

HISTOLOGY

QUESTIONS

ON

BONE

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DR.KANDEEL**20) spongy bone not contain:**

- a) volkman canal b) Haversian system c) bone marrow cavity d) a, b

21) origin of osteogenic:

- a) osteoblast b) osteocyte c) pericyte d) all the above

22) osteogenic:

- a) immature cell with free ribosome, centriole
 b) give chondroblast in case poor vascularity
 c) divide to give osteoblast
 d) all the above

23) all characters of osteoblast except:

- a) single layer in periosteum, endosteum
 b) secrete osteoid matrix
 c) mature bone cell with canaliculi
 d) oval cell with dark basophilic, long process

24) all the following are characters of osteocyte except:

- a) single in lacuna with oval cell, process
 b) divide to give more osteocyte
 c) maintain matrix
 d) contain canaliculi, gap junction

25) is ruffled surface, multinucleated, high lysosome

- a) osteoblast b) osteocyte c) osteoclast d) osteogenic

26) transport lysosome to howship lacuna:

- a) endocytotic vesicle b) exocytotic vesicle c) golgi

27) transport degraded product to interior of cell:

- a) endocytotic vesicle b) exocytotic vesicle c) golgi

28) is considered phagocytic cell

- a) osteoblast b) osteocyte c) osteoclast d) osteogenic

29) osteoporosis:

- a) common bone disease
 b) low bone density
 c) treated by calcitonin
 d) resorbing is more than forming
 e) all the above

30) intramembranous ossification in:

- a) flat bone b) irregular bone c) short bone d) long bone

31) intracartilagenous ossification in:

- a) flat bone b) irregular bone c) short bone d) long bone e) all except a

32) primary ossification in:

- a) flat bone b) shaft of long bone c) irregular bone d) short bone

33) secondary ossification in:

- a) flat bone b) short bone c) epiphysis d) irregular bone

34) proliferation mean:

- a) increase in size b) increase in number c) increase in size, number d) none of above

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BONE

35)hypertrophy means:

- a)increase in size b)increase in number c)increase in size, number d)none of above

36)parathyroid hormone:

- a)increase osteoclast b)decrease osteoclast c)increase osteoblast d)decrease osteoblast

37)calcitonin hormone:

- a)increase osteoclast b)decrease osteoclast c)increase osteoblast d)decrease osteoblast

38)which zone of the following contains the organelles of osteoclasts ??

- a)vesicular zone b)basal zone c)clear zone d)ruffled border zone

39)bone resorption is due to :

- a)secretion of organic acids b)secretion of hydrolytic enzymes
c)phagocytic activity of osteoclast d)all of the above

40)Endosteum is :

- a)avascular membrane that line all bone marrow cavity
b)calcified C.T that covers the bone from outside
c)vascular membrane that lines all internal cavities of bone
d)vascular membrane that covers the surface of the bone

41)the outer layer of the periosteum is :

- a)responsible for appositional growth of bone
b)responsible for supplying the bone with blood & nourishment
c)formed mainly of osteogenic cells and osteoblasts
d)formed mainly of elastic fibers

42)the bone matrix consists primarily of :

- a)collagen type II b)collagen type III c)collagen type I d)collagen type IV

43)in compact bone ,the transverse canals that connects haversian canals together are :

- a)sharpey canals b)Volkman canals c)howship canals d)Eustachian canals

44)osteoblasts have receptors for:

- a)parathyroid hormone b)calcitonin hormone c)estrogen hormone d)testosterone hormone

45)the periosteum is fixed to the underlying haversian system by :

- a)haversian canals b)Volkman canals c)howship lacunae d)sharpey fibers

46)the process of osteocytes are joined together by :

- a)gap junctions b)desmosomes c)adherent junctions d)tight junctions

47)all of the following are present in the bone matrix except :

- a)collagen type I b)sulphated glycosaminoglycans c)urate crystals d)hydroxyl apatite crystals

48)the structural unit of compact bone is :

- a)volkmann system b)haversian system c)ossification center d)osteoid system

49)which one of the following zones in osteoclasts contains actin microfilaments :

