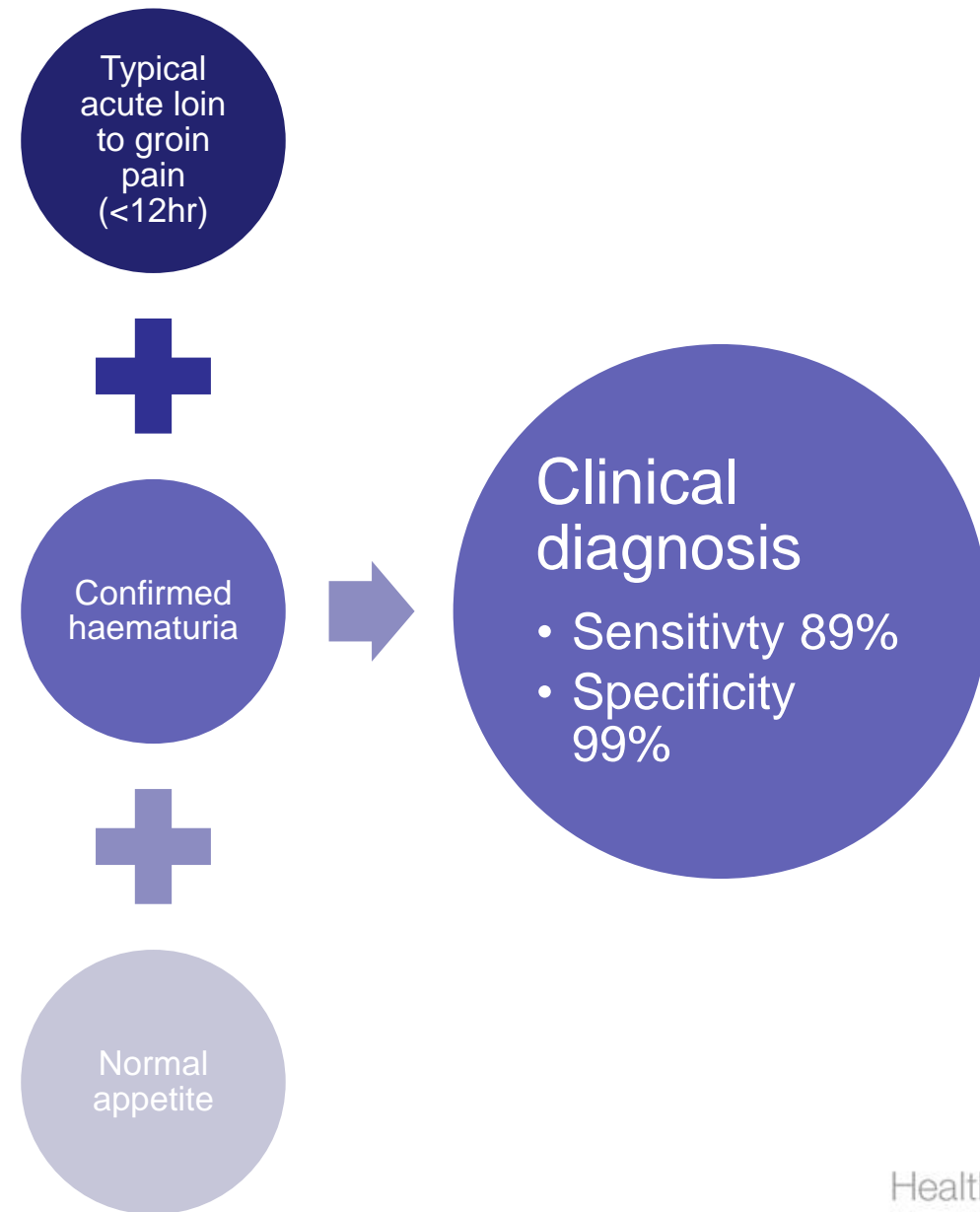
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Clinical diagnosis of renal colic in general practice setting

Eskelinen M et al Eur. Urol. 1998; 34:467-73



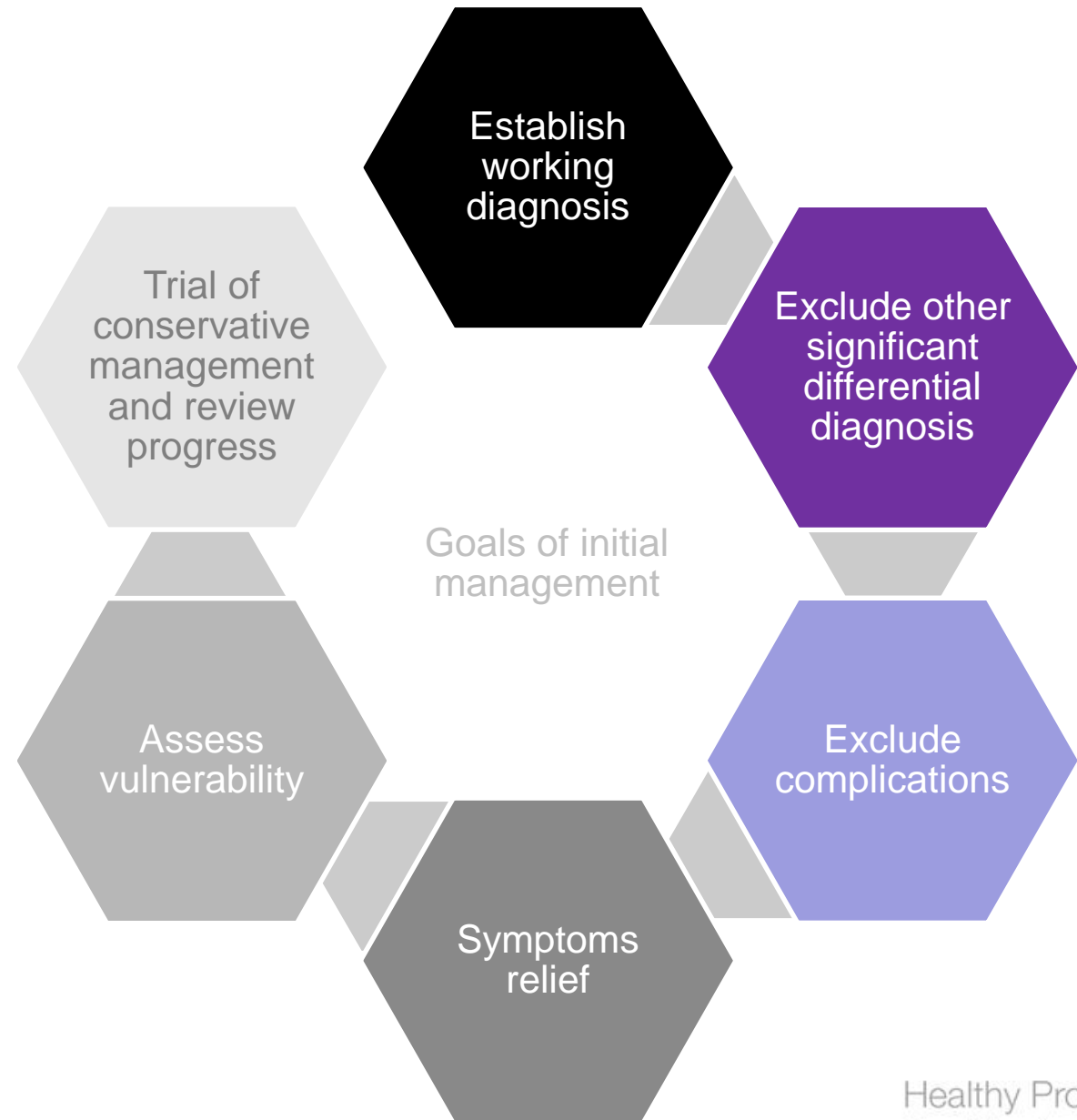
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Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonably accurate.



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Exclude other differential diagnosis

Differential diagnosis

See also haematuria

GIT inflammation/obstruction

Appendicitis

Mesenteric ischemia

AAA

Musculoskeletal

Suggestions

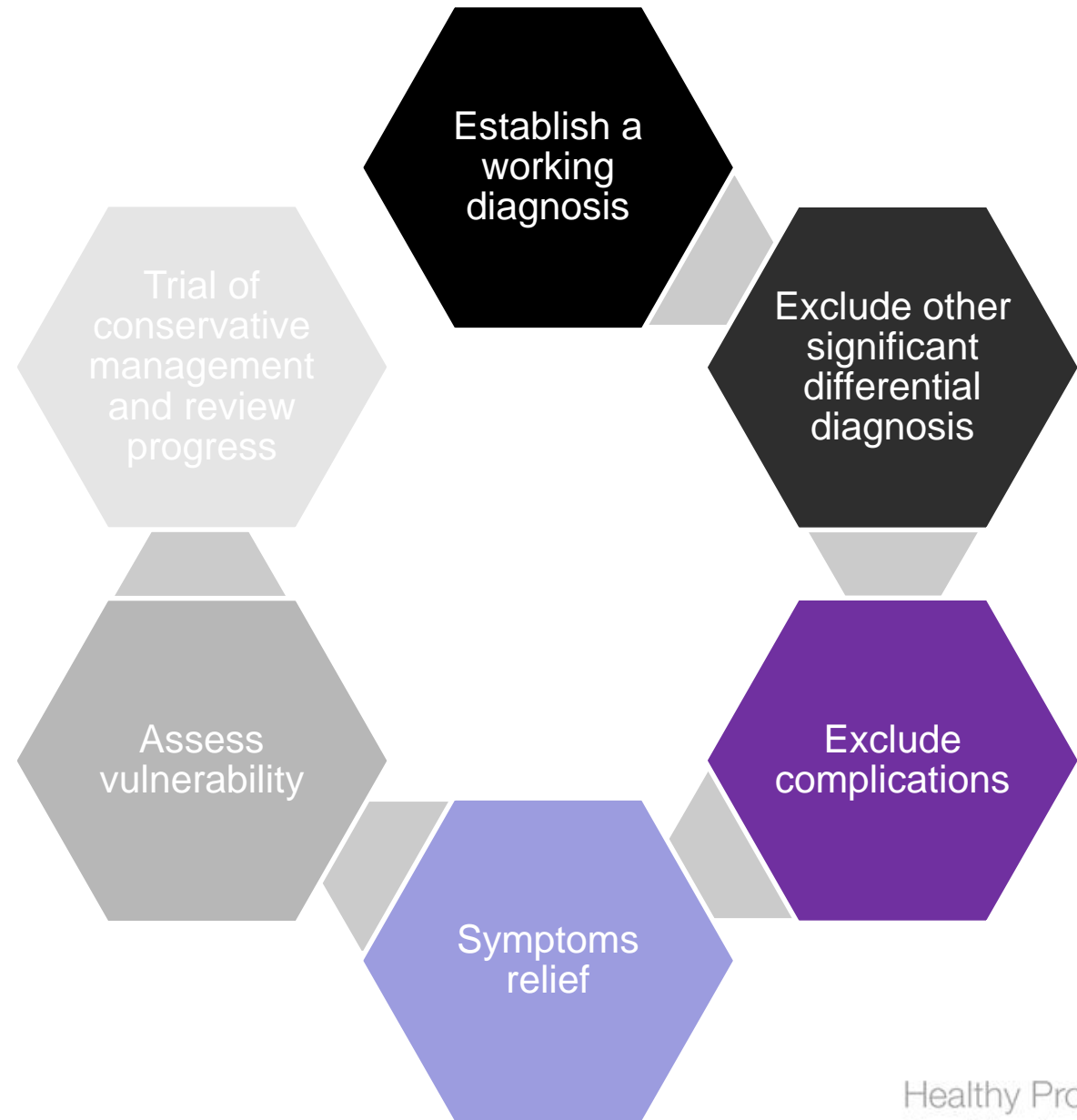
True ureteric colic has very little specific signs

Look out for the following signs if symptoms not typical:

- Pulse and BP
- Murphy's sign
- Peritonism
- Hernia
- Musculoskeletal
- PV bleeding
- Factitious haematuria

Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonable.
- Initial exclusion of other differential diagnosis based on the absence of certain clinical symptoms and signs is reasonable.

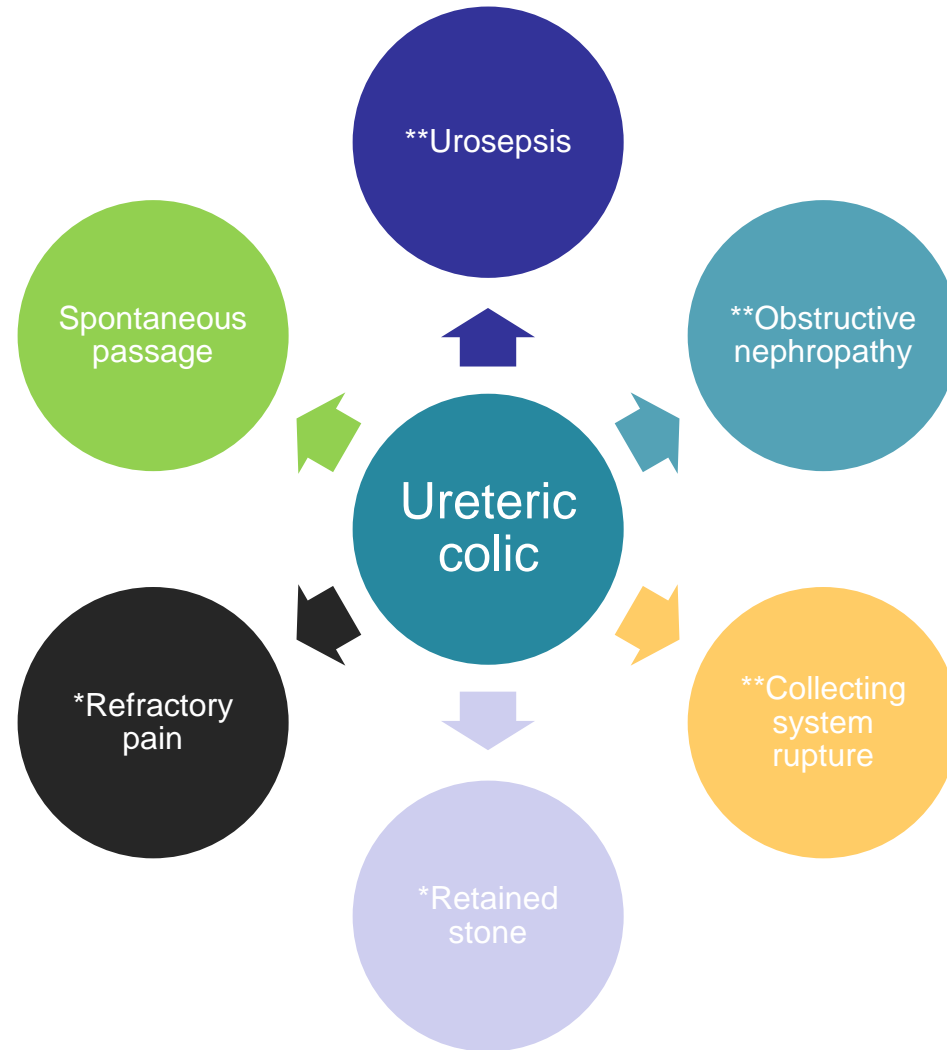


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Renal stone disease: Natural outcomes



