

# UROLOGY FOR MEDICAL STUDENTS

Milan Hora,  
Olga Dolejšová  
et al.

# Urology for Medical Students

**Milan Hora**  
**Olga Dolejšová et al.**

---

Reviewers:

MUDr. Viktor Eret, Ph.D.

MUDr. Tomáš Vavřík

Authors:

prof. MUDr. Milan Hora, Ph.D., MBA, MUDr. Olga Dolejšová, Ph.D., FEBU,

MUDr. Ivan Trávníček, Ph.D., MUDr. Tomáš Ůrge, Ph.D., MUDr. Tomáš Pitra, Ph.D.,

MUDr. Hana Sedláčková

Published by Charles University

Karolinum Press

Prague 2021

Typeset by DTP Karolinum Press

First edition

© Charles University, 2021

Text © Milan Hora, Olga Dolejšová et al., 2021

Translation © Božena Hosnedlová, 2021

Illustrations © Anna Dolejšová, 2021

ISBN 978-80-246-4545-2

ISBN 978-80-246-4587-2 (online : pdf)



Univerzita Karlova  
Nakladatelství Karolinum

[www.karolinum.cz](http://www.karolinum.cz)  
[ebooks@karolinum.cz](mailto:ebooks@karolinum.cz)



# CONTENTS

Introduction	9
<b>1. GENERAL UROLOGY</b>	<b>10</b>
1.1 Urological symptoms	10
1.2 Special methods in urological diagnostics	13
1.2.1 Medical history and physical examination	13
1.2.2 Laboratory diagnostics	14
1.2.2.1 Urine examination	14
1.2.2.2 Blood tests	16
1.2.3 Imaging examinations	16
1.2.4 Urodynamic examination – see the special chapter	19
1.3 Special methods of urological treatment	20
1.3.1 Catheterization	20
1.3.2 Endoscopy	21
1.3.3 Nephrostomy	23
1.3.4 Laparoscopy	23
1.3.5 Biopsy	23
1.4 Renal failure	24
1.4.1 Acute renal failure	24
1.4.2 Chronic renal failure	25
1.4.2.1 Division according to the degree of damage to the glomerular filtration capacity	25
1.4.2.2 Treatment of chronic renal failure	26
<b>2. CONGENITAL DEFECTS OF URINARY AND GENITAL TRACTS</b>	<b>29</b>
2.1 Congenital defects of the bladder and kidneys	30
2.1.1 Congenital anomalies of kidneys	30
2.1.1.1 Deviations in kidney count, kidney volume, renal rotational anomalies, kidney shape varieties	30
2.1.1.2 Position deviations of kidneys – renal dystopia (renal ectopia)	30
2.1.1.3 Renal dysplasia, renal hypoplasia and cystic kidney diseases	31
2.1.1.4 Abnormalities of renal calyces	31
2.1.2 Congenital defects of the renal pelvis and ureter	31
2.1.2.1 Congenital hydronephrosis	31
2.1.2.2 Megaureter	32
2.1.2.3 Supernumerary ureters	32
2.1.2.4 Ureterocele	33
2.1.2.5 Ectopic megaureter	33
2.1.2.6 Vesicoureteral (vesicorenal) reflux – VUR	33
2.1.2.7 Retrocaval ureter	34

