

UROGENITAL SYSTEM

URINARY SYSTEM

1. What is the common body layer from which the urinary system and the genital systems develop from?

ANS: Intermediate mesoderm

2. What are the 3 kidney systems formed in a cranial-to-caudal sequence during intrauterine life in humans?

ANS: 1) Pronephros 2) Mesonephros 3) Metanephros

3. What represents the pronephros in the cervical region at the beginning of the 4th week?

ANS: 7 to 10 solid cell groups

4. The pronephros completely disappears at the end of 5th week. T/F

ANS: False [it is by the end of the 4th week]

5. When do the first excretory tubules of the mesonephros appear?

ANS: early in 4th week

6. What is the vertebral extent of the mesonephros?

ANS: from upper thoracic to upper lumbar (L3)

7. The glomerulus of the mesonephros is formed by its excretory tubules. T/F

ANS: False [the glomerulus is formed by the tuft of capillaries acquired by its excretory tubules]

8. Which structures constitute a renal corpuscle?

ANS: glomerulus and Bowman's capsule

9. What is the wolffian duct?

ANS: it is the longitudinal collecting duct into which the excretory tubules of the mesonephros empty into [it is also called Mesonephric duct]

10. When is the urogenital ridge formed?

ANS: middle of 2nd month

11. What is formed by intermediate mesoderm during the 4th week at the lower thoracic, lumbar and sacral regions?

ANS: nephrogenic cord

12. By the end of 2nd month, the whole of pronephros and majority of mesonephros have disappeared. T/F

ANS: True

13. What portion of the mesonephros remains in both male and female?

ANS: In males, a few of the caudal tubules and the mesonephric duct persist and participate in formation of the genital system, but they disappear in the female

14. When does metanephros appear?

ANS: 5th week

15. Where do the excretory units of the metanephros develop from?

ANS: metanephric mesoderm

16. The collecting ducts of the metanephros, which is the permanent kidney, develops from the metanephric blastema. T/F

ANS: False [they develop from the ureteric bud]

17. The ureteric bud is an outgrowth of the mesonephric duct, close to its entrance to the cloaca. T/F

ANS: True

18. How many generations of collecting tubules are formed from the ureteric bud?

ANS: 12 or more

19. What are the 5 groups of things formed from the ureteric bud?

ANS: 1) ureter 2) renal pelvis 3) major calyces 4) minor calyces 5) approximately 1 to 3 million collecting tubules

20. What attach the mesonephros and gonad to the posterior abdominal wall?

ANS: urogenital mesentery

21. What are the 3 things formed due to continuous lengthening of the excretory tubule of the metanephros?

ANS: 1) proximal convoluted tubule 2) loop of Henle 3) distal convoluted tubule

22. What are the origins of the excretory system and collecting system of the kidney respectively?

ANS: metanephric mesoderm and ureteric bud

23. How many nephrons are formed in each kidney at birth?

ANS: 1 million

24. When does urine production begin?

ANS: 11th week

25. The lobulated appearance of the kidney at birth disappears during infancy only as a result of further growth of the nephrons and not increase in number. T/F

ANS: True

26. Which transcription factor is expressed by the mesenchyme of the metanephric blastema, so as to make the tissue competent to respond to induction by the ureteric bud?

ANS: WT1

27. During the kidney's ascent from the pelvic region to the abdominal region, it is vascularised by arteries originating from the pelvic region. T/F

ANS: False [it is vascularised by arteries that originate from the aorta at continuously higher levels]

28. When does the kidney become functional?

ANS: 12th week

29. Why is the kidney not responsible for excretion of waste products during foetal life?

ANS: it is because the placenta serves this function

30. When does the cloaca divide?

ANS: during the 4th to 7th weeks

31. What forms the perineal body?

ANS: the tip of the septum

32. What is the largest part of the 3 portions of the urogenital sinus?

ANS: urinary bladder

33. How is the urachus formed?

ANS: it is formed when the lumen of the allantois gets obliterated

34. What does urachus form in an adult?

ANS: median umbilical ligament

35. What are the 2 things formed from the pelvic part of the urogenital sinus in the male?

ANS: 1) prostatic & 2) membranous parts of the urethra

36. Development of the phallic part of the urogenital sinus is greatly different in male and female. T/F

ANS: True

37. What is formed from the mesonephric duct in males?

ANS: Ejaculatory duct

38. Why is the trigone of the bladder originally mesodermal even though the bladder is endodermal?

ANS: The trigone is formed by incorporation, into the bladder, of the mesonephric duct and ureters, which are mesodermal in origin.

39. The epithelium of the urethra in both sexes is endodermal but the surrounding connective and smooth muscle tissue are mesodermal. T/F

ANS: True

40. When and how is the prostate gland formed?

ANS: 3rd month. It is formed by proliferation of the epithelium of the prostatic urethra.