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Spontaneous ureteric stone passage

Likelihood of passage related to location and size



Two thirds pass within 4 weeks (Hubner 1993)

< 4mm diameter - more than 80% chance of passage

< 7mm

- Proximal ureter - 25%
- Mid ureter - 45%
- Distal ureter - 70%



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Suggested initial laboratory investigations in general practice setting

MSU

- Haematuria
- Gram stain+ culture
- pH
- Specific gravity
- Protein and cell casts
- Crystals

EUC

- Cr +eGFR
- Calcium(c)

FBC

- WCC

*Consider

- bhcg
- Uric acid
- Coagulation
- Imaging



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Renal colic imaging: Qualitative comparison

	CTIVP	CTKUB	U/S
Confirmation of working diagnosis	+++	+++	+
Exclusion of other significant differential diagnosis	+++	++	+
Assess disease extent	+++	+++	+
Exclude complications	+++	++(+)	+
Treatment planning	+++	+++	+



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Ultra-low dose CTKUB



As low as 1mSv
(comparable to digital KUB
x-ray)



Lower specificity and
sensitivity 95%



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Enhanced non-contrasted CT stone analysis

Single energy
Laplacian
filter

Dual energy x-
ray analysis



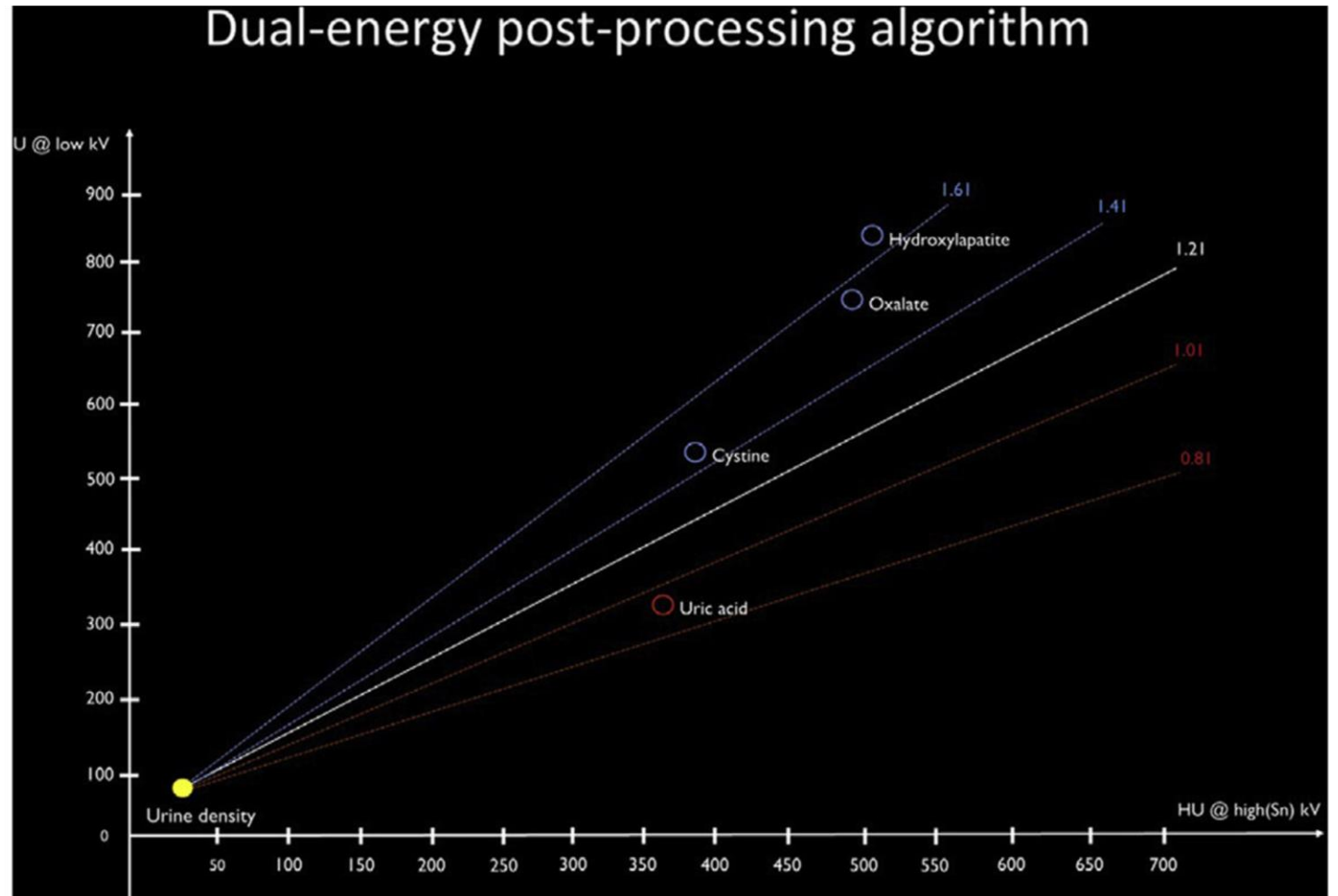
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CT with Dual Energy X-ray Analysis

Different materials demonstrate different energy absorption when exposed to different level of energy of X-ray

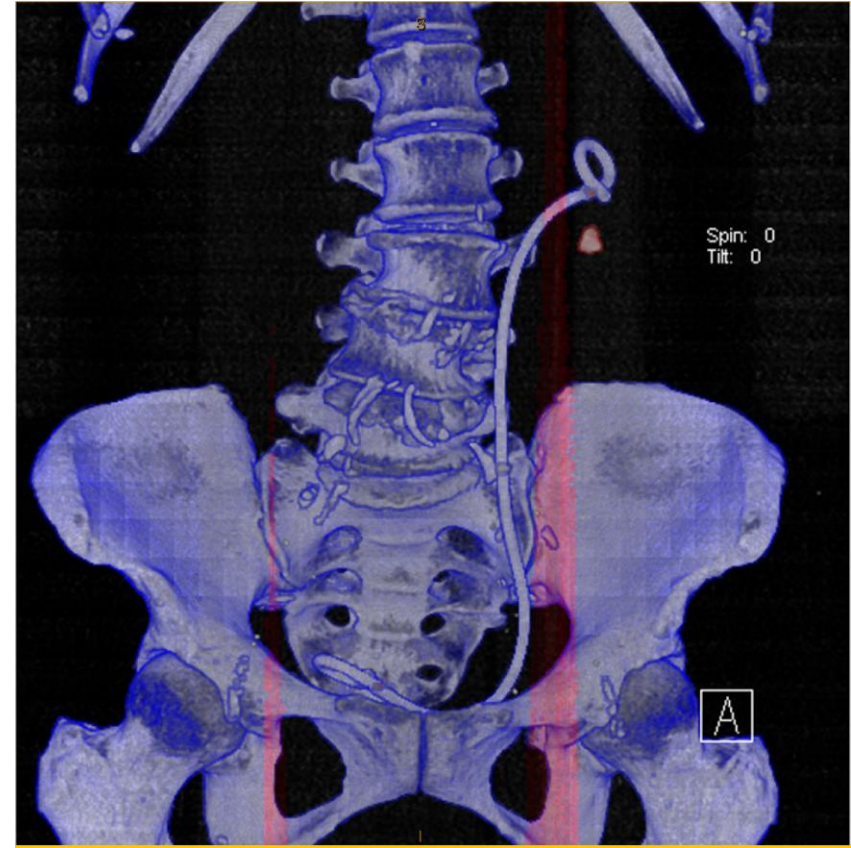


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CT with DEXA: Uric acid stone

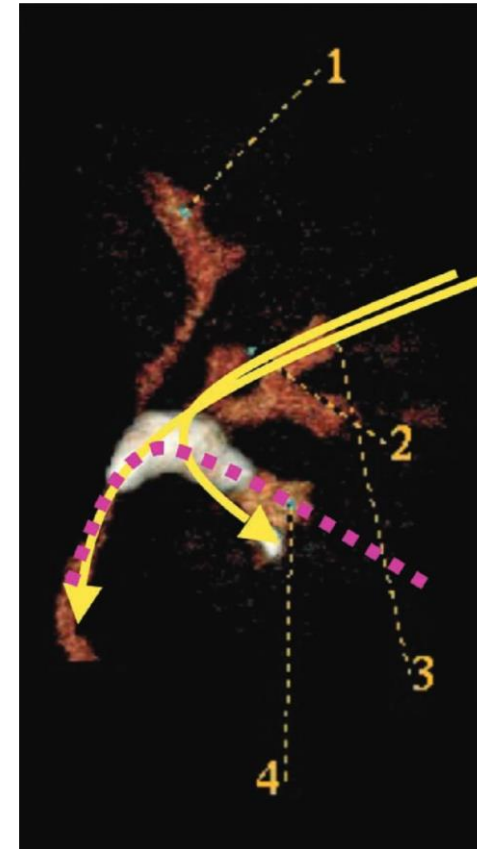


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CTIVP with DEXA: PCNL planning



Laplacian filtered single energy CT

Urolithiasis (2018) 46:325–332
<https://doi.org/10.1007/s00240-017-0994-x>



ORIGINAL PAPER

A new method for predicting uric acid composition in urinary stones using routine single-energy CT

Mats Lidén¹

Received: 5 April 2017 / Accepted: 15 June 2017 / Published online: 28 June 2017
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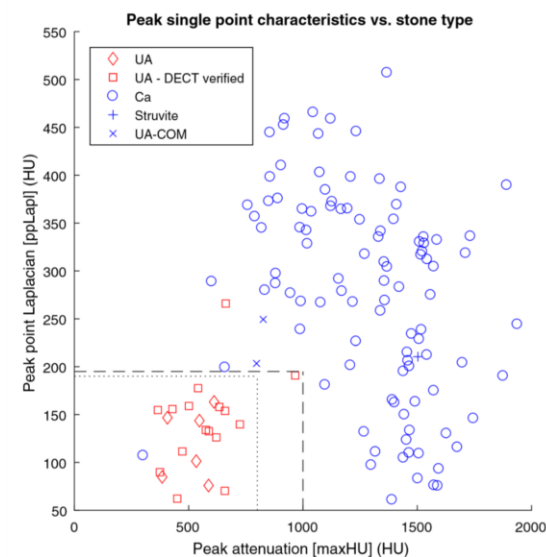


Fig. 2 Scatterplot demonstrating the clustering of pure UA stones using the peak attenuation and the peak point Laplacian. The dashed (---) lines indicate the post hoc-defined cutoff values for pure UA stones 1000 HU/195 HU (maxHU/ppLapl). The dotted lines (...) indicate the alternative cutoffs for the major UA cluster (800 HU/190 HU)

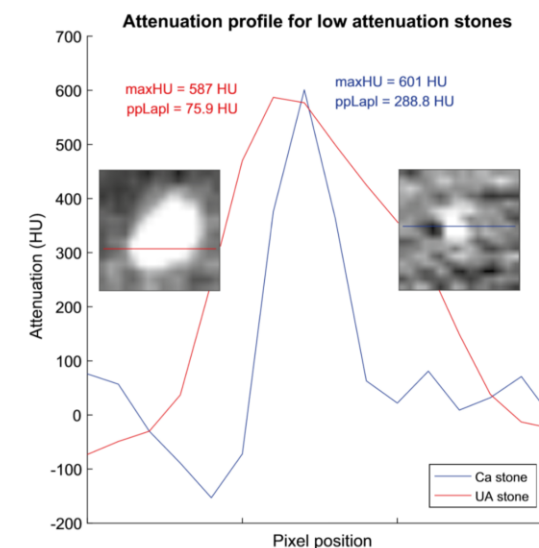
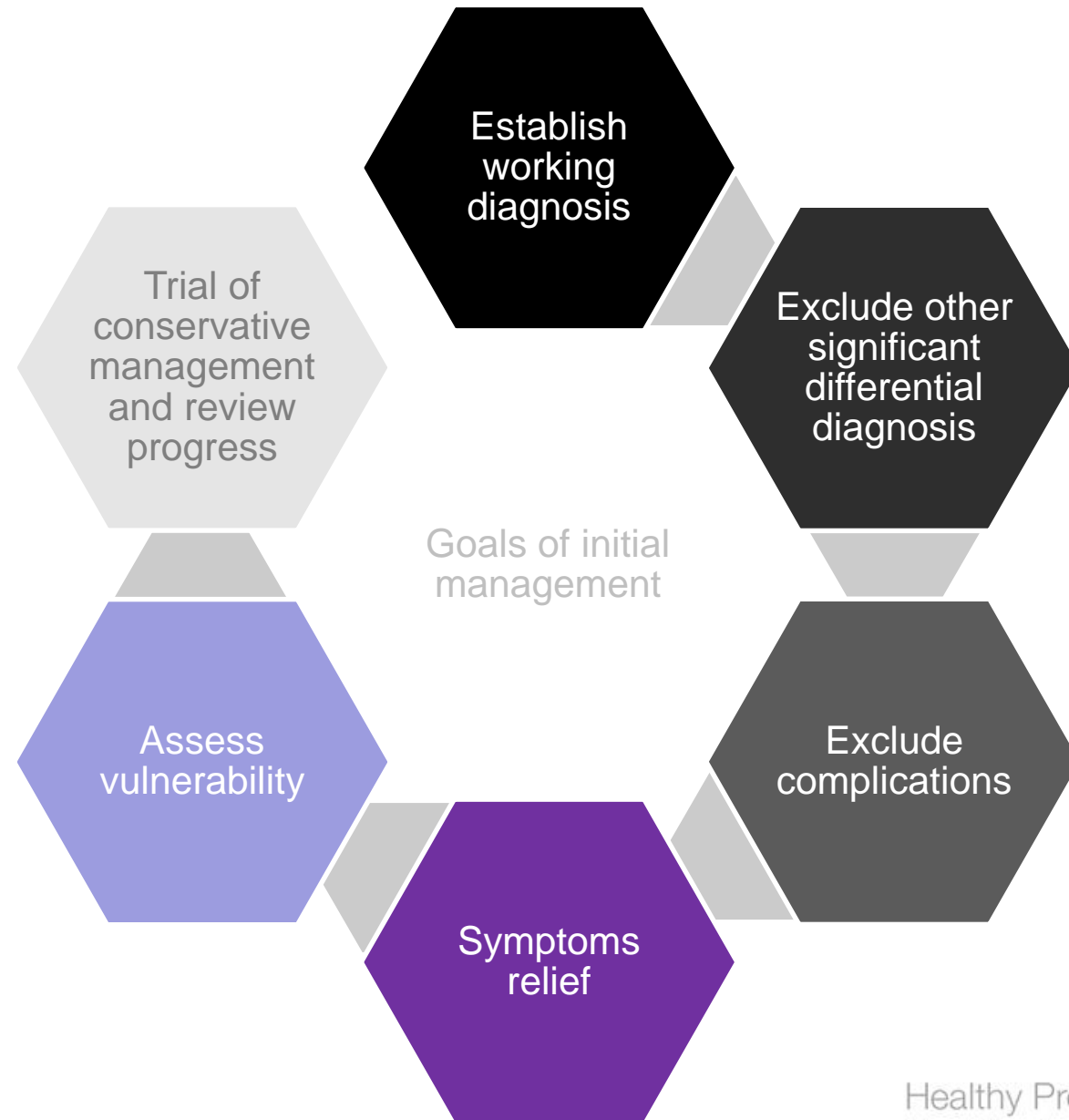