- a)ruffled border b)basal zone c)clear zone d)vesicular zone

DR.KANDEEL**50)osteoblast :**

- a)presents inside lacunae
- C)originates from blood monocyte

- b)is a bone resorbing cell
- d)has a negative golgi image

51)osteoclast is characterized by all the following except :

- a)it displays 4 regions by EM
- c)its cytoplasm is basophilic

- b)it occupies howship lacunae
- d)it has multiple nuclei

52)spongy (cancellous) bone is present in all the following except :

- a)outer & inner tables of the skull
- c)epiphysis of long bones

- b)bodies of vertebrae
- d)young embryonic bones

53)osteo-progenitor cell is characterized by all the following except :

- a)numerous ribosomes
- c)small rough endoplasmic reticulum

- b)well developed golgi complex
- d)flat nucleus

54)which one of the following characteristic is attributable to osteocyte processes

- a)they disappear when osteocytes divide
- c)they secrete elastin

- b)they contain many tono-filaments
- d)they are joined by gap junctions

55)which one of the following statements best describes osteoblasts ?

- a)they are deeply acidophilic
- c)they secrete collagen type I

- b)they contain little rough rER
- D)they do not contain nucleoli

56)osteocytes are characterized all the by following except :

- a)they cause bone resorption
- C)they feed by capillaries in canaliculi

- b)they are sensitive to parathyroid hormone
- d)they have many processes

57)parathyroid hormone :

- a)it stimulates osteocyte to resorb bone
- b)it lowers serum calcium level
- c)it stimulates osteoblasts to secrete osteoclast stimulating factors
- d)its receptors are present on osteoclasts

58)cadltonin hormone :

- a)it stimulates osteocytes to resorb bone
- b)it increases the serum calcium level
- c)it stimulates osteoblast to secrete osteoclast stimulating factors
- d)its receptors are present on osteoclast

59)the clear zone of the osteoclasts is characterized by all the following :

- a)it contains actin micro filaments
- c)it doesnt contain organelles

- b)it contains multiple nuclear
- d)it surrounds the ruffled border

60)haversian canals are characterized by all the following except :

- a)they run parallel to the long axis of the long bones
- b)they are lined with the osteo progenitor cells and osteoblasts
- c)they contain loose C.T , blood vessels and nerves
- d)they contain microfilaments

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61)compact bone is present in all the following sites except :

- a)outer and inner tables of the skull
c)epiphysis of the long bones

- b)outer covering of the vertebrae
d)outer covering of ribs

62)the process by which long bones are formed is called :

- a)intramembranous ossification b)endochondral ossification c)synchondrosis d)synostosis

63)the process by which most of the flat bones are formed is called :

- a)intramembranous ossification b)endochondrial ossification c)synchondrosis d)synostosis

64)the irregular trabecula of the primary bone that join ends of fractured bone is called :

- a)bone plate b)bone canal c)bone callus d)bone lamella

65)deposition of bone under the periosteum is accompanied by bone resorption in other site ,this is called :

- a)sutural growth b)appositional growth c)bone remodeling d)bone ossification

66)In zone of calcification in the growing end of the long bone :

- a)osteocytes deposit calcium salts around them by activity of alkaline phosphatase
b)chondrocytes deposit calcium salts around them by activity of alkaline phosphatase
c)osteoblasts deposit calcium salts around them by activity of growth hormone
d)osteoclasts deposit calcium salts around them by activity of calcitonin hormone

67)the cytoplasm of osteogenic cells appear :

- a)basophilic due to presence of abundant free ribosomes
b) basophilic due to presence of abundant rER
c)acidophilic due to presence of abundant mitochondria
d) acidophilic due to presence of abundant sER

68)osteogenic cells originate from :

- a)undifferentiated mesenchymal cells b)osteoblasts , c)chondroblasts , d)osteocytes

69)osteoblasts originate from :

- a)osteocytes b)osteogenic cells c)osteocasts d)UMCs

70)in the presence of poor blood supply the osteogenic cells can differentiate into :

- a)fibroblasts b)osteoblasts c)chondroblasts d)osteocytes

71)the stem cell of bone is :

- a)osteogenic cells b)osteoblasts c)osteoclast d) osteocytes

72)osteogenic cells are present in :