2.1.3	Congenital anomalies of lower urinary tract (the urinary bladder and urachus)	34
2.2	Congenital anomalies of the male genitalia	34
2.2.1	Congenital anomalies of the male urethra	34
2.2.2	Cryptorchism	35
2.2.3	Phimosi s.	35
2.2.4	Hydrocele	36
2.2.5	Varicocele – See the chapter 8.2 Scrotal diseases	36
2.3	Disorders of sex development	36
2.4	Transsexualism	37
<b>3.</b>	<b>URINARY AND GENITAL TRACT INFECTIONS</b>	<b>39</b>
3.1	Urinary tract infections in adults	41
3.2	Male genital tract infections	48
3.3	Urinary tract infections in children	50
3.4	Specific infections	50
3.4.1	Urogenital tuberculosis (UGTB)	50
3.4.2	Schistosomosis (schistosomiasis, bilharziasis)	51
3.4.3	Actinomycosis	52
<b>4.</b>	<b>UROLITHIASIS</b>	<b>54</b>
4.1	Definition and occurrence	54
4.2	Etiopathogenesis – causative factors of urolithiasis and its types	54
4.3	Nomenclature	57
4.4	Clinical signs and diagnostics	57
4.5	Treatment of nephrolithiasis	60
4.6	Treatment of ureterolithiasis	61
4.7	Prevention of urolithiasis	62
4.8	Cystolithiasis	63
<b>5.</b>	<b>URO-ONCOLOGY</b>	<b>64</b>
5.1	Introduction	64
5.2	Penile carcinoma (C60)	65
5.3	Prostate carcinoma (C61)	66
5.3.1	Clinical notes	66
5.3.2	Diagnosis	67
5.3.3	Treatment of prostate carcinoma	70
5.3.3.1	Locally confined prostatic carcinoma T1-2N0M0	70
5.3.3.2	Locally advanced prostatic carcinoma T3-4N0-1M0	72
5.3.3.3	Generalized prostatic carcinoma TXNXM1	72
5.3.4	Screening and early detection of prostate carcinoma	74
5.4	Testicular tumours (C 62)	74
5.4.1	Classification of testicular tumours	75
5.4.1.1	Histological classification	75
5.4.1.2	Clinical classification – by radiosensitivity	75
5.4.1.3	Characteristics of individual testicular tumours	75
5.4.2	Clinical notes	76
5.4.3	Treatment of testicular tumours	78
5.4.3.1	Seminomas	78
5.4.3.2	Non-seminomas	78
5.5	Cystic kidney disease	79
5.6	Kidney tumours	81
5.6.1	Clinical notes	81
5.6.2	Treatment of renal cell carcinoma (RCC)	82
5.6.2.1	Localized tumours	82
5.6.2.2	Metastatic renal cell carcinoma (mRCC)	82

5.6.3 Treatment of other histological types of kidney tumours	83
5.7 Urothelial tumours	83
5.7.1 Urinary bladder tumours (C 67)	84
5.7.1.1 Clinical notes	84
5.7.1.2 Therapy	85
5.7.2 Urothelial carcinoma of the renal pelvis (C 65) and ureter (C 66)	88
5.8 Adrenal diseases	89
<b>6. RETROPERITONEAL DISEASES</b>	<b>91</b>
6.1 Upper urinary tract obstruction	91
6.2 Causes of ureteral obstruction	91
6.2.1 Vascular lesions	92
6.2.2 Benign diseases of the female reproductive system	92
6.2.3 Gastrointestinal diseases	92
6.2.4 Retroperitoneal tumours	92
6.2.5 Retroperitoneal fibrosis (Ormond's disease) – RPF	93
<b>7. LOWER URINARY TRACT DISEASES</b>	<b>94</b>
7.1 Urodynamics	94
7.1.1 Urodynamics of the lower urinary tract	94
7.2 Neurogenic bladder	97
7.3 Urinary incontinence	101
7.4 Enuresis	104
7.5 Urinary fistulas	105
7.6 Benign prostatic hyperplasia – BHP	106
7.6.1 Pathology	107
7.6.2 Clinical signs	108
7.6.3 Examination	109
7.6.4 BPH treatment	109
<b>8. NON-NEOPLASTIC DISEASES OF THE MALE GENITALIA</b>	<b>113</b>
8.1 Penis diseases	113
8.1.1 Balanitis	113
8.1.2 Phimosi and paraphimosis	113
8.1.3 Lichen sclerosus et atrophicus	114
8.1.4 Condylomata accuminata	114
8.2 Scrotal diseases	114
8.2.1 Hydrocele	114
8.2.2 Varicocele	115
8.2.3 Spermatocele	116
8.2.4 Testicular torsion (or spermatic cord torsion)	116
8.2.5 Torsion of appendix testis or epididymis	116
8.3 Fracture of the penis	116
8.4 Urethral stricture	117
8.5 Urethritis	117
8.5.1 Acute urethritis	117
8.5.2 Chronic urethritis	119
<b>9. ANDROLOGY</b>	<b>120</b>
9.1 Hormonal control	120
9.2 Erection and ejaculation	121
9.3 Male infertility	124
9.4 Priapism	127
9.5 Health of the aging man	128
9.6 Induratio penis plastica (Morbus Peyronie)	128