Fig. 3 Example of one-dimensional attenuation profiles through a section of a UA and a Ca stone with similar peak attenuation. The corresponding CT images are enclosed. The different shapes of the profile curves are quantified with the peak point Laplacian value

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Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonable.
- Initial exclusion of other differential diagnosis based on the absence of certain clinical symptoms and signs is reasonable.
- FBC EUC MSU CT provide best additional information on diagnosis and complications

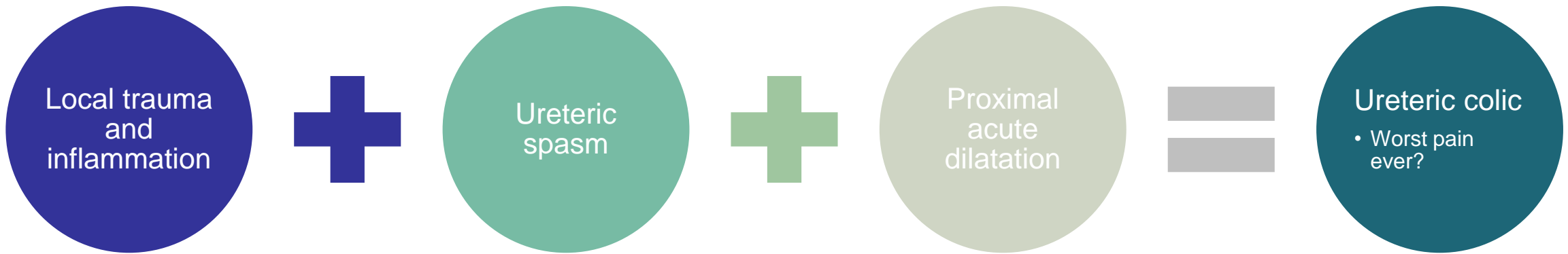


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Mechanism of pain

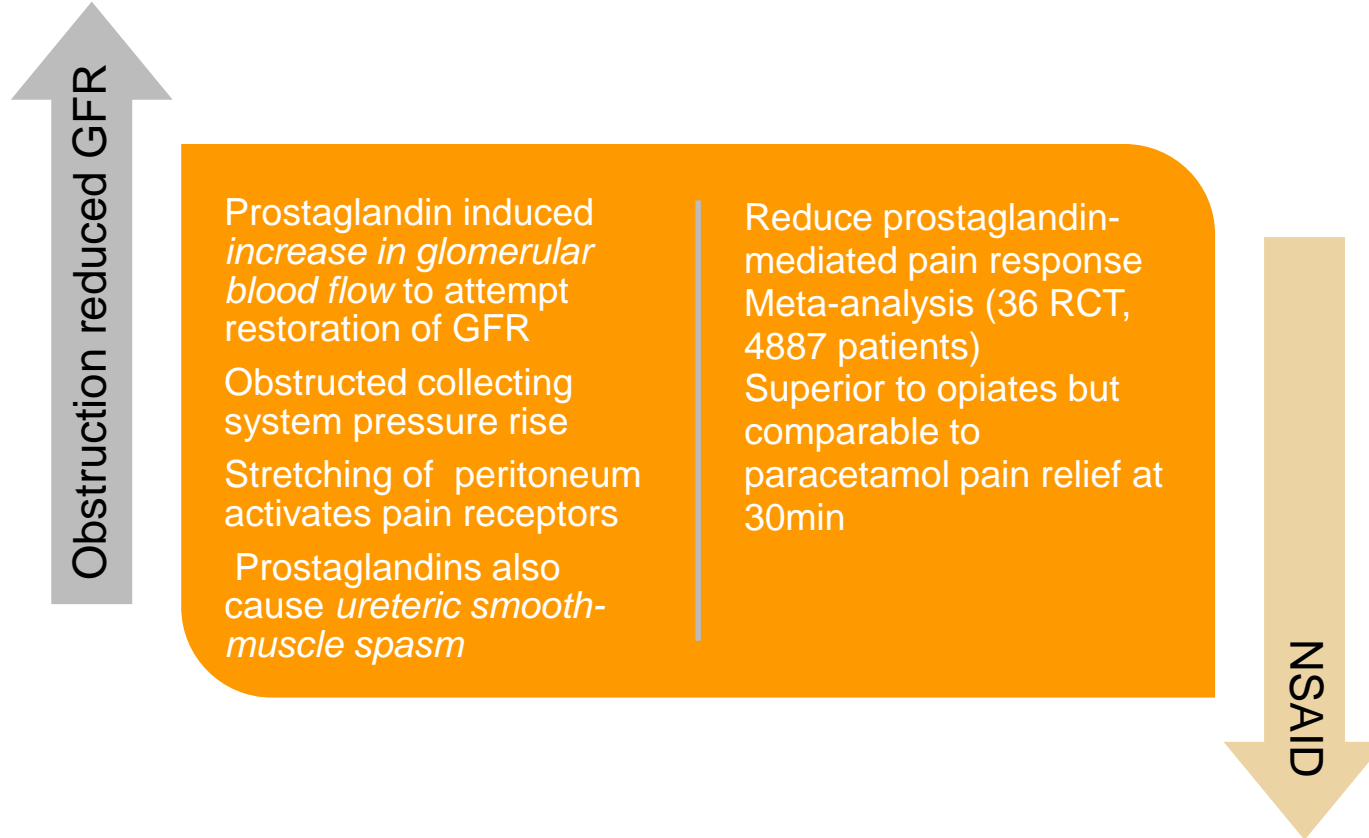


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NSAID: Analgesia of choice



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Unilateral obstruction and transient renal impairment

Urolithiasis (2017) 45:249–254
DOI 10.1007/s00240-016-0904-7



ORIGINAL PAPER

Transient renal impairment in the absence of pre-existing chronic kidney disease in patients with unilateral ureteric stone impaction

Hee Youn Kim¹ · Hyun-Sop Choe¹ · Dong Sup Lee¹ · Jae Mo Yoo¹ · Seung-Ju Lee¹

5.6 % study population

- 1926 patients without CKD
- Defined as eGFR < 60 ml/min/1.73 m²

Independent factors

- Age (45 and above)
- HT

Indicators for sub-clinical CKD?



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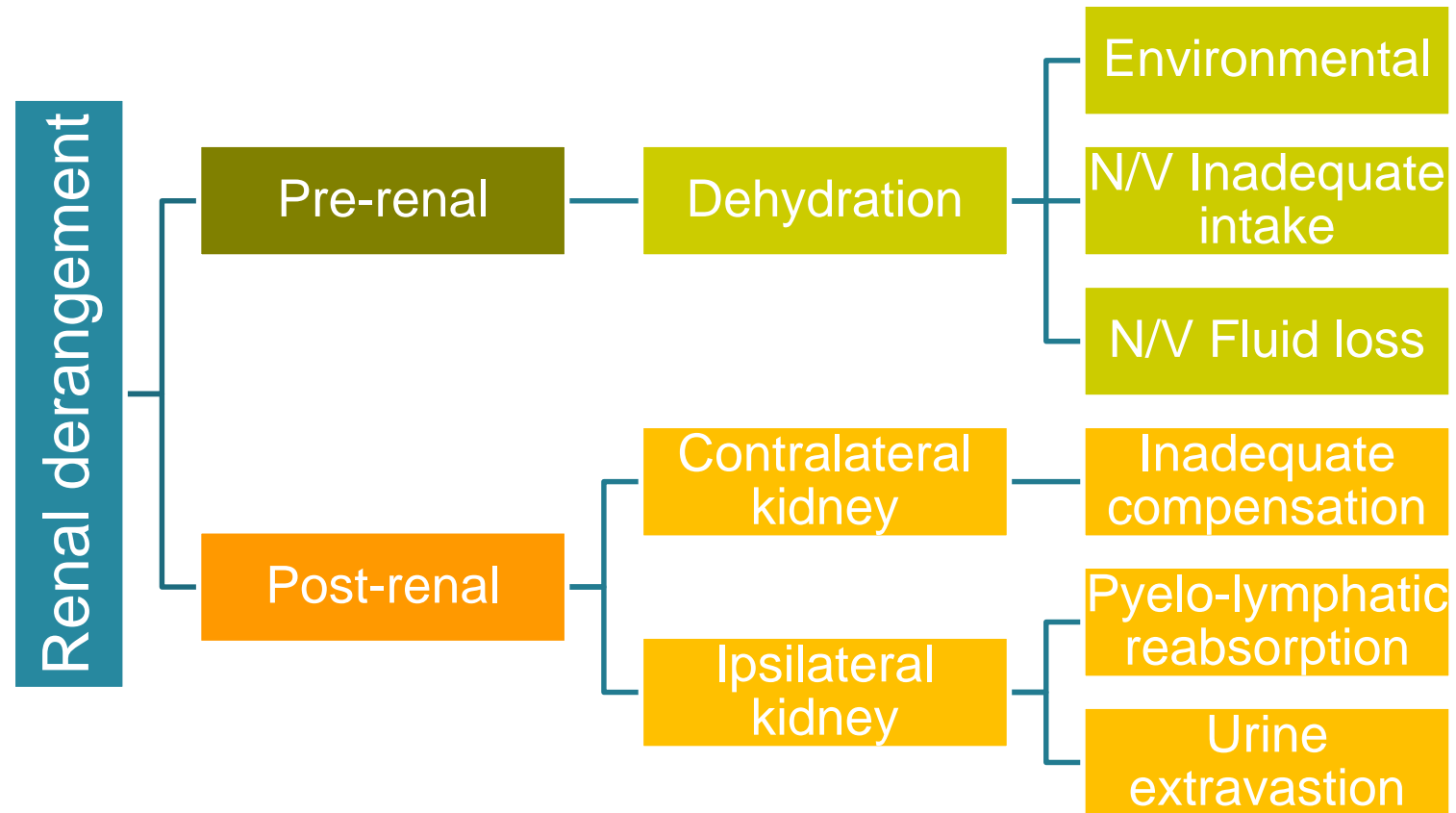
Table 3 Multivariable logistic regression analysis to evaluate risk factors for renal impairment in unilateral ureteric stone patients without chronic kidney disease

	OR	95 % CI	p value
Age	1.069	1.049–1.089	<0.001
DM	1.371	0.756–2.486	0.298
HTN	2.302	1.467–3.611	<0.001
Hydronephrosis grade			
None	1.000		
Grade 1	1.844	0.206–16.511	0.584
Grade 2	1.925	0.233–15.926	0.544
Grade 3	2.465	0.282–21.563	0.415
Grade 4	0.673	0.043–10.462	0.777
Perinephric stranding	1.577	0.902–2.758	0.110
Stone size	1.141	1.057–1.231	0.001
Average HFU	1.000	0.998–1.001	0.422
WBC count	1.132	1.055–1.215	0.001
Hematuria	0.383	0.231–0.636	<0.001

DM diabetes mellitus, HTN hypertension, HFU Hounsfield unit, WBC white blood cell, OR odds ratio, CI confidence interval

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Likely causes of renal impairment in unilateral obstruction



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Tips on hydration

Fluid intake objectives:

Adequate hydration

Most cases of AKI are due to dehydration

Avoid excess hydration and forced diuresis

Avoid further overdistention of collecting system

Consider evidence from vasopressin pilot studies

Be specific with instruction to avoid water intoxication

Water with a mix of other oral fluid

Citrus juice



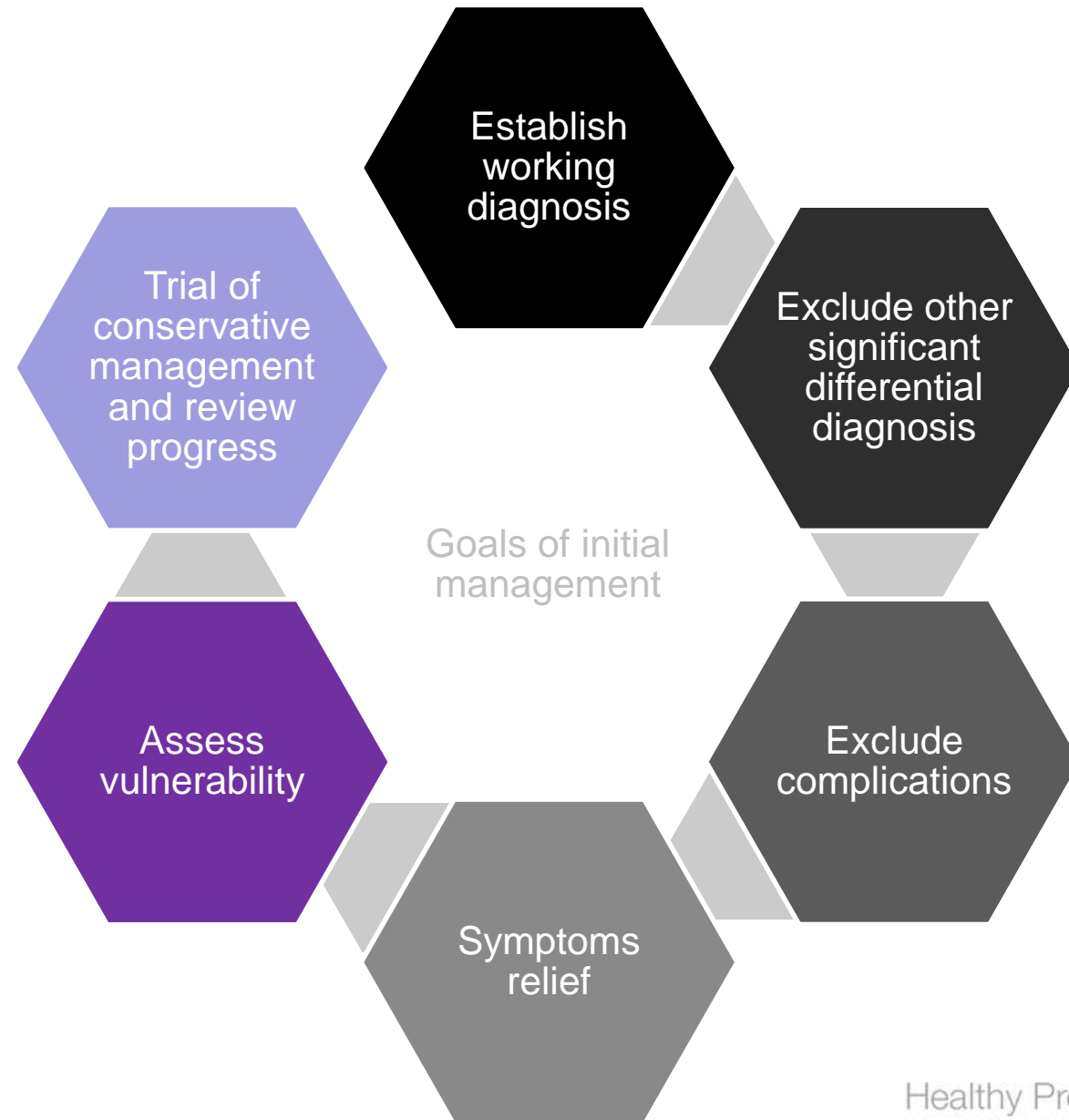
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Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonable.
- Initial exclusion of other differential diagnosis based on the absence of certain clinical symptoms and signs is reasonable.
- Confident exclusion of complications such as UTIs, collecting system rupture and renal impairment from obstruction require laboratory tests and imaging.
- Risk of acute kidney injury in unilateral ureteric colic is <6%.
- NSAID is the analgesia of choice
- Fluid intake to maintain hydration but not to excess.