- a)outer layer of periosteum b)endosteum c)within bone matrix d)howship lacuna

73)the matrix vesicles which bud from the cell membrane of the osteoblast contains

- a)glycoprotein b)calcium c)alkaline phosphatase d)all the above

74)which cell has a parathyroid hormone receptors on their cell membrane :

- a)osteogenic cells b)osteocyte c)osteoblast d)osteoclast

75)which of the following bone cells have the ability to divide :

- a)osteogenic cells b)osteocytes c)osteoblasts d)osyeoclast

76)osteoblasts are present

- a)inside lacuna on the bone surfaces
 c)without lacuna on bone surface
 b)inside lacuna in bone matrix
 d)without lacuna in bone matrix

77)bone cell that has features of protein secreting cells is :

- a)osteogenic cells
 b)osteocytes
 C)osteoblasts
 d)osteoclasts

78)one of the following is false about osteoclasts :

- a)originate from osteoblasts
 c)have ruffled border zone
 b)presnt in howship lacuna
 d)contain multiple nuclei

79)by E.M the nuclei and organelles of the osteoclasts are present in :

- a)the ruffled border
 b)the clear zone
 c)the vesicular zone
 d)the basal zone

80)a large motile cell 150 pm in diameter with striated border facing the bone surface is called

- a)osteogenic
 b)osteoblast
 C)osteocyte
 d)osteoclast

81)the following statements are true about osteocytes except

- a)are derived from osteoblast cells
 b)are housed in their lacuna within the calcified bony matrix
 c)branched oval cells with oval nucleus and basophilic cytoplasm
 d)can divide

82)otseoclasts originate from :

- a)osteogenic cells
 b)osteocytes
 c)megakrocytes
 d)blood monocytes

83)bone canaliculi :

- a)are branching bone trabeculae
 c)connect haversian canal to one another
 b)are channels containing cell process of osteocytes
 d)connect haversian canal to perostieum

84)the function of osteoclast is :

- a)keeping integrity of bone matrix
 c)resorbing bone matrix
 b)secreting the components of bone matrix
 d)dividing and differentiated to osteocytes

85)the clear zone of osteoclast is characterized by the presence of

- a)lysosomes
 b)microfilaments
 c)secretory vesicles
 d)phagosomes

86)concerning osteoclast cells the following statements are nature except :

- a)small oval cells within bone matrix
 b)large giant cells within bone matrix
 c)present on the surface of bone where resorption takes place
 d)present on the surface of the bone where formation takes place

87)cell located on the surface of bone with deep basophilic cytoplasm and negative golgi image is known as

- a)osteogenic cell
 b)osteoblast
 c)osteocyte
 d)osteoclast

88)removalfrom bone matrix make bone fragile while removal offrom bone matrix makes bone flexible

- a)glycoprotein ,collagen
 b)collagen ,calcium
 c)calcium ,collagen
 d)proteoglycans ,calcium

89)the inorganic portion of the bone matrix represents

- a)20% of dry weight of the bone
 c)40% of the dry weight of the bone
 b)65% of the dry weight of the bone
 d)50% of the dry weight of the bone

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90)all of the following cells line the endosteum except :

- a)osteogenic cell b)osteocyte c)osteoblast d)all the above

91)the outer fibrous layer of the periosteum is :

- a)formed mainly of osteogenic and osteoblasts b)responsible for nourishment of bone
c)responsible for appositional growth of the bone d)formed mainly of elastic fiber

92)osteoporosis is genetic disease characterized by heavy dense bone ,which cell is most probably affected :

- a)osteogenic cell b)osteocyte c)osteoblast D)osteoclast

93)periosteum is formed of :

- a)calcified collagen and bone forming cell b)non-calcified collagen and bone forming cells
c)bundles of collagen fibers d)bundles of shower by fibers

94)cancellous bone is present in the following sites except :

- a)young embryonic bones b)epiphysis of long bones
c)middle dipole of flat bones d)shaft of long bones

95)all the following sites are composed of compact bone except :

- a)shaft of long bones b)outer and inner tables of skull
c)epiphysis of long bones d)outer covering of short bones as vertebrae

96)regarding haversian system one of the following is false :