<b>10. UROGENITAL TRAUMA</b> .....	130
10.1 Kidney trauma .....	130
10.2 Ureteral trauma .....	131
10.3 Bladder trauma .....	132
10.4 Urethral trauma .....	133
10.5 Penile trauma .....	134
10.6 Scrotal and testicular trauma .....	135
<b>11. ACUTE UROLOGICAL CONDITIONS</b> .....	136



# INTRODUCTION

Urology is a dynamically developing field. Since the mere offshoot of surgery, it has during the second half of the 20<sup>th</sup> century become a completely separate field with its own postgraduate education system. There is separate postgraduate education in urology, including a separate urological strain. Furthermore, it is possible to specialize in the form of a follow-up study attestation (certified course) from paediatric urology, onco-urology and intensive medicine. At most medical faculties in the Czech Republic, urology is taught separately from other surgical disciplines.

Urology deals with a wide range of diseases. The urologist performs both a complete diagnosis and treatment (both standard and surgical treatment) of these diseases. A large part of the care volume includes follow-ups, especially in the case of tumours. Surgical treatment includes a wide range of surgical methodologies. These are open operations including the use of the intestinal tract to replace the bladder, endoscopic operations on the lower and upper urinary tract, laparoscopic or robotic-assisted surgical procedures, which have really been developing dynamically in recent years. Urology is an expensive field – expensive instrumentation is used for endoscopic and laparoscopic or robotic surgery, and equipment for extracorporeal lithotripsy, equipped with modern lasers facilities (mainly Ho:YAG is used) is also expensive. Operational methodologies are becoming more sophisticated, so the time to routinely manage the operation is prolonged. For these and many other reasons, modern surgical urology must be concentrated in large urological workplaces. A subspecialisation of urologists is developing. Close cooperation with a number of disciplines is needed (especially radiology, pathology, anaesthesiology, clinical and radiation oncology, internal medicine, surgery, paediatrics, neurology, and others).

The importance of the field of urology is documented by the following figures. Urinary tract infections are the second most common after respiratory tract infections. Over 5% of people experience some form of urolithiasis during their lifetime. One-third of malignancies in men are urological tumours, the most common male malignancy is definitely prostate carcinoma. About 40% of elderly women suffer from urinary incontinence. Benign prostatic hyperplasia affects about 30% of older men. Erectile dysfunction is found in 20% of men. For these reasons, a student of General Medicine in the Faculty of Medicine should be familiar with urological diseases.

Only selected schematic images are included in the text. Students will be acquainted with extensive image documentation presented in the electronic form, including video sequences, during practical exercises in urology; this documentation is also available on the clinic's website.

# 1 GENERAL UROLOGY

## 1.1 UROLOGICAL SYMPTOMS

The ordering of the symptoms is in alphabetical order.

Anuria – daily diuresis under 100 mL.

Aseptic (abacterial) pyuria – the presence of significant amounts of leukocytes in the urine without evidence of bacteriuria (e.g., urogenital tuberculosis).

Bacteriuria – bacteria in urine.

Biliuria – bile pigments in urine.

Cystalgia – pain over the pubic symphysis caused mainly by cystitis.

Dysuria (from Greek dys-disorder, from Greek ūron – urine) – generally difficult to urinate, feelings of cutting and burning in the urethra during urination, mostly caused by inflammation.