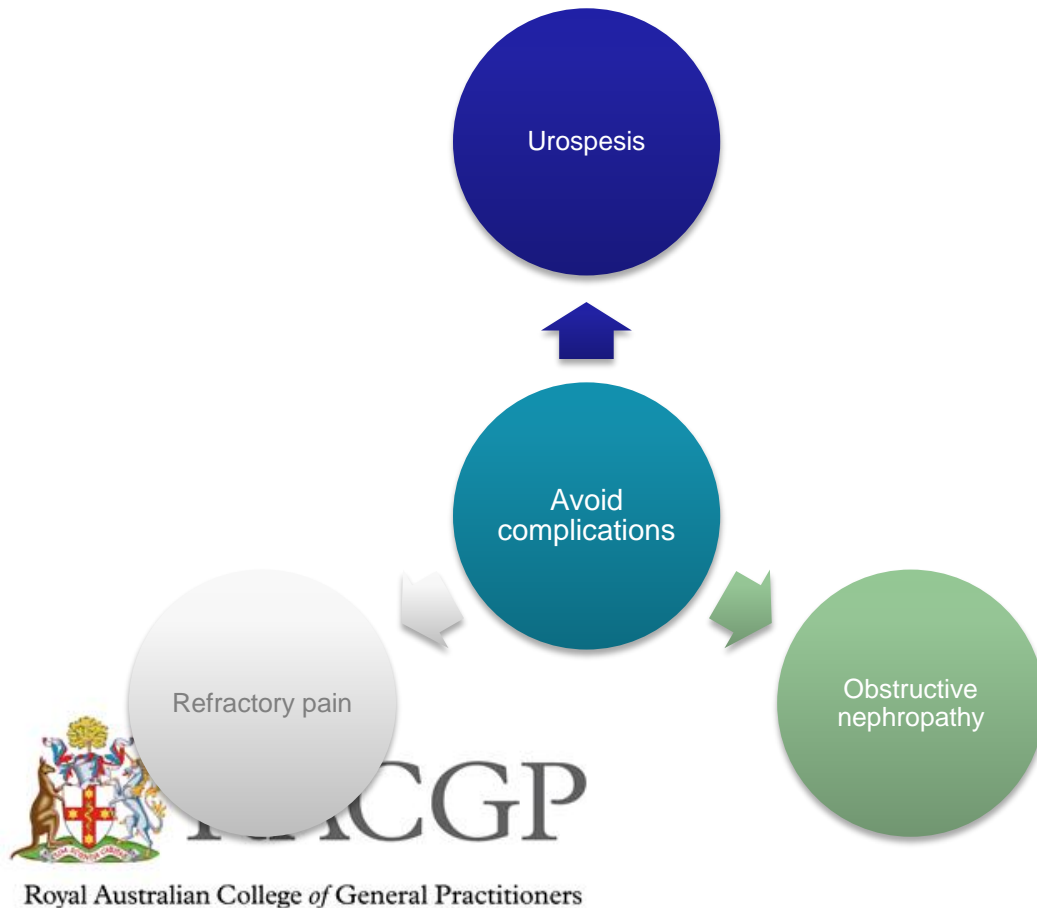
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Assess vulnerability to complications

Aim to avoid complications



Establish what is acceptable risks

Patient factors and preference

The old and the young

Poor physiological reserve

Single kidney

Transplant kidney

Pregnancy

Geographical or social isolation

Resources

Local urology referral process

Local emergency access

Pathology

Bilateral vs unilateral

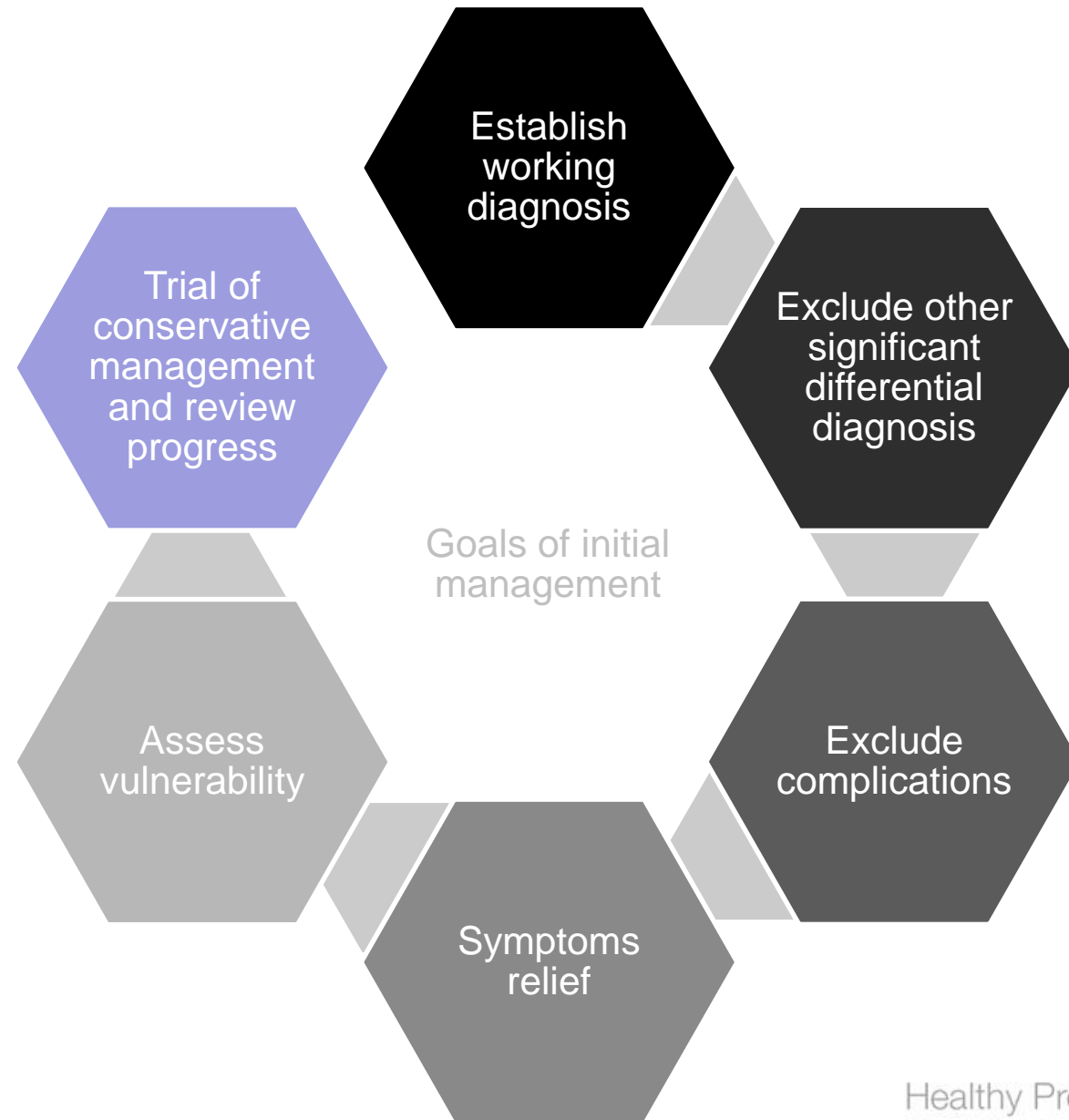
Likelihood of spontaneous passage

Likelihood of complications

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Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonable.
- Initial exclusion of other differential diagnosis based on the absence of certain clinical symptoms and signs is reasonable.
- Confident exclusion of complications such as UTIs, collecting system rupture and renal impairment from obstruction require laboratory tests and imaging.
- NSAID is the analgesia of choice with risk of kidney injury in well hydrated otherwise healthy individuals extremely low.
- Fluid intake to induce diuresis should be avoided.
- Clinician's judgement on appropriateness to trial conservative management



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MET: current international guidelines

Name	Target population	Guidance
EAU guidelines 2018 [21]	Urologists	Offer α -blockers as MET as one of the treatment options for (distal) ureteric stones >5 mm (strong)
AUA guidelines 2016 [22]	Urologists	Patients with uncomplicated ureteric stones ≤ 10 mm should be offered observation, and those with distal stones of similar size should be offered MET with α -blockers (strong)
EBM guidelines, 2017 [23]	Primary care physicians	α -blockers (either tamsulosin or alfuzosin) may be prescribed to facilitate passage of small (<5 mm) ureteric stone
UptoDate, 2016	Primary care physicians and urologists	We initiate treatment with tamsulosin (0.4 mg once daily) for 4 weeks to facilitate spontaneous stone passage in patients with stones ≤ 10 mm in diameter
NHG 2016 [6]	GPs	Tamsulosin is not recommended

EAU, European Association of Urology; EBM, Evidence-Based Medicine; NHG, Dutch College of General Practitioners.



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Medical expulsion therapy: How good is the evidence?

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α -Blockers for uncomplicated ureteric stones: a clinical practice guideline

Mieke Vermandere*, Ton Kuijpers[†], Jako S. Burgers^{††}, Ilkka Kunnamo^{§¶}, Jan van Lieshout**, Emma Wallace^{††}, Joan Vlayen^{††}, Elizabeth Schoenfeld^{§§}, Reed A. Siemieniuk^{¶¶}, Lyndal Trevena***, Xiaoye Zhu^{†††}, Francis Verermen^{†††}, Ben Neuschwander^{§§§}, Philipp H. Dahm^{¶¶¶}, Kari A.O. Tikkinen****, Kris Aubrey-Bassler^{††††}, Robin W.M. Vernooij^{††††}, Bert Aertgeerts*§§§§, and Gertrude E. Bekkering*§§§§



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Medical Expulsion Therapy: Practical considerations

Side-effects

- “There is possibly no difference between groups in MAEs, but *ablockers may cause orthostatic hypotension and dizziness, especially when combined with antihypertensive medication.*”

Patient's value and preference

- α -blockers as MET is an **off-label use** of this drug class.
- “The panel believes that for most patients the possible benefit (small decrease in number of pain episodes and small reduction of hospitalisations) outweighs the risk of AEs.”

Use in practice

- The duration of α -blockers treatments in the RCTs was typically 4 weeks or until stone clearance.
- Tamsolusin was the most commonly prescribed α blocker, given as a single dose of 0.4 mg per day.



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Mirabegron: Use in medical expulsion

Urolithiasis

<https://doi.org/10.1007/s00240-018-1075-5>

ORIGINAL PAPER

Efficacy of mirabegron in medical expulsive therapy

Mehmet Solakhan¹  · Omer Bayrak²  · Ersan Bulut³ 

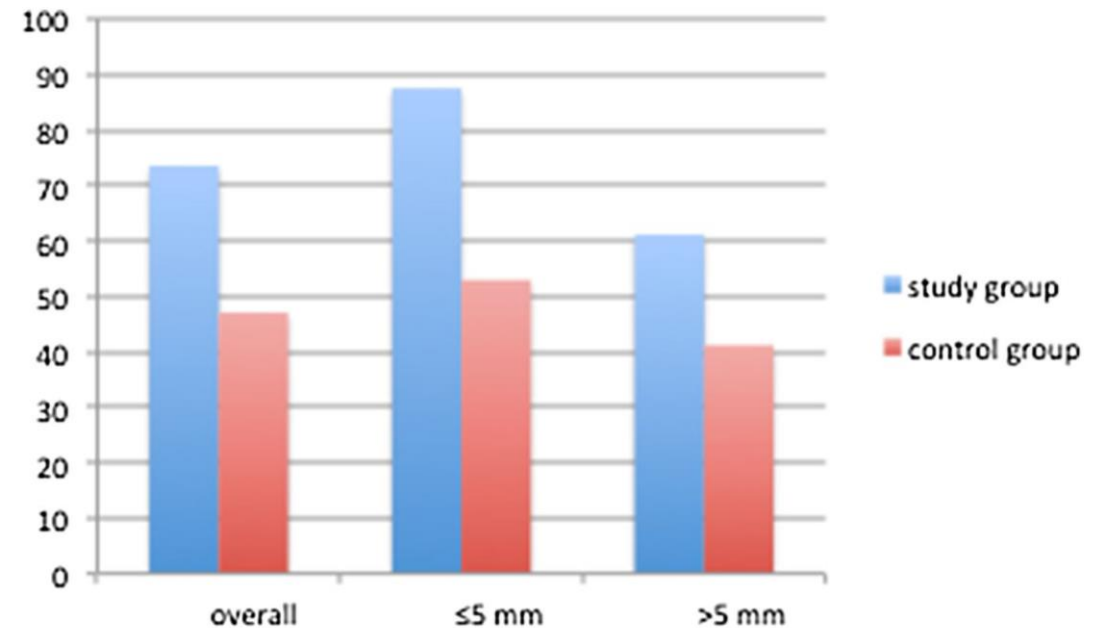
Received: 23 March 2018 / Accepted: 1 August 2018