- a)contain haversian canal b)formed of irregular bone lamella
c)contains osteocytes inside lacuna d)formed of concentric bone lamella

97)the interstitial lamella represent thehaversian system .the outer circumferential lamella is under theand the inner circumferential lamella is under the

- a)old,periosteum ,endosteum b)new,endosteum ,periosteum
c)old , endosteum ,periosteum d)new ,periosteum ,endosteum

98)you are looking at a cross sectional slide of the stained bone you see several concentric esinophilic circles around a non-stained area .what is normally present in the non stained area

- a)artery b)lamella C)glycogen d)lipids

99)during endo-chondrial ossification which zone has cartilage cells arranged in rows

- a)zone of calcified cartilage b)zone of hypertrophy
c)zone of proliferation d)zone of reserve cartilage

100)which type of ossification occurs in the flat bones of the embryo skull

- a)endochondrial b)intramembranous c)intra-cratilagneous d)epiphyseal

101)cells involved in bone remodeling include all of the following except :

- a)osteocytes b)osteogenic cells c)osteoblast d)osteoclast

102)the bone loss in osteoporosis is due to defect in :

- a)osteocytes and osteoblasts b)osteocytes and osteoclasts
c)osteoblasts and osteoclasts d)decalcification

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103)Rickets is a disease that affects children suffering from vitamin D deficiency ,which is important for bone calcification .rickets is characterized by poor bone growth .X-ray examination show :

- a)thick periosteum
- b)thick epiphyseal cartilage
- c)thin epiphyseal cartilage
- d)early closure of bone

104)Fine cytoplasmic processes of osteocytes are present within :

- a)lacuna
- b)haversian canal
- c)canaliculi
- d)Volkman canal

105)calcitonin is given in the treatment of patient with osteoporosis because it :

- a)stimulate osteoblast activity
- b)stimulate osteoclast activity
- c)inhibit osteoblast activity
- d)inhibit osteoclast activity

106)haversian canals :

- a)are present in portal tract of liver tissue
- b)their lumens contain loose CT in which nerve & vessels are present
- c)act as arterio-venous shunt
- d)are macroscopic bony canals

107)sharpey fibers :

- a)fix endosteum to bone
- b)are calcified collagen fibers
- c)are thick elastic fibers
- d)are thick reticular fibers

108)formation of compact bone from spongy bone starts in the stage of :

- a)calcification
- b)remodeling
- c)resorption
- d)invasion

109)osteoporosis is a common bone disease ,caused by :

- a)increased bone formation over bone resorption
- b)increased bone density over bone formation
- c)increased bone density over bone resorption
- d)increased bone resorption over bone formation

110)which of the following bone cells has acidophilic cytoplasm :

- a)osteoclast
- b)osteocytes
- c)osteoblast
- d)chondroblast

111)old woman was carried to the orthopedic clinic with a fractured leg where she was diagnosed to suffer from osteoporosis .the following mechanism is the cause of her fracture :

- a)osteoblasts are stimulated by calcitonin
- b)osteoclasts are stimulated by parathyroid hormones
- c)osteoclasts are inhibited by parathyroid hormones
- d)osteoblasts are stimulated by parathyroid hormones

112)osteocalst is found on bone surface in shallow depression is called :

- a)lacuna
- b)caralliculus
- c)periosteum
- d)howship lacuna

113)interstitial bone lamellae are :

- a)under & parallel to the periosteum
- b)parallel to endosteum
- c)the trabeculae of spongy bone
- d)in between haversian system

114)regarding intramembranous ossification ,one of the following is correct :

- a)it requires the presence of cartilage model
- b)it occurs in the epiphyseal plate
- c)it occurs in flat bones
- d)it occurs in long bones

115-the active bone forming cells produced from osteogenic cells are :

- a-osteoclast
- b-osteocytes
- c-osteoblast
- d-chondroblast

116-the bony canal that has a narrow lumen, containing delicate loose connective tissue in which blood vessels and nerves lie, is :

- a-Osteon canal
- b-osteoid canal
- c-portal canal
- d-haversian canal

117-Regarding bone, the following statement is incorrect :

