Radiology of rickets

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Rickets is a systemic disease of infancy and childhoodin which the calcification of growing skeletal elements isdeficient. It is equivalent of osteomalacia in matureskeleton. Prematurity is a predisposing factor.Clinically there are several classifications of differenttypes of rickets according to the aetiology and the age ofoccurance but vito D deficiency rickets is a main clinicalproblem in Egypt rather than any other types of rickets.Infantile vito D. deficiency rickets usually developsbetween 6th month and one year of age and resulting fromdeficiency of vito D in the diet or from lack of exposureto ultra-violet rays. The human skin contains pro-vitaminD3 (7-dehydrocholecalciferoll which is activated by ultravioletrays. This vitamin is not active. but is transportedto the liver where it is hydroxylated and from there to thekidney where it is hydroxlated again and becomes dihydroxyvitoD. which is the most active form of the vitamin. It actsas a hormone. Liver and kidney disease may cause rickets ~fhydroxylation cannot take place.Rickets is characterised by defect of bone growth dueto lack of normal mineralisation. Cartilage cells of theepiphyseal plate grow and reproduce normally, but fails to-56-calcify and degenerate as normal. These cells continueto proliferate but with disturbance of the columnarconfiguration causing patchy widening of the epiphysealplate seen roentgengraphically as a radiolucent area, sothat the end of bones are frayed and the epiphyseal lineis irregular.Mineralisation of the osseus tissue and cartilage.matrix fails, the zone of preparatory calcification doesnot form and malleable non rigid tissue is produced instead.It become compressed, cupped and flared.Changes in bone shafts are caused by failure of osteoidmineralisation and a shell of sub-periosteal osteoid tissuesurrounds the shaft. The osteoid continues to heap, theunderlying cortical bone is resorbed and replaced by unmineralisedosteoid, thus the shaft loss rigidity and moldingand fractures occures.By administeration of vito D. healing occurs and thezone of preparatory calcification becomes identifiable.Cartilage cells then degenerate normally and invasion ofblood vessels and osteoblasts allows normal epiphysealgrowth. The skeleton is rapidly mineralised and the subperiostealosteoid collections are mineralised and resorbedand bone outline returns.-57-The serum calcium level in vito D. deficiency ricketsranges from normal to slightly lowered and the serumphosphate concentration is slightly lowered. The serun,alkaline phosphatase level is elevated but not specific.Clinically, softening of skull bones or craniotabesmay be presented initially followed by frontal and parietalbossing in later stages of the disease. The wrists andankles swell. Also the ribs show enlargement of the co:stochondraljunction ”Rachitic rosary”. Increased

irritabilityand sweating also occurs.In advanced rickets, calvarial sutures are open andsoft with box-like appearance skull, denition is delayE,d,the sides of the thorax are flattend and develops pigeonbreat deformity and curvature of the long bones also occurs.Roentgenographically, the characteristic changes occurin the ends of the long bones. These changes are similarfor rickets of all aetiologies (Greenfield, 1975). Epiphysealwidening and ill definition of zone of provisional calcificationfollowed by metaphyseal cupping and widening owing tothe pull of -muscular and ligamentous attachment. In theshafts of long bones uncalcified sub periosteal osteoidis present, causing loss of sharp cortical outline and allowingdevelopment of bowing deformities particularly in tibia.-58-Bone texture is also coarsened. Green-stick fracturesare also common Pseudofractures are rarely present. Theappearance of ossification centers in the epiphysis ofsmall bones are delayed because of the lack calcification.With healing, mineralisation of the zone of provisionalcalcification appears as a dense line in the epiphysealcartilage, -separated from the metaphysis. The cupping increases.Remineralization of the sub periosteal osteoid appears asperiosteal new bone formation which may be solid and laminated.Calcification of the ossification centers occurs ~~itha marginal ring shadow that gradually fuses with the center.Although complete healing usually occurs, residual deformitiesmay persist.The rachitic skull in active phase of the diseasecharacterised by bossings at frontal and parietal emineencesthat are devoid of mineral contents and so, are not wellvisualised roentgenographically with the onset of healingthe calcium contents of bosses increases and the healedhyperostosis become more evident radiologically (Caffey,1972) .-------- ----- --59-This rachitic bossing persist in adult life andgiving the head a ”Caput quadratum” deformity.Due to bone softening in rachitic skull especiallyskull base, basilar invagination occurs, which can bedemonstrated radiologically in postero - anterior viewby cephalic angulation of a line drawn along the superiormargins of petrous ridges (normally this line directedcaudally). And in lateral view by increase in the basalangle more than 150° (normally between 125-142°), and byprotrusion of the odontoid process ~ em. or more abov.athe Mc-Gregor’s line.The rachitic vertebrae are characterised by rarefactioneither diffuse or in the form of globul~r areasof rarefaction. The heights of the vertebral bodies arereduced with consequent -widening of the intervertebralspaces.The spinal deformity in the form of dorso lumbarKyphosis occurs in several cases of rachitic childrenwho sit-up.The radiological changes in rachitic chest appearearly in the anterior ends of the ribs in the form ofsplaying and irregularity and impaired endochondral ossification.-60-Gross demineralization of the thoracic cage associated withformation of Harrison sulcus at the site of costal originof the diaphragm.The rachitic deformities in the thoracic cage usuallyassociated with chest infection as bronchitis and bronchopneumonia.These roentgenographic findings of rickets si.muLat;eother many skeletal disorders and the radiological differentiatingsigns should be considered.Hypophosphatasia is similar radiologically to ricketsbut with more pronounced demineralisation and marked liabilityto fractures.In scurvey the deficiency is mainly in bone matrix notin its mineralisation. So, the zone of provisional calcificationsmore dense with sharp definition and marked periostealreaction is noticed due to sub-peri-osteal haematoma. Scurveyis also

characterised by Pencil-thin epiphyseal cortex.The widened metaphysis which is seen in rickets shouldbe differentiated from other causes of metaphyseal wideningas cretinism, leukaemia, hypervitaminosis 0, osteopetrosisand congenital syphilis.-61-Basilar invagination in rachitic skull due to softeningof bones of skull base. This radiological sign is alsoseen in other conditions leading to bone softening asPaget's disease, fibrous dysplasia, osteogensisimperfec~AchonDROPlasia and cleidocranial dysplasia.The double contour of the long bones seen in ricketsis not -fairly due to periosteal elevation and periostealreaction but mainly due to non mineralised sub-corticalosteoid tissue formation and falsly termed periostealreaction and so must be differentiated from other causesof periosteal elevation as congenital syphilis, scurvey,prematurity and Caffey's disease.It is to be noted that the radiation risks for apaediatric patients include genetic, leukogenic carcinogenicfactors and cataret production. And although, theoreticallythere is really no safe dose but the risk will begreater if a large portion of the body irradiated or ifa higher dosage is used and also, the sensitivity of theirradiated area should be considered.A proper communication between the radiologist andpaediatrician is essential for delivery of a good radiologiccare.-62-Also, a good communication between the radiologistand technologist is essen~ial for the maintenance ofa good quality films.The rooms for paediatric radiology should have thebiggest x-ray generators possible. High milliamperageis essential so that short times can be used.Accurate callimators with light localization isessential.Pleasant and safe surroundings in the radiologicroom is essential to gain a sympathetic attitude towardthe child to ensure a good examination.