41. What are formed by the cranial part of the urethra in females?

ANS: Urethral and paraurethral glands

42. What is formed from the definitive urogenital sinus in males?

ANS: Penile urethra

43. What is the origin of the seminal vesicles?

ANS: budding from the ductus deferens

CLINICAL CORRELATES

i. What causes the cancer of the kidneys that usually affects children by 5 years of age?

ANS: This cancer is Wilm's tumor. It is caused by mutations in the WT1 gene on 11p13

ii. What are the components of the 2 syndromes that this cancer may be associated with?

ANS: 1) WAGR syndrome {Wilm's tumor, Aniridia, Gonadoblastomas & Mental retardation} 2) Denys-Drash syndrome {WAR→Wilm's tumor, Ambiguous genitalia & Renal failure}

iii. Which substance produces branching and growth of the ureteric bud?

ANS: GDNF (glial-derived neurotrophic factor)

iv. What sequence of defects characterise Potter sequence?

ANS: Oligohydramnios, Hypoplastic lungs & Anuria {OHA}

- v. What are the 2 types of congenital polycystic kidney disease?
ANS: 1) Autosomal recessive type [ARPKD] 2) Autosomal dominant type [ADPKD]
- vi. What are the 4 differences between these 2 types?
ANS: 1) the frequency of ARPKD is 1/5000 while that of ADPKD is 1/500
2) ARPKD is progressive while ADPKD is less progressive
3) In ARPKD cysts form only from collecting ducts while in ADPKD cysts form from all segments of the nephron
4) In ARPKD renal failure occurs in infancy or childhood while in ADPKD renal failure does not occur until adulthood
- vii. What are the components of the 2 ciliopathies that these 2 types are linked to?
ANS: The 2 ciliopathies are i) Bardet-Biedal syndrome & ii) Meckel Gruber syndrome
- Bardet-Biedal → a) renal cysts b) obesity c) intellectual disability d) limb defects
- Meckel Gruber → a) renal cysts b) hydrocephalus c) microphthalmia d) cleft palate e) absence of the olfactory tract & f) polydactyly
- viii. What causes duplication of the ureter?
ANS: early splitting of the ureteric bud
- ix. All duplications of the ureter results from early splitting of the ureteric bud. T/F
ANS: False [it could also result from development of 2 ureteric buds]
- x. What causes pelvic kidney?
ANS: failure of one of the kidneys to ascend during the ascent of the kidney
- xi. What causes a horseshoe kidney?
ANS: It is when the kidneys come so close together during their ascent
- xii. What is the cause of the usual level of location of a horseshoe kidney?
ANS: The usual location is at the level of the lower lumbar vertebrae. This is because the ascent of a horseshoe kidney is prevented by root of the inferior mesenteric artery
- xiii. What is the origin of accessory renal arteries?
ANS: they are derived from the persistence of embryonic vessels that formed during ascent of the kidneys
- xiv. Urachal fistula and urachal sinus are usually continuous with the urinary bladder. T/F
ANS: True

xv. Which defect is a constant feature of extrophy of the bladder?

ANS: Epispadias

xvi. Extrophy of the bladder and extrophy of the cloaca are both rare defects. T/F

ANS: True

xvii. What other 2 defects are associated with extrophy of the cloaca?

ANS: 1) anal canal malformations 2) imperforate anus

FREQUENCIES OF RENAL TUMORS AND DEFECTS

- | | | |
|---|---|------------------------|
| I. Bilateral renal agenesis | → | 1/10,000 |
| II. Autosomal recessive polycystic kidney disease | → | 1/5,000 |
| III. Autosomal dominant polycystic kidney disease | → | 1/500 – 1/1,000 |
| IV. Horseshoe kidney | → | 1/600 |

FREQUENCIES OF BLADDER DEFECTS

- | | | |
|----------------------------|---|------------------|
| V. Extrophy of the bladder | → | 2/100,000 |
| VI. Extrophy of the cloaca | → | 1/30,000 |

GENITAL SYSTEM

1. Why is the Y chromosome the key to sexual dimorphism?
2. When do the gonads acquire the male or female morphological characteristics?
3. What forms the genital or gonadal ridges?
4. When do germ cells appear during development?
5. When do the primordial germ cells (PGCs) reside among endoderm cells in the wall of the yolk sac close to allantois?
6. When do PGCs migrate along the dorsal mesentery of the hindgut?
7. When do PGCs arrive at the primitive gonads?
8. When do the PGCs invade the genital ridges?
9. The gonads can develop irrespective of PGCs. T/F
10. In the 4th month, what are the 2 components of testis cords?
11. What is the source of sustentacular cells of Sertoli?
12. What is the origin of the cells that lie between the testis cords?
13. What happens to Leydig cells in the 8th week?