- a-osteocytes are present in lacunae
- b-osteoblasts deposit organic bone matrix
- c-compact and spongy bone types are naked eye classifications
- d-Bone lamellae refer to appearance of bone under microscope

118-bone matrix is characterized by one of the following :

- a-organic matrix is secreted by osteoclast
- b-35% of matrix is inorganic
- c-it contains collagen type II
- d-calcium crystals are the main constituent of inorganic part

119-osteocyte is known as :

- a-Bone forming cell
- b-mature bone cell
- c-osteoprogenitor cell
- d-Bone destroying cell

120-osteoblast is called :

- a-Bone forming cell
- b-mature bone cell
- c-osteoprogenitor cell
- d-bone destroying cell

121-which of the following bone cells is multinucleated :

- a-osteoclast
- b-osteocyte
- c-osteoblast
- d-chondroblast

122-spongy bone is characterized by the following :

- a-haversian system
- b-volkmann's canal
- c-one bone marrow cavity
- d-bone trabeculae

123-in the epiphyseal plate, spongy bone is formed in the following zone:

- a-zone of resting cartilage
- b-proliferative zone
- c-zone of calcification
- d-zone of ossification

124-osteoblast is characterized by the following :

- a-originate from pericyte
- b-secrete organic bone matrix
- c-are polyhedral cells
- d-is formed by fusion of large numbers of monocytes

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125-compact bone is present in the following site:

- a-Ear pinna b-Eustachian tube c-irregular bone d-covering plate of flat bone

126-A child is presented o the orthopedic unit with his legs bend inward toward each other. The case is diagnosed as bone weakness and deformity. The expected mineral in bone matrix that is responsible for this case is :

- a-phosphate chloride b-sodium carbonate
c-sodium oxide and hydroxide d-calcium phosphate and carbonate

127-A 57-years-old woman undergoes spine fusion surgery .following operation the surgeon prescribed osteogenic protein-1 to promote bone growth & healing. This drug stimulates differentiation of mesenchymal stem cells to provide which of the following cell types:

- a-chondroblasts b-fibroblasts c-myoblasts d-osteoblasts

128-young boy was exposed to an accident that resulted in a broken arm. The fracture was healed in a short time, the main mechanism is the increased bone vascularity which change the :

- a-osteoprogenitor cells into osteogenic cells
b-chondrogenic cells into osteogenic cells
c-osteoprogenitor cells into osteoclast cells
d-chondroblast cells into chondrocyte cells

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*ANSWERS:

1-a	2-d	3-b	4-a	5-d
6-c	7-b	8-d	9-b	10-e
11-b	12-e	13-a	14-b	15-c
16-d	17-e	18-c	19-a	20-d
21-c	22-d	23-c	24-b	25-c
26-b	27-a	28-c	29-e	30-a
31-e	32-b	33-c	34-b	35-a
36-a	37-b	38-ملغي	39-d	40-a
41-b	42-c	43-b	44-ملغي	45-b
46-a	47-ملغي	48-b	49-ملغي	50-d
51-c	52-ملغي	53-b	54-d	55-c
56-a	57-c	58-d	59-ملغي	60-d
61-c	62-b	63-a	64-ملغي	65-c
66-b	67-a	68-a	69-b	70-c
71-a	72-b	73-c	74-d	75-a,c
76-c	77-c	78-a	79-ملغي	80-ملغي
81-d	82-d	83-b	84-c	85-ملغي
86-c	87-b	88-c	89-b	90-b
91-c	92-d	93-b	94-d	95-c
96-b	97-ملغي	98-ملغي	99-c	100-b
101-a	102-c	103-b	104-c	105-a
106-b	107-b	108-b	109-d	110-a
111-b	112-d	113-d	114-c	115-c
116-d	117-c	118-d	119-b	120-a
121-a	122-d	123-d	124-b	125-d
126-d	127-d	128-b		

*** BONE: HARD TYPE OF CT (due to calcified matrix), highly vascular, FUNCTION: 1) body support (form skeleton) 2) protect vital organ brain 3) mineral (Ca+2) store**

structure of bone:

A) Bone Matrix, Fibers	B) Bone Covering
<p>1) Organic part (35%): formed of type I collagen fibrin (thick bundle), ground substance (proteoglycan, glycoprotein)</p> <p>2) Inorganic part (65%): formed of Ca salt (phosphate, carbonate)</p> <p>on surface of collagen bundle, within ground substance</p> <p>-N-B- bone matrix is arranged in lamellae of calcified collagen bundle embedded in calcified ground substance</p>	<p>1) Periosteum: C.T layer, cover outer surface of bone, consist of two layers:</p> <p>a) Outer fibrous layer: dense collagen fiber (type I), fibroblast, blood vessels</p> <p>b) Inner osteogenic layer: osteogenic cell differ into osteoblast, thick in growth, fracture</p> <p>-FUNCTION: 1) bone protection 2) attachment for muscle 3) nutrition for bone</p> <p>a) Appositional growth: osteogenic cell differentiate into osteoblast then osteocyte</p> <p>2) Endosteum: C.T layer, contain single layer of osteogenic cell</p> <p>-function: 1) protection of bone 2) bone growth from inside</p>

C) Bone cells:		3) Osteocyte	4) Osteoclast
1) Osteogenic cell	2) Osteoblast	Mature bone cell	Bone destroying cell
called: Osteoprogenitor cell	Bone forming cell	osteoblast	Fusion of mononuclear progenitor in B.M
origin: UMCs, pericyte	Osteogenic cell		Surface of bone (Haversian lacuna)
site: Inner layer of periosteum, endosteum	Same osteogenic	Single in small bone lacunae	Large irregular cell, have brush border facing bone surface, multinucleated (6-12), foamy, acidophilic cytoplasm
LM: Flat (cell, nucleus), pale basophilic cytoplasm (low organelles)	Oval cell, few process, eccentric nucleus, dark basophilic cytoplasm, negative Giemsa, rich in alk. phosphatase enzyme	Single in small bone lacunae	
EM: Sign of immature cell w/ form of free ribosome	protein forming cell: ER, mito, well developed golgi	Process of lacuna communicate by canaliculi (cells connected by gap junction: imp for exchange of nutrition, waste product as matrix is calcified, no fluid can pass less ribosome, ER than osteoblast	-has ruffled surface show microvilli -cytoplasm rich in lysosome, mito, golgi, multivesicle
Function: -can divide: give osteoblast -numerous in case of fracture, young -give chondroblast in case poor vascularity	-secrete matrix (collagen bundle + Ca) called osteoid -deposition of Ca by alk. phosphatase enzyme -change into osteocyte	-bone maintaining cell -formation of organic part of matrix -calcification of matrix by Ca deposition -viability of matrix -can not divide: no interstitial growth	a) Bone resorbing in 2 steps: 1) carbonic anhydrase induce action: H2O + CO2 give HCO3- + H+ that acidify medium, dissolve Ca 2) secretion of lysosomal proteolytic enzymes that lysis organic matrix b) Bone remodeling during ossification

N.B: 1) osteoclast are phagocytic cell, contain exocytotic vesicle that transfer lysosomal enzymes to howship lacuna, endocytotic vesicle that transfer degraded bone products to interior of cell

2) Osteoporosis: common bone disease, characterized by loss of normal bone density that increase the risk of bone fracture, caused by increase bone resorbing over bone formation, treated by calcitonin hormone

3) bone repair is faster than cartilage (due to high vascularity), degradation of platelet from blood clot formed around fracture ends of bone, cytokines released from degradation initiate acute inflammatory response to start healing process

Methods for preparation of bone section:

a) Decalcification method:

1) bone + mineral acid (10% Nitric acid) → Ca removal, soft bone: can be cut

2) can be stained: demonstrate bone cell, soft tissue

b) Grinding method/ ground bone method: not used for spongy bone

-bone is left to dry air, small pieces of bone are cut by saw, then thinned by grinding by using (carborandum wheel), unstained

-show bone lamellae, lacunae, canaliculi (no cells), Volkmann canal

*** Classification of bone: anatomical:** 1) long 2) short 3) flat 4) irregular

1) Cancellous (spongy) bone: present in center of flat, short, irregular bone, epiphysis of long bone

-formed of irregular branching, anastomosing bony trabeculae enclosing between them irregular B.M cavity