Enuresis diurna (diurnal enuresis) – previously used term, today replaced by the term of urinary incontinence.

Enuresis nocturna (nocturnal enuresis) – bedwetting during sleep (at night).

Erythrocyturia – erythrocytes in urine.

Faecaluria and pneumaturia. Gas in urine (pneumaturia) and the admixture of faeces to the urine (faecaluria) suspect pathological communication (fistula) between intestine and bladder (diverticulitis, sigmoid carcinoma, Crohn's disease, advanced bladder carcinoma). The presence of mere gas in urine can be due to uroinfection by gas-forming micro-organisms, mostly in diabetics.

Haematuria – blood in urine. See below.

Haemospermia (haematospermia) – blood in semen. The patient should be examined to exclude testicular and prostate cancers in particular.

Ischuria paradoxa – incontinence due to abnormal dripping of urine from the bladder in urinary retention.

Lower urinary tract symptoms (LUTS) – see also BPH (benign prostatic hyperplasia). LUTS include symptoms of uptake or irritation (pollakiuria, nocturia, urgency, urge incontinence) and miction or obstructive symptoms (weak urine flow, retardation of starting micturition, discontinuous urination, terminal dribbling – drip, urine retention, straining during voiding by abdominal press). Note: straining during voiding, retardation

- of starting micturition, poor urine flow, and post-evacuation incontinence are signs of subvesicular obstruction. Pollakiuria, nycturia, urgency, and urge incontinence may be without subvesicular obstruction, but are often seen in patients with obstruction and a secondary unstable detrusor.
- Nephralgia – blunt pain of constant intensity in the lumbar region resulting from the expansion or irritation of the renal capsule.
- Nocturia – urination at night, which wakes up the patient.
- Oliguria – daily diuresis under 500 mL.
- Orchialgia – see testalgia.
- Pneumaturia – gas in urine (diabetics, gastrointestinal fistulas). See also fecaluria.
- Pollakiuria (extraordinary daytime urinary frequency) – more frequent frequency of urination (8 times or more per day).
- Polyuria – daily diuresis over 2000 mL. Manifestation of decreased concentration ability of the kidney (e.g., chronic renal insufficiency, diabetes mellitus) or insufficient production of antidiuretic hormone in the pituitary gland.
- Post-micturition dribble – leakage of a few drops of urine after the urination has ended. It is common in severe urethral strictures or tight phimosis with urine emptying from the preputial pouch.
- Prostatalgia, prostatodynia (algos or *odynē* = in Greek pain) – prostate pain, mainly in prostatitis.
- Proteinuria – evidence for the presence of protein in urine.
- Pyuria – evidence for the presence of leukocytes in urine.
- Renal colic – a suddenly occurring fluctuating pain in the lumbar region with propagation (see urolithiasis) and with vegetative accompaniment given by the reflex irritation of the sympathetic ganglia (nausea, vomiting, sweating, physical restlessness). The cause is upper urinary tract obstruction. The propagation of pain is in the case of the obstruction in the upper third of the ureter into the back, and in the case of the supravescical obstruction into the inside of the thigh, into the scrotum or labia – due to irritation of *n. genitofemoralis* and *n. ilioinguinalis*. If the obstacle is intramural, urgency and pollakiuria are added. The cause of the obstruction is mainly ureterolithiasis, alternatively blood coagulum or urothelial tumour.
- Retardation of starting micturition – delay between the impulse to urinate and starting urination.
- Sexual dysfunction (male sexual dysfunction, female sexual dysfunction) – includes loss of libido, erectile dysfunction (ED), ejaculation disorders (ejaculatory dysfunction) – mainly anejaculation (aspermia), premature ejaculation, absence of orgasm.
- Significant bacteriuria – demonstration of more than  $10^5$  bacteria in a 1 mL of sample of the mid-stream urine causing clinical symptomatology.
- Stranguria – (from Greek *stranx*-strangos – squeezing, dropping) painful urination, burning and cutting pains while urinating.
- Testalgia – testicular pain. It is caused by epididymitis, orchitis, pain propagation in renal colic, affection in the inguinal canal, testicular torsion.
- Urethral discharge – the most common symptom in venereal diseases.
- Urethralgia – pain in the urethra, especially in urethritis.
- Urethrorrhagia – bleeding from the urethra.
- Urgent incontinence – the involuntary leakage of urine in very strong urge to urinate.