14. When is the testis able to influence sexual differentiations of the genital ducts and external genitalia?
15. When are seminiferous tubules formed?
16. What link the rete testis and the Wolffian duct?
17. The surface epithelium of the female gonad and that of the male gonad both proliferate. T/F
18. When are the cortical cords formed, and what is their origin?
19. When do cortical cords split into isolated cell clusters?
20. What constitute a primordial follicle?
21. In which type of embryos do their medullary cords develop and there is no secondary generation of cortical cords?
22. In which type of embryos do their medullary cords develop and there is not secondary generation of cortical cords?
23. What form the uterine canal?
24. What open into the urogenital sinus on either side of the Mullerian tubercle?
25. Differentiation of the testes does not continue without penetration of the gonadal ridge by the mesonephric duct. T/F
26. What are the 4 structures formed when testosterone receptor complexes mediate virilisation of the mesonephric ducts?
27. What modulate differentiation of the male external genitalia?
28. What is the ovary-determining gene?
29. What are the 4 things formed under the influence of oestrogens from Mullerian ducts?
30. What are the 4 things formed from the external genitalia of females under the influence of oestrogens?
31. What form the efferent ductules of the testis?
32. Paragenital tubules, which are located at the caudal pole of the testis, do not join the cords of the rete testis. T/F
33. What is paradidymis?
34. What is formed from the most cranial position of the mesonephric ducts?
35. The cranial and caudal segments of the mesonephric system regress. T/F
36. What is the only part of paramesonephric duct that does not degenerate?

37. Which part of the mesonephric duct forms the ejaculatory duct?
38. What form the antimullerian hormone?
39. What is the function of antimullerian hormone?
40. How is the broad ligament of the uterus formed?
41. What divide the pelvic cavity into uterorectal pouch and uterovesical pouch?
42. What is the origin of the corpus and cervix of the uterus?
43. When is the vaginal outgrowth entirely canalised?
44. Why is the vagina said to have dual origin?
45. What separates the lumen of the vagina from that of the urogenital sinus?
46. The paroophron and epooophron are respectively the remnants of the cranial and caudal excretory tubules in the mesovarium. T/F
47. What forms Garner' cyst later in life?
48. What lies in the upper border of the broad ligament of the uterus?
49. What lies on the posterior surface of the broad ligament of the uterus?
50. It is impossible to distinguish between the two sexes at end of 6th week. T/F
51. The urethral groove extends along the caudal aspect of the elongated phallus but does not reach the most distal part, the glans. T/F
52. What forms the urethral plate?
53. The urethral plate and the external urethral meatus are both endodermal in origin. T/F
54. When is the penile urethra formed?
55. What separates the two scrotal swellings?
56. The most distal part of the penile urethra is formed at the same time that the penile urethra is formed. T/F
57. In hypospadias, there are abnormal openings of the urethra along the superior aspect of the penis. T/F
58. What is the difference between hypospadias and epispadias?
59. What are the 2 disorders that are most often associated with epispadias?
60. What are the 3 usual causes of micropenis?
61. What can cause a double penis?
62. The genital tubercle of females is larger than in males during the early stages of development. T/F

63. What is the most common cause of sexual ambiguity?
64. Individuals with androgen insensitivity syndrome may be males or females. T/F
65. What are the 3 common features of individuals suffering from androgen insensitivity syndrome (AIS)?
66. What are the 5 features associated with AIS?
67. The testes are usually undescended in cases of mild or partial AIS?
68. External genitalia do not develop normally without dihydrotestosterone. T/F
69. What is the most common sex chromosome disorder?
70. What is the most common causative factor of Klinefelter syndrome?
71. Which syndrome could result from point mutations or deletions of the SRY gene?
72. When does the attachment of the urogenital mesentery serve as the mesentery for the gonads?
73. When does the extra-abdominal portion of the testis form?
74. The gubernaculum forms both in males and females. T/F
75. At what weeks, during the descent of the testes, do the testes reach the inguinal region, migrate through the inguinal canal, and reach the scrotum respectively?
76. What is the processus vaginalis?
77. What forms the inguinal canal?
78. The narrow canal connecting the lumen of the vaginal process with the peritoneal cavity is obliterated before birth. T/F
79. How does each of the muscle layers of the anterior abdominal wall contribute to the layers of the testis?
80. Why doesn't the transversus abdominis muscle contribute a layer to the testis?
81. When does the processus vaginalis normally lose its connection to the abdominal cavity?
82. What could result from non-closure of this connection?
83. What causes hydrocele of the testis?
84. What is the major cause of cryptorchidism?
85. What result from the cranial and caudal genital ligaments of the ovary respectively?
86. What is the distal attachment of the 2nd ligament formed from the caudal genital ligament?