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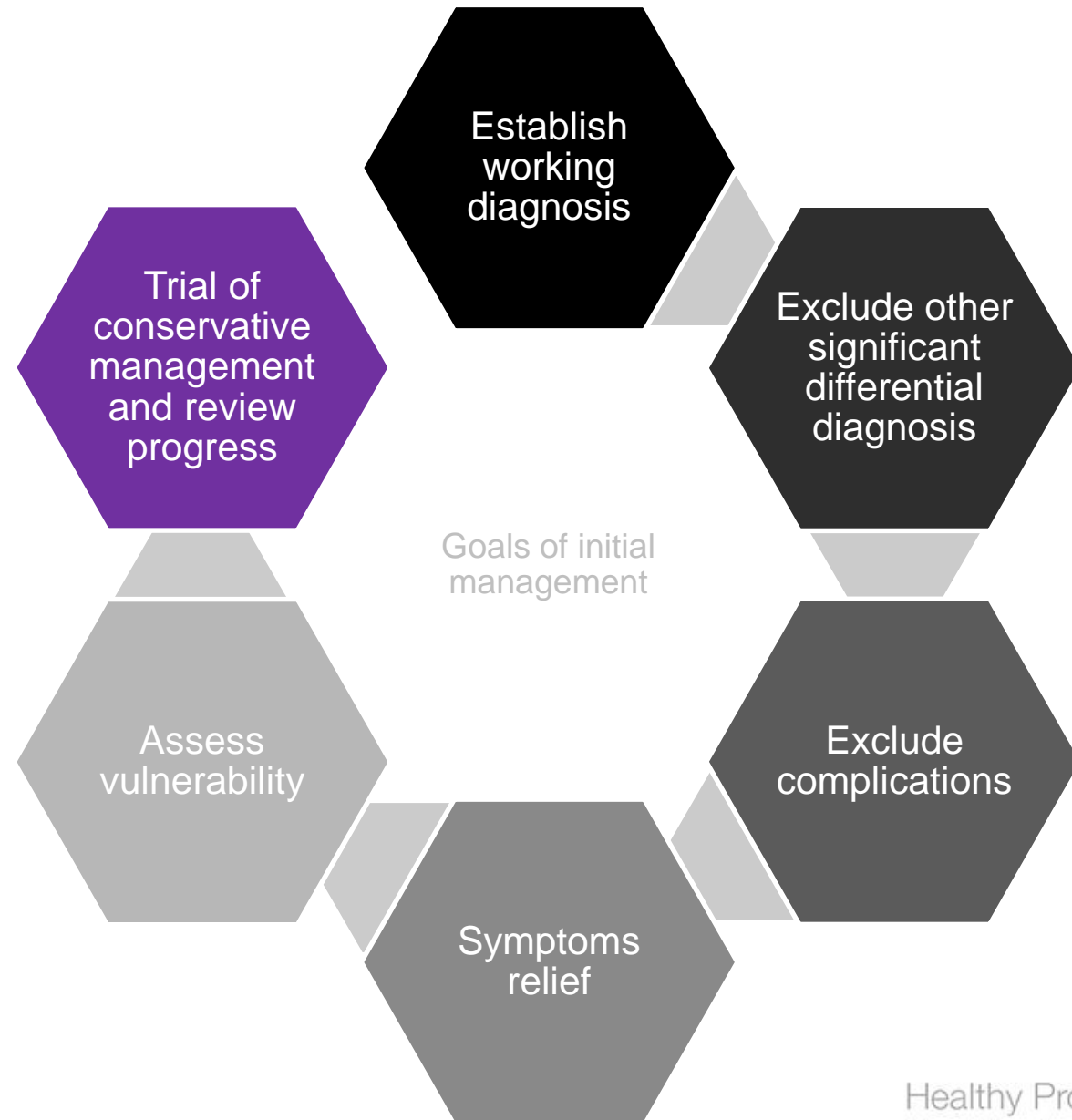
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Renal stone disease: Initial management principles

- Initial working diagnosis based on clinical symptoms and signs is reasonable.
- Initial exclusion of other differential diagnosis based on the absence of certain clinical symptoms and signs is reasonable.
- Confident exclusion of complications such as UTIs, collecting system rupture and renal impairment from obstruction require laboratory tests and imaging.
- NSAID is the analgesia of choice with risk of kidney injury in well hydrated otherwise healthy individuals extremely low.
- Fluid intake to induce diuresis should be avoided.
- Clinician's judgement on appropriateness to trial conservative management
- 2 weeks NSAID, paracetamol, adequate hydration, tamsulosin, +/-miragegron



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Renal stone disease

WHEN TO REFER TO UROLOGY SERVICE?



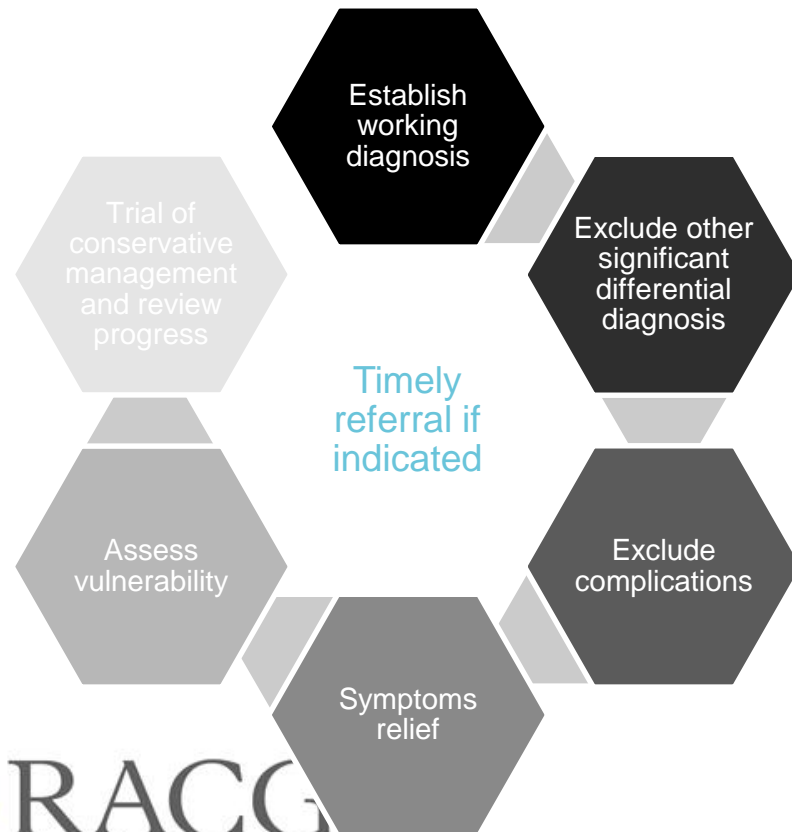
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Renal stone disease: GP vs urological management principles

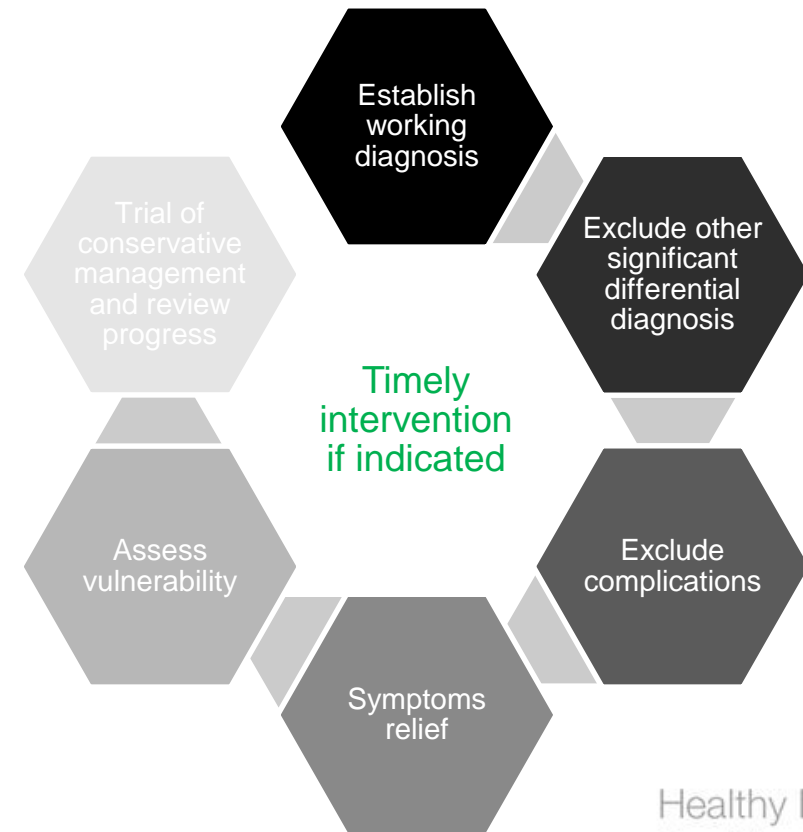
General practice



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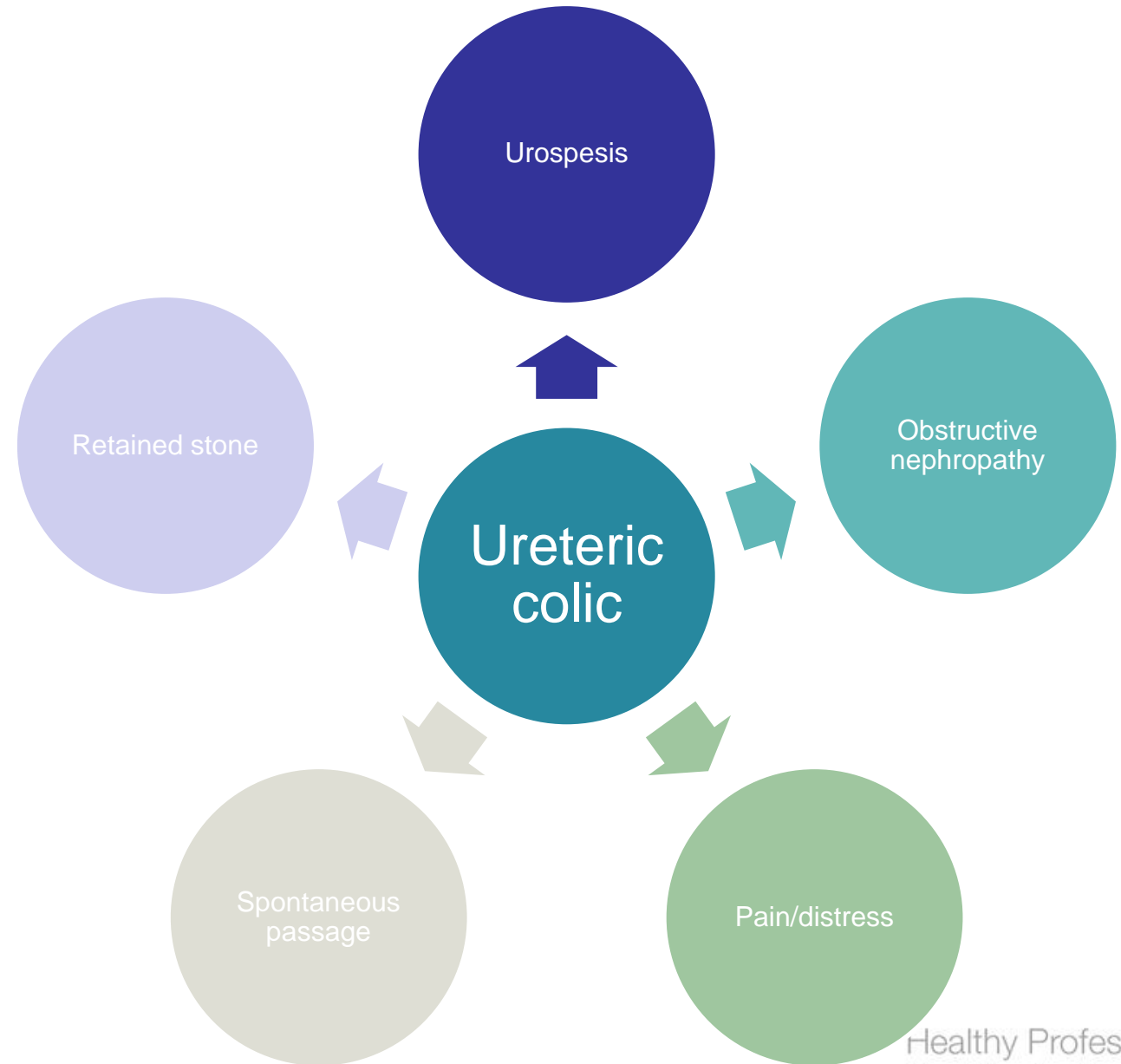
Urology



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Urological intervention objective:

Prevention or management of complications with drainage via retrograde stent or nephrostomy

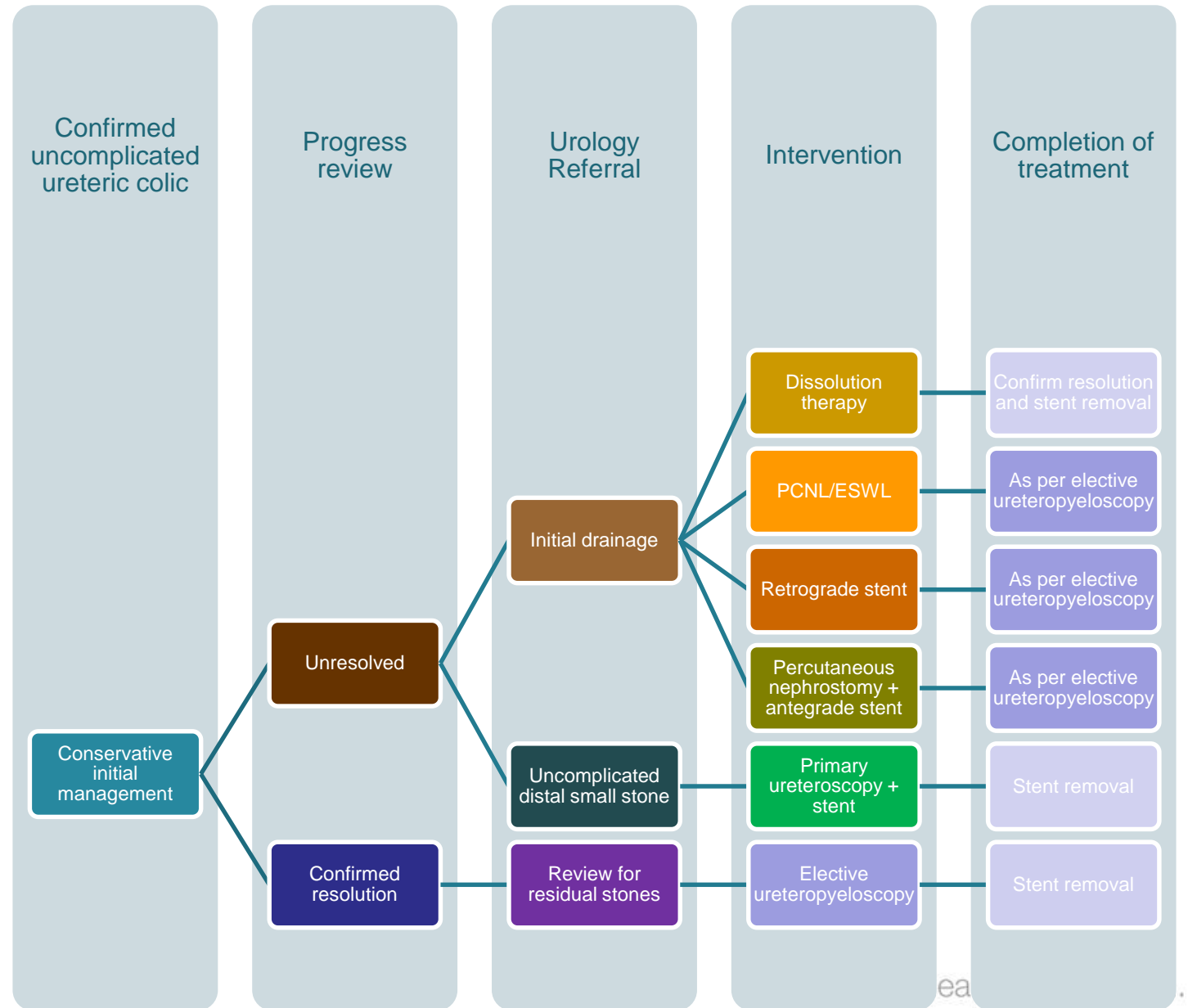


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Renal stone disease: Management overview



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Renal stone disease

WHAT CHANGES ARE LIKELY TO IMPACT GP?