Urinary incontinence – involuntary loss (leakage) of urine which is objectively demonstrable, see the special chapter.

Urinary retention – arrest of urinary output. Most often they are based on subvesical obstruction in BPH and prostate carcinoma.

Urinary stream spraying – a consequence of distal urethral stenosis or stenosis of the external urethral meatus.

Urinary urgency – urgent urge to urinate.

Urosepsis – sepsis induced by urinary tract bacteria.

## **Haematuria**

Haematuria is an abnormal presence of erythrocytes or blood in urine. We divide it into macroscopic or microscopic. If the macroscopic haematuria is of a high intensity, it is called a massive haematuria. Bladder tamponade is a condition in which blood clots in the bladder with subsequent retention. This is a serious condition requiring immediate resolution – see ‘Acute urological conditions’. Every case of haematuria should be examined! Haematuria should be distinguished from urethrorrhagia, which is an urination-independent spontaneous bleeding from urethra. Some foods (beetroot, rhubarb, blackberries) or some medicines (e.g., pyridium, rifampicin) may cause red urine discoloration. If serpentine-like coagula are present in the urine during massive bleeding, haematuria with a source in the upper urinary tract may be suspected. The shape is formed by the passage of the coagulum through the ureter and is accompanied by renal colic. What is important is whether the bleeding is free of other symptoms (so-called asymptomatic haematuria). This is often caused by urothelial carcinoma of the bladder. Urolithiasis or inflammatory affections are accompanied by pain, micturition difficulties and other symptoms.

Chemical detection of blood in the urine is based on heme detection. Heme catalyzes the cleavage of the organic peroxide and the released oxygen oxidates the colourless chromogen to the blue-green dye. A false positive finding may be due to contamination of urine from outside of the genital area during menstruation. Haematuria in glomerulopathies is often associated with cylinders in the urine and significant proteinuria. On the other hand, significant haematuria in urological diseases may not increase proteinuria above 1–3 g/L or using a dipstick test to values 2+ to 3+. Erythrocytes from glomerulopathies are typically dysmorphic and have a wide range of morphological alterations. In contrast, erythrocytes originating from tubulointerstitial renal diseases or present in urological diseases have a well-preserved round shape. The erythrocyte shape can be determined microscopically in phase contrast. See biochemistry for more details.

According to the cause, we distinguish prerenal (haemolytic anaemia, muscle traumas, burns), renal (glomerulonephritis, kidney tumours) and subrenal haematuria (inflammation, urolithiasis, urinary tract tumour). It is important to distinguish glomerular (glomerulonephritis) and nonglomerular haematuria (may be caused by almost all urological diseases, with uroinfections, urolithiasis, urological malignancies, and BPH being the most common causes).

Examination of haematuria: Medical history, physical examination including per rectum examination, examination of the mid-stream urine (chemically, sediment, bacteriologically, cytologically), ultrasonography. According to the findings, further examinations are then indicated. If the initial examination explains the cause of haematuria, contrast agent-enhanced CT including excretion phase or classical intravenous urography – IVU, also referred as excretory urography – EU) (see imaging methods) and urethroscopy are added. If these tests

are also negative, it is necessary to check the patient at least once every 3–6 months (clinical examination, urine examination, ultrasonography).

**Treatment:** It is performed according to basic diagnosis, e.g., transurethral resection of bladder tumour (TURBT) is indicated in bladder tumours. If the patient is taking anti-coagulants (warfarin) or anti-aggregants (acetylsalicylic acid, clopidogrel, ticlopidine), the drug should be discontinued, or vitamin K or, in acute cases, frozen plasma may be given. Low-molecular-weight heparin (nadroparin, enoxaparin) is administered to prevent thrombo-embolic disease while warfarin is discontinued.