-each trabeculum is formed of irregular arranged bone lamellae, osteocyte, no Haversian system

-covered by periosteum, B.M cavity lined by endosteum

2) Compact bone: forms shaft of long bone, also covering plate over surface of spongy bone

formed of: 1) Periosteum: cover outer surface of bone

2) External circumferential lamellae: under periosteum, formed of osteocyte within lacuna embedded in between lamellae of collagen bundle, parallel to surface of bone

3) Haversian system (osteon): -structural unit of compact bone, cylindrical arranged parallel to axon of bone, each one is formed of Haversian canal that contain blood vessels, nerves surrounded by 5-20 of concentric arranged bone lamellae, osteocyte in lacunae embedded in between them

-Volkmann canal: transverse canals that connect Haversian canal together or with periosteum B.M cavity

4) Interstitial lamellae: irregular arranged bone lamellae, osteocyte in lacunae in between Haversian system

5) Internal circumferential lamellae: parallel to inner circumference of bone, surround B.M cavity

6) Endosteum: lines B.M cavity

N.B: perforating fibers of Sharpey: calcified collagen fibers that arise from tendons or ligaments at the site of muscle attachment.

-they perforate periosteum at angle to be attached to the external circumferential lamellae and become continuous with collagen fibers of the matrix, they fix the tendons into the bone

-Ossification (Bone Formation):

Intramembranous Ossification:

-occurs in flat bones, starts in membrane of C.T & ends by formation of spongy bone.

occurs in the following steps:

a) UMCs are condensed in central vascular area rich in blood capillaries, this area is called Ossification center.

b) UMCs change into osteogenic cells that differentiate into osteoblasts.

c) Osteoblast form bone matrix, change to osteocyte

d) Periosteum create protective layer of compact bone superficial to trabecular spongy bone

II- Intra cartilaginous ossification:

-means replacement of cartilage model by compact or spongy bone, occurs in long, short, irregular bone

N.B: long bone is formed of shaft (diaphysis) and two ends (epiphysis)

-its types:

1) Primary ossification:

-occurs in middle of diaphysis, as result of vasculature of perichondrium, chondrogenic cells change into osteogenic then osteoblast, so perichondrium is changed into periosteum

-osteoblast form layer of bone around cartilage model under periosteum called **periosteal bone collar**

-chondrocyte in center of cartilage model increase in size, deposit calcium

-calcification of cartilage matrix will lead to death of chondrocyte leaving irregular cavity

-osteoclast form holes in bone collar, UMCs, around blood vessels invade irregular cavity within model then change into osteogenic then osteoblast that deposit matrix forming irregular bone trabeculae (spongy bone) spaces between trabeculae is filled with irregular B.M cavity then become irregular by osteoclast

-bone lamellae become irregular, arranged forming Haversian system then compact bone

2) Secondary ossification:

-present in epiphysis, steps are similar to primary until cartilage (except epiphyseal plate cartilage: between epiphysis, diaphysis) is replaced by spongy bone

*** changes at epiphyseal cartilage:**

-zone of resting hyaline cartilage: formed of cartilage cell arranged in parallel rows

-proliferation zone: increase in number of cartilage cell, accumulation of glycogen, alkaline phosphatase enzymes

-hypertrophy zone: increase in size of cells due to accumulation of glycogen, alkaline phosphatase enzymes

-zone of calcification: chondrocyte deposit calcium in surrounding matrix, under periosteum, so cartilage cells die leaving empty spaces

-zone of invasion: UMCs, blood capillaries enter through holes formed by osteoclast in periosteal collar

-zone of ossification: chondrocyte change into osteogenic then osteoblast that deposit matrix, form irregular trabeculae of spongy bone

-remodeling stage: result from resorption of bone from certain areas by osteoclast, deposition of new bone in higher area by osteoblast, this stage result in single B.M cavity

-stages of compact bone formation: Haversian system develop, only one central B.M cavity

N.B: -balance between osteoblast, osteoclast activity is necessary for stable calcium level in blood

-osteoclast activity is hormonally regulated, stimulated by parathyroid hormone and inhibited by calcitonin from C-cell of thyroid gland

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