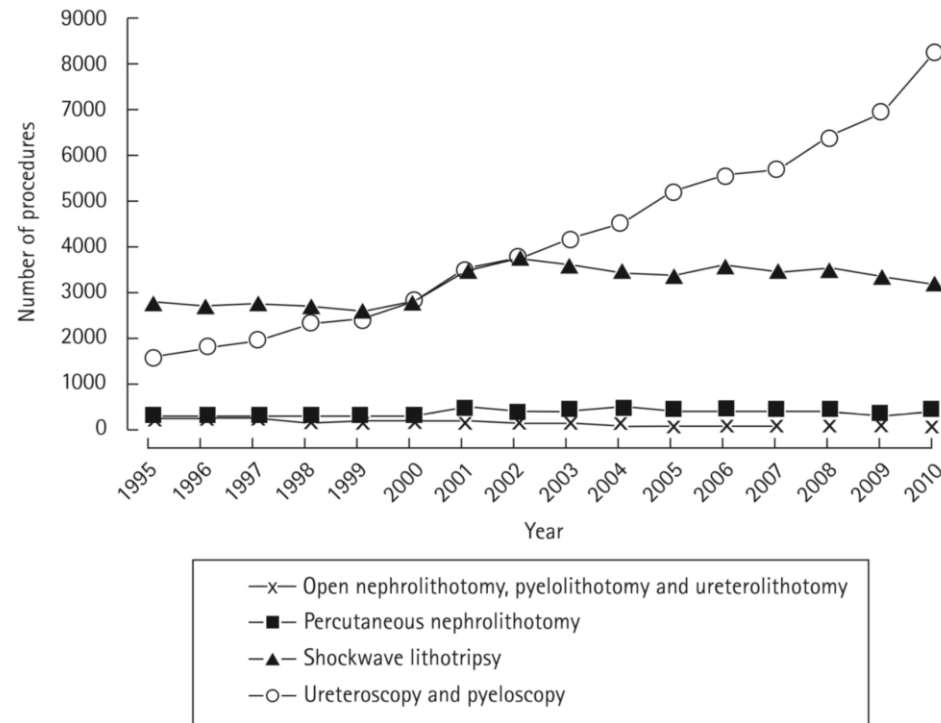
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Renal stone surgeries: Increasing retrograde endoscopic treatment

FIG. 2. Number of procedures claimed under Medicare Australia for different stone treatment modalities between 1995 and 2010.



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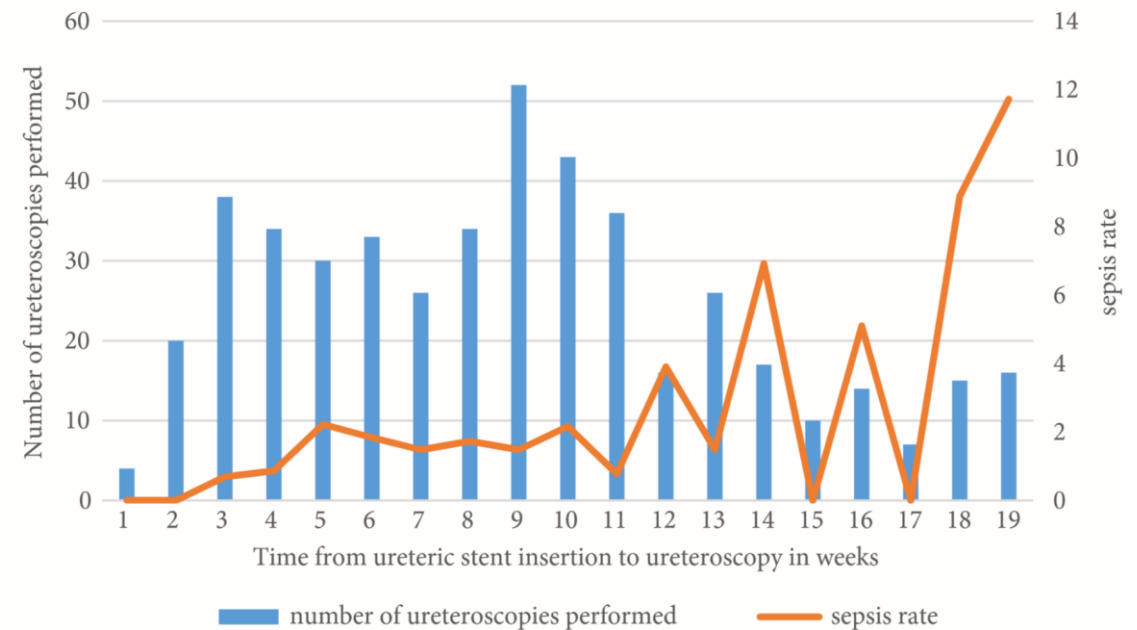
Delay in post-stent ureteroscopy is associated with increased post-operative sepsis risk

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BJU International

Ureteric stent dwelling time: a risk factor for post-ureteroscopy sepsis

Amihay Nevo^{*†}, Roy Mano^{*†}, Jack Baniel^{*†} and David A. Lifshitz^{*†}

^{*}Department of Urology, Rabin Medical Centre, Petach Tikva, Israel, and [†]Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel



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Transition to single use equipment

Disposable flexible ureteroscopes

Disposable cystoscope for stent removal

Lithovue, Pusen

- Enhanced image resolution
- Preserved deflection with thick LASER fibre
- Contained damage and cost when use in the setting of expanded indications

Isiris

- Single operator
- Outpatient or bed-side local aesthetic



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LASER technology improvement

Higher power 100W/120W LASER

Fragmentation: Directed
very high energy 1J: low
frequency 3-5Hz

Dusting: Low energy
200-500mJ: very high
frequency 40-50Hz

Popcorning: Undirected
higher energy 500-
600mJ: high frequency
20-40Hz



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Retrograde flexible pyeloscopy for larger stones



Retrograde intrarenal surgery for kidney stones larger than 2.5 cm

Alberto Breda and Oriol Angerri

Purpose of review

The management of large intrarenal stones (>2 cm) is typically percutaneous nephrolithotomy. Although the stone-free rate (SFR) of such a procedure is high (up to 95%), the complications related mainly to the renal access are sometimes a concern. Because of the evolution in technology, it is nowadays possible to treat intrarenal stones with retrograde intrarenal surgery. It remains unclear whether or not retrograde intrarenal surgery (RIRS) may be effective also for the treatment of larger stones (>2 cm). The purpose of this review is to provide recent data on the ureteroscopic management of kidney stones larger than 2.5 cm.

Recent findings

A systematic review of the literature for studies identified between January 2000 and September 2013 was performed. Only English language articles reporting on more than 10 cases treated with RIRS for intrarenal stones larger than 2.5 cm were considered for this review.

Particular emphasis was given to studies published within the last 12 months. Of the 324 studies identified, only 10 were considered suitable for this review. There were a total of 441 patients with a mean stone size of 2.9 cm. The SFR with an average of 1.6 procedures was 89.3%. The overall complication rate was 8% with major complication rate of 1.9%.

Summary

Although not supported by high evidence because of the absence of prospective randomized studies, it appears that in selected patients with large intrarenal stones, RIRS and laser lithotripsy may offer an acceptable efficacy with low morbidity.

Keywords

2.5 cm, holmium laser, retrograde intrarenal surgery, stones

	N patients	Stone size (cm)	Stone free (%)	Procedures
Riley <i>et al.</i> [14]	22	3	91	1.8
Bader <i>et al.</i> [8]	24	3	92	1.7
Al-Qahtani <i>et al.</i> [7 [*]]	120	2.6	96.7	1.6
Hussain <i>et al.</i> [10]	36	2.8	94.4	1.29
Akman <i>et al.</i> [6]	34	2.6	88.2	1.2
Cohen <i>et al.</i> [9 [*]]	131	3	87	1.6
Mariani [11]	15	3.3	92	1.5
Mariani [12]	16	6.5	88	2.4
Ricchiuti <i>et al.</i> [13]	23	3.1	74	1.4
Takazawa <i>et al.</i> [15]	20	3.1	90	1.4



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What to expect in the future?

Cost effective single-use equipment

Improved LASER technology

Faster patient management
but more stents

Expanding indications for retrograde endoscopic
treatment

More timely follow-up surgery



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Urological management

TROUBLE SHOOTING: URETERIC STENT

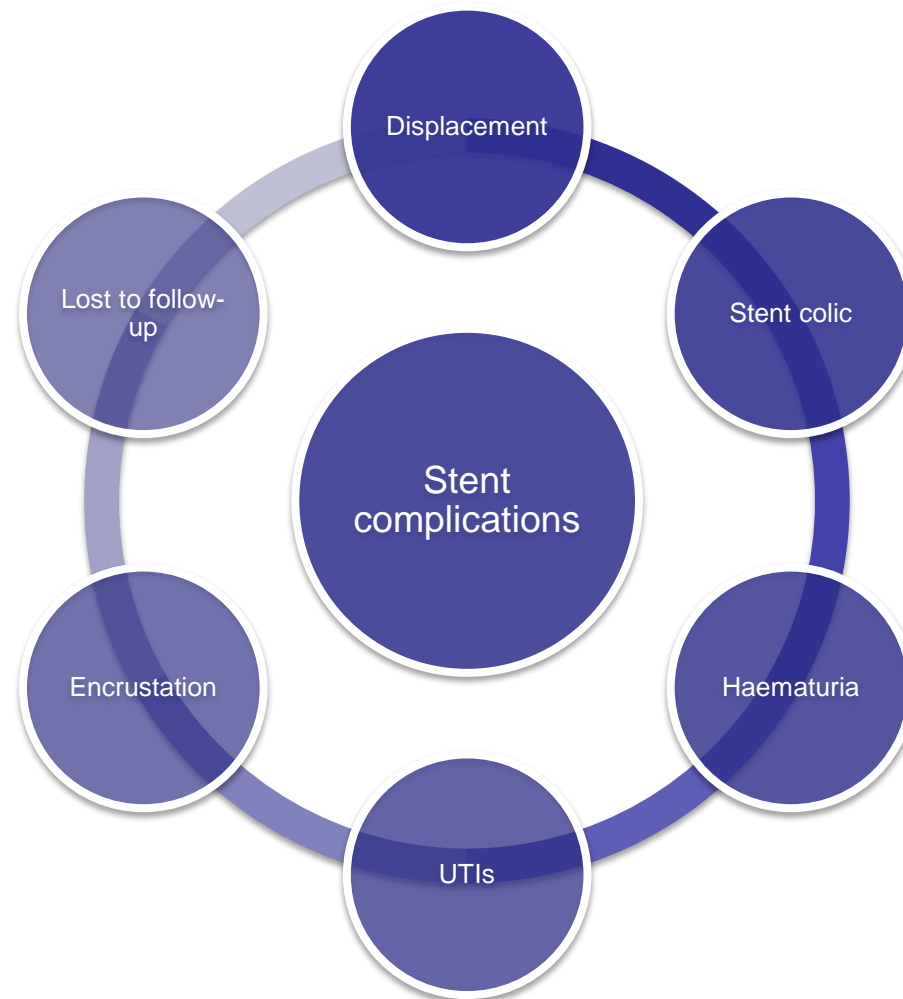


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Stent related complications



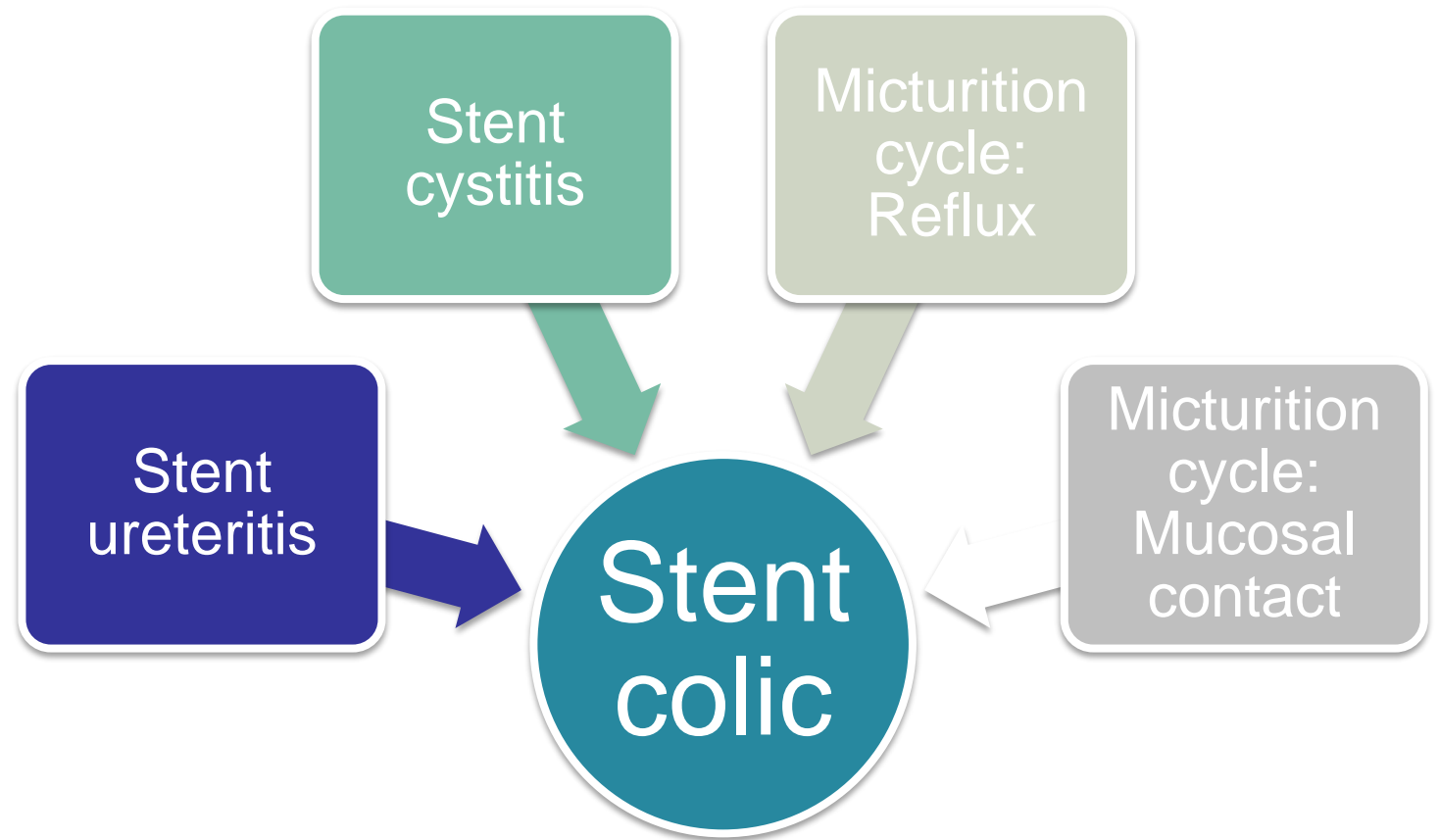
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Stent colic and related haematuria

Mimics symptoms of stent displacement and stent related UTIs.