## 1.2 SPECIAL METHODS IN UROLOGICAL DIAGNOSTICS

### 1.2.1 Medical history and physical examination

#### Medical history

Compared to a medical history (anamnesis) taken by doctors of other medicine disciplines, it is targeted at possible urological diseases. The family history is focused on the occurrence of genetically determined and familial diseases (hereditary cystic diseases, tuberous sclerosis, von Hippel-Lindau disease, renal tubular acidosis, cystinuria). Personal history identifies past illnesses, operations and injuries. Allergic history (drugs, antibiotics, iodine-based contrast media), substance abuse and smoking are equally important. The current disease (urological anamnesis) describes the diagnosis of its own urological disease. It is based on general symptoms and urological symptomatology (pain and urinary symptoms).

#### Physical examination

Physical examination includes inspection, percussion, palpation, auscultation and examination per rectum.



**Fig. 1** Bimanual palpation of the kidney

Bimanual palpation of the kidney (Figure 1) is carried out on the back with bent knees. The hand that is lowered is pushing the kidney against the hand that is raised. In palpation examination, the kidney of adult patients is not palpable. Children and asthenic individuals may have a palpable lower kidney pole. Kidney pathological resistance is palpable bimanually in the lumbar region, usually moving except for advanced tumours or inflammations, when the disease is already fixed to the surroundings; resistance moves with breathing excursions that may be ejected above as opposed to enlarged liver or spleen. Tapotement is a gentle strike using the ulnar side of the hand on the kidney area. Like bimanual palpation of the kidney, it is particularly painful in renal inflammation and renal colic. Rectal examination of the prostate – see BPH, prostatitis and prostate carcinoma.

## 1.2.2 Laboratory diagnostics

### 1.2.2.1 Urine examination

It is usually done from a mid-stream urine from spontaneous miction. The first portion of urine contains bacteria and cells from the urethra, and the patient leaves it to drain, and then a further urine stream is collected in a sterile tube.

Alternatively, bladder catheterization may be used, especially in women, for urine collection. In young children, urine for examination can be obtained by collection into sterile bags attached to the external genitalia. Urine collection for examination from a permanent catheter or collection bag is usually worthless due to its early pathogen colonization. We prefer collection from a freshly introduced (replaced) catheter. The final possibility is taking urine sample by using a suprapubic puncture with a thin needle.

#### Chemical tests

Urine test strips (dipstick tests) = a strip of squares of chemicals to measure pH and to detect glucose, protein, blood, bilirubin, urobilinogen, ketones, and nitrates. For example, Heptaphan® is used in practice.

Urine pH – the norm is 4.5 to 8.0, the average is about 6.0. It depends on the content of trisodium phosphate, bicarbonates, and ammonia. Alkaline urine (pH > 8.0) is found in humans on a plant diet or in uroinfections by urea-cleaving bacteria (mainly *Proteus mirabilis*).

Proteinuria – the norm is 30–100 mg/24 hours. Paper strips (Heptaphan®) detect levels higher than about 300 mg/L. Proteinuria is transient (e.g., urinary tract infections – UTIs) or permanent (glomerulopathy).

Glycosuria – usually in poorly compensated diabetes mellitus [attention – glycosuria is caused by treated with oral antidiabetic drugs – gliflozins or SGLT2 (sodium-glucose cotransporter 2) inhibitors]; rarely, renal glycosuria occurs.

Ketonuria – decompensated diabetes mellitus, fasting, febrile, vomiting, condition after general anaesthesia.

Blood in urine – see haematuria.

Urobilinogen and urobilin – urobilinogen is a catabolite of conjugated bilirubin. A small portion passes through the liver and is excreted in the urine (a standard is 1–4 mg/day). Elevated levels are caused by excessive supply of bilirubin into the liver, e.g., in hemolytic anemia or acute hepatitis.