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How common is stent colic?



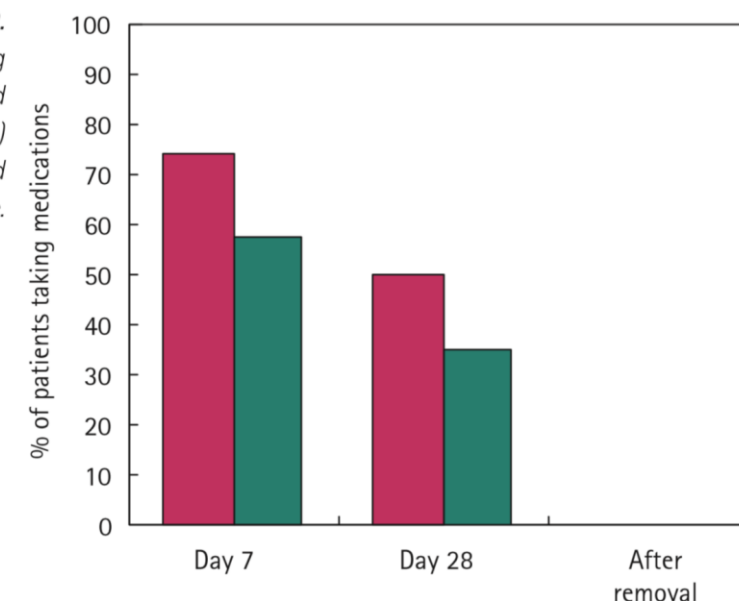
Predictors of morbidity in patients with indwelling ureteric stents: results of a prospective study using the validated Ureteric Stent Symptoms Questionnaire

Gianluca Giannarini, Francis X. Keeley Jr*, Francesca Valent[†],
Francesca Manassero, Andrea Mogorovich, Riccardo Autorino* and
Cesare Selli

Department of Urology, University of Pisa, Pisa, [†]Institute of Epidemiology, University of Udine, Udine, ^{*}Urology Clinic,
Second University of Naples, Naples, Italy, and ^{*}Bristol Urological Institute, Southmead Hospital, Bristol, UK

Accepted for publication 12 March 2010

FIG. 2.
Proportion of patients taking
analgesic (red bars) and
anticholinergic (green bars)
medications for stent-related
symptoms as a function of time.



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Predictors for stent colic and related morbidities

Distal loop location across midline is the only consistent predictor in the same study

However the stent length has no statistical correlation to distal coil location

TABLE 4 Multivariate analysis assessing predictors of morbidity on day 7 after stent placement

Variable	Urinary symptoms		Body pain		General health		Work performance		Sexual matters		Additional problems		General quality of life	
	β	P	β	P	β	P	β	P	β	P	β	P	β	P
Age (per year)	0.045	0.347	0.120	0.318	0.012	0.731	-0.011	0.625	-0.087	0.229	-0.020	0.081	0.005	0.531
Gender (male vs female)	8.082	0.059	3.352	0.732	-1.392	0.010	-5.710	0.634	-0.488	0.777	-0.567	0.537	0.403	0.522
Body mass index (per unit)	-2.998	0.047	-1.842	0.321	-0.459	0.303	0.305	0.166	-0.621	0.113	-0.170	0.224	-0.185	0.056
Side (right vs left)	0.788	0.618	4.902	0.219	0.294	0.805	0.199	0.736	-0.674	0.371	-0.482	0.196	0.104	0.685
Length (per cm)	0.089	0.892	1.068	0.514	-0.016	0.974	0.679	0.110	-0.612	0.299	0.141	0.359	-0.053	0.616
Calibre (per F)	0.590	0.598	3.478	0.219	1.457	0.087	1.534	0.010	-0.486	0.317	-0.192	0.468	0.411	0.059
Distal loop location (crossing vs not crossing the midline)	11.680	<0.001	13.033	<0.001	1.992	<0.001	2.023	<0.001	4.649	<0.001	-0.132	0.722	0.364	0.157

β , parameter estimate.

TABLE 5 Multivariate analysis assessing predictors of morbidity on day 28 after stent placement

Variable	Urinary symptoms		Body pain		General health		Work performance		Sexual matters		Additional problems		General quality of life	
	β	P	β	P	β	P	β	P	β	P	β	P	β	P
Age (per yr)	0.055	0.143	0.068	0.480	0.045	0.177	0.047	0.062	-0.026	0.091	-0.002	0.863	0.010	0.184
Gender (male vs female)	5.138	0.097	5.109	0.518	2.526	0.350	-1.826	0.283	0.206	0.856	-0.629	0.515	0.246	0.688
Body mass index (per unit)	-2.740	0.025	-1.019	0.161	-0.577	0.031	0.064	0.791	-0.181	0.275	-0.017	0.907	-0.117	0.213
Side (right vs left)	1.375	0.270	1.676	0.601	0.917	0.402	-0.817	0.218	0.690	0.116	-0.616	0.119	-0.108	0.665
Length (per cm)	-0.01	0.979	-0.139	0.916	0.263	0.560	0.198	0.487	-0.211	0.320	0.202	0.212	0.070	0.494
Calibre (per F)	0.909	0.304	2.677	0.241	1.240	0.113	1.034	0.060	-0.104	0.731	0.285	0.306	0.326	0.168
Distal loop location (crossing vs not crossing the midline)	3.401	<0.001	6.413	<0.001	-0.375	<0.001	0.847	<0.001	1.847	<0.001	-0.054	0.890	-0.143	0.565

β , parameter estimate.

Stent colic management

Investigations

- MSU
- FBC
- EUC

Imaging

- KUB x-ray
- CTIVP
- CTKUB

Analgesia

- Paracetamol
- NSAID

Uncertain

- Antibiotic
- Tamsulosin
- antispasmodic



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Mirabegron: Stent colic relief

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Does mirabegron relieve ureteric stent-related discomfort? A prospective, randomized, multicentre study

Bum Sik Tae*^{ID}, Seok Cho[†], Byung Jo Jeon*, Hoon Choi*, Jae Young Park*^{ID},
Sung Yong Cho[†], Keon-Cheol Lee[†] and Jae Hyun Bae*^{ID}

**Department of Urology, Korea University Ansan Hospital, Korea University College of Medicine, Ansan , and*

†Department of Urology, Inje University Ilsan Paik Hospital, Inje University School of Medicine, Goyang, Korea



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Stent displacement

- 10% stent with extraction string dislodge within 7 days
- May worsen discomfort if distal coil migrates across bladder midline
- May fail to provide relief to obstruction if migrate entirely distal to obstruction site
- KUB x-ray generally appropriate as initial imaging
- Prompt urology review and patient fasting if displaced



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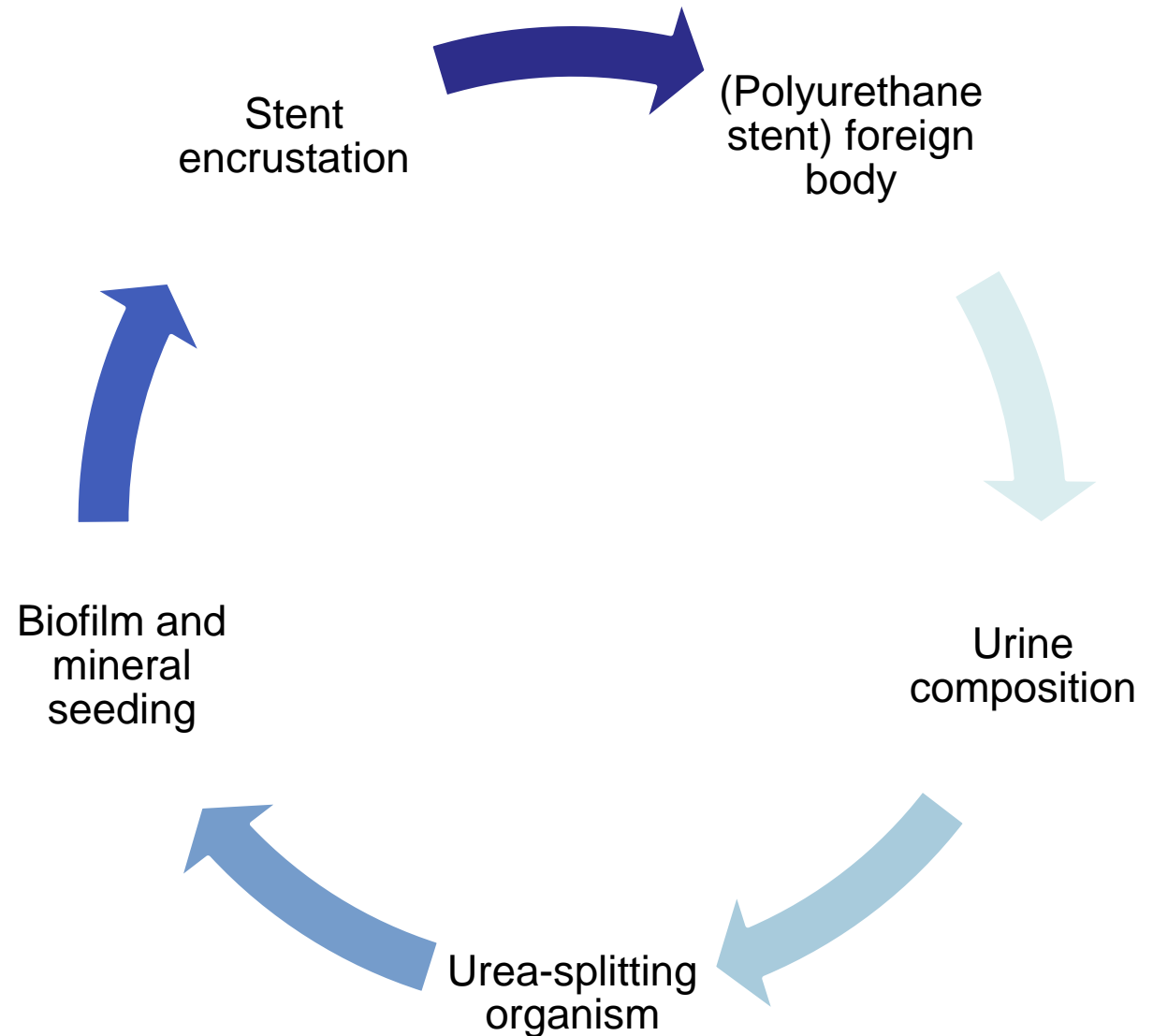
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Stent related UTIs and encrustation

Cystitis symptoms common without +ve microbiology

Empirical short course antibiotic based on clinician's judgement while culture results pending is very reasonable

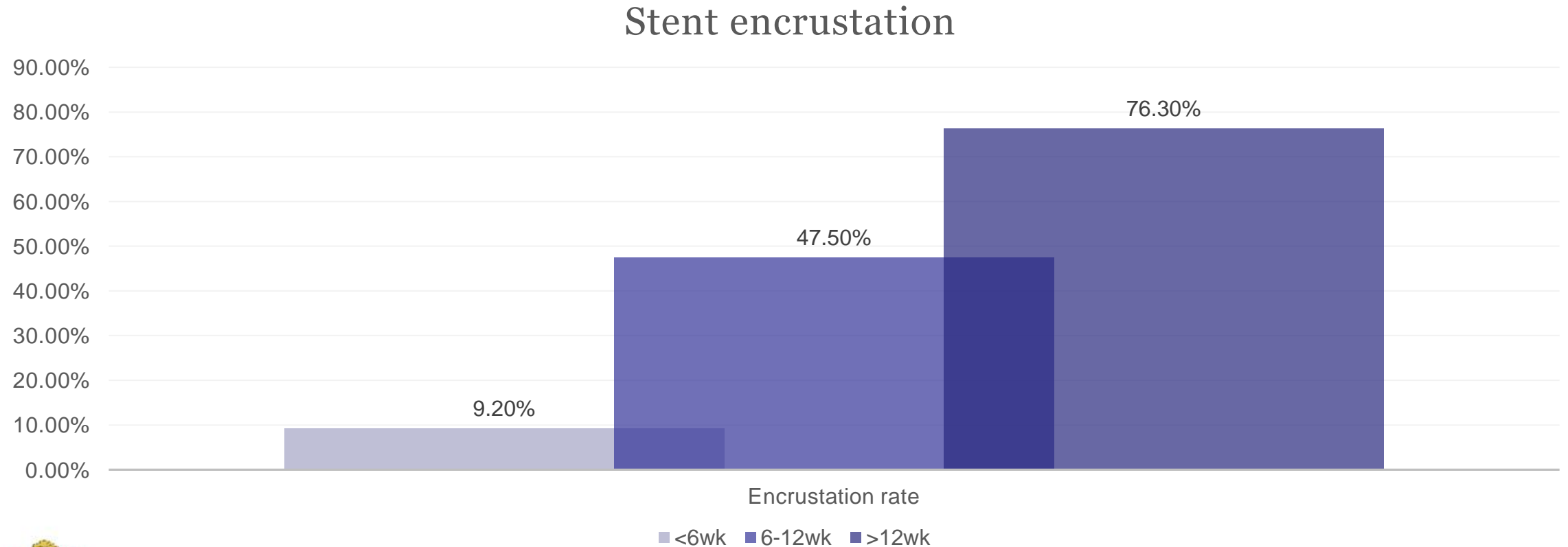


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Stent encrustation risk

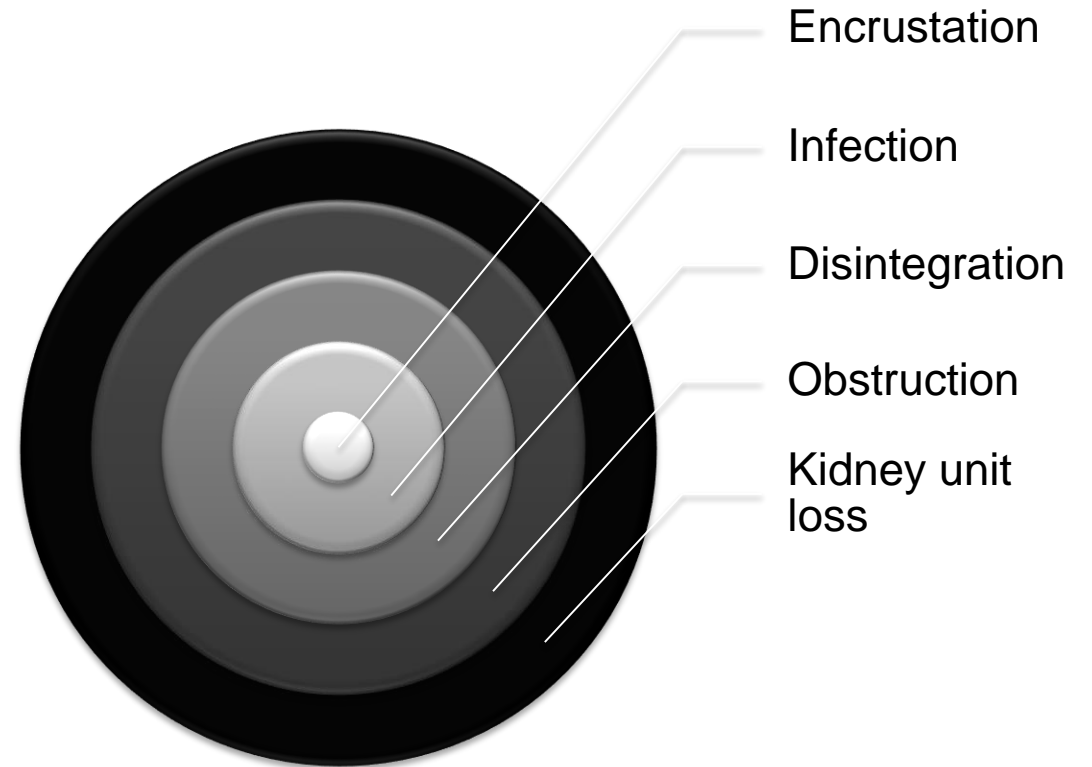
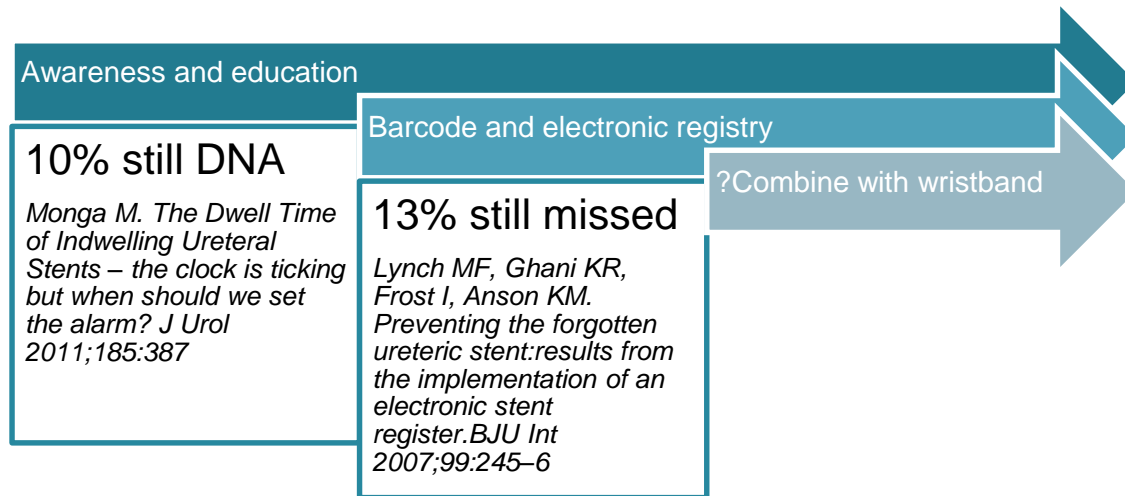


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Stent: Lost to follow-up



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Urological management

ASYMPTOMATIC STONES FOLLOW-UP



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Rise in asymptomatic stone diagnosis

5 047 patients undergoing screening CT colonography found the screening prevalence of asymptomatic urolithiasis was 7.8%

Average 2.1 stones per patient

- Boyce CJ, Pickhardt PJ, Lawrence EM, Kim DH, Bruce RJ. Prevalence of urolithiasis in asymptomatic adults: objective determination using low dose noncontrast computerized tomography. *J Urol* 2010; 183: 1017–21



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Previous studies on natural history

Natural history of retained non-obstructive renal calculi

2-10% adverse event
annual risk

conflicting
results

Glowacki 1992
(n=107) 32% episode
of renal colic within 2
yrs 50% symptomatic
within 5yrs (10% per
yr)

Hubner 1993 (n=63) 7
year outcomes: 45%
increased in size 70%
symptomatic 40%
required surgery

Burgher 2004 (n=300)
77% increased in size
26% required
intervention

stone progression
rates ranging from
32% to 77%,

spontaneous stone-
passage rates
between 12.5% and
29.1%



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A contemporary study of natural history

238 patients median follow-up was 63 (12–132) months between 2005-2016

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Upper Urinary Tract

The natural history of asymptomatic calyceal stones

Maitrey P. Darrad , Sachin Yallappa, John Metcalfe and Kesavapillai Subramonian

Urology Department, University Hospital Birmingham, Birmingham, UK



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Variable	Value
Renal units, <i>n</i>	301
Patients, <i>n</i>	238
Male : female, <i>n</i> (%)	196 (65): 105 (35)
Cumulative stone size, mm, mean (range)	10.8 (3–63.8)
Age, years, median (range)	56 (24–87)
<i>N</i> (%)	
Age, years	
<50	105 (35)
>50	196 (65)
Cumulative stone size, mm	
0–9	194 (64)
10–19	67 (22)
≥20+	40 (13)
Location	
Upper pole	52 (17)
Mid-pole	68 (23)
Lower pole	128 (43)
Multiple sites	53 (18)
Number of stones	
Single	196 (6)
Multiple	105 (35)
Previous stones	
Ever	129 (43)
Never	172 (57)
Laterality	
Left	172 (57)
Right	129 (43)
Radio-opaque	
Yes	272 (90)
No	29 (10)

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Contemporary study results

	Spontaneous stone passage	Active surgical intervention	Continual surveillance	Stone-related symptoms	Any stone-related AE (either symptoms and/or active surgical intervention*)
Number of renal units (%)	44 (14.6)	80 (26.6)	177 (58.8)	91 (30.2)	117 (39.5)
Time to event, months, median (range)	31 (2–85)	48 (2–120)	63 (12–132)	43 (1–119)	42 (1–120)

**Excluding renal units of patients that remained asymptomatic and proceeded to surgery entirely due to patient choice rather than an actual AE.*



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Summary of study findings

Risk of adverse events

- 1yr: 3.4%
- 3yr:18.9%
- 5yr:30.7%

Risk of clinically significant outcomes

- Spontaneous passage: 14.6%
- Surgical interventions: 26.6%

Predictors

- Spontaneous passage: Patients aged <50 years, with smaller stones, and no stone growth
- Need for surgery: <50 years and stone growth >1 mm per year



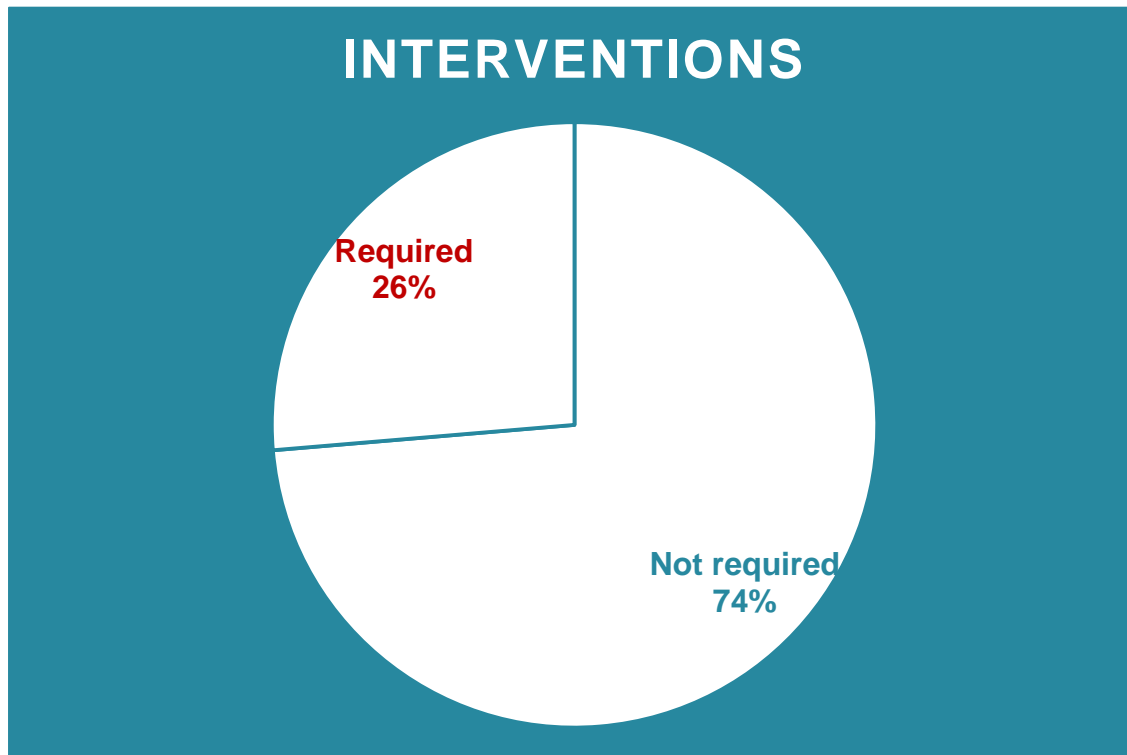
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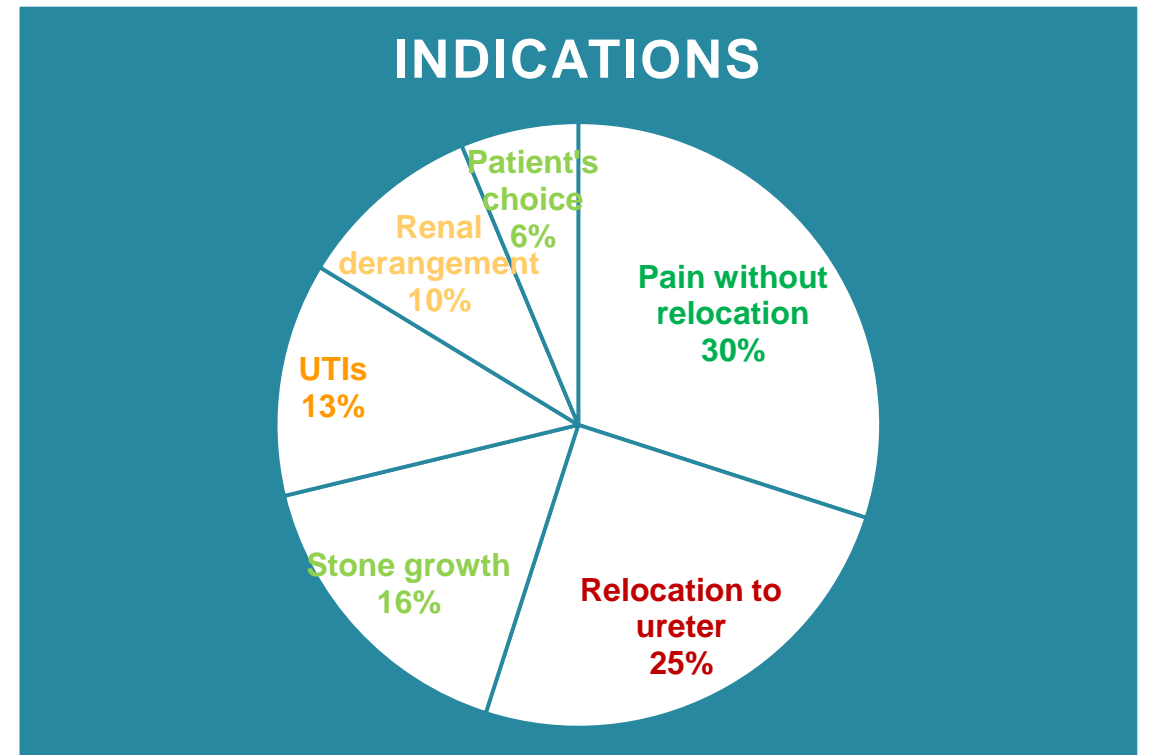
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Absolute vs relative indications for interventions in the study

Interventions required



Indications for interventions



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Study findings for acute adverse events?

Risk of adverse events

- 1yr: 3.4% (1.7%)
- 3yr: 18.9% (9.45%)
- 5yr: 30.7% (15.35%)

Clinical outcomes

- Spontaneous passage: 14.6%
- Surgical interventions: 26.6%

Predictors

- Spontaneous passage: Patients aged <50 years, with smaller stones, and no stone growth
- Need for surgery: <50 years and stone growth >1 mm per year



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Next: Summary

QUESTIONS?



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Summary

Take home message

Clinical diagnosis and trial of conservative management in selected cases reasonable

Clinical symptoms/signs and office dipstick

Practical and still accurate

NSAID essential

AKI risk minimal

MET

Define end-points accordingly

Additional testing and verification essential in urology setting

CT, urine microscopy verification preferred

ACT Health referral pathway under further development

Evolving technology and expanding treatment indications

Expect to see more patients with stent

Be familiar with stent colic management



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