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SHORT-RIB-POLYDACTYLY SYNDROME

(Saldino-Noonan Type)*

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In 1972 Saldino and Noonan observed a peculiar combination of a series of congenital anomalies in two stillborn siblings and identified this entity as a new malformation syndrome. Both infants had severe thoracic dystrophy, micromelia, hypoplastic long bones and multiple internal organ anomalies[1]. Since then, 19 more cases of the same syndrome have been described in the literature[1-10]. The osseous changes affecting the ribs, flat bones and the long bones of the extremities have been uniformly present in all the reported cases. Since these bony changes are diagnostic for this syndrome, their recognition is of great value in the differential diagnosis of neonatal short-limbed dwarfism[11]. We wish to report another case of this rather striking disease with characteristic radiological findings in the skeletal system and post-mortem findings.

Case Report

A male infant, the third child of apparently healthy parents (father aged 24 and mother 17 years) who were third degree relatives, was born in the Hacettepe University Hospital. The first pregnancy had been aborted, and the second had produced a stillbirth at five months of gestation. The family reported oligohydramnios in association with the third pregnancy, and the intrauterine movements were noted to have been very weak.

The infant was delivered at 34 weeks by cesarean section. The Apgar score was 2 at birth. There were only occasional respiratory gasps. Attempts at resuscitation failed and he died two minutes after birth.

Post-mortem external examination of the body showed a short-limbed type dwarfic hydropic male infant with generalized cyanosis and multiple anomalies. The infant

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weighed 2350 gm, crown-heel length was 34 cm (3rd percentile) and head circumference was 34 cm. The head was deformed with a prominent forehead and low set ears. The mandible was hypoplastic. The anterior-posterior diameter of the head was short. Post-axial polydactyly was present on both hands and both feet (Figure 1). The digits, particularly of the hands, were extremely short. The chest was very narrow and the abdomen was protuberant. There was agenesis of the penis and the scrotum was extremely small, yet the testes were palpable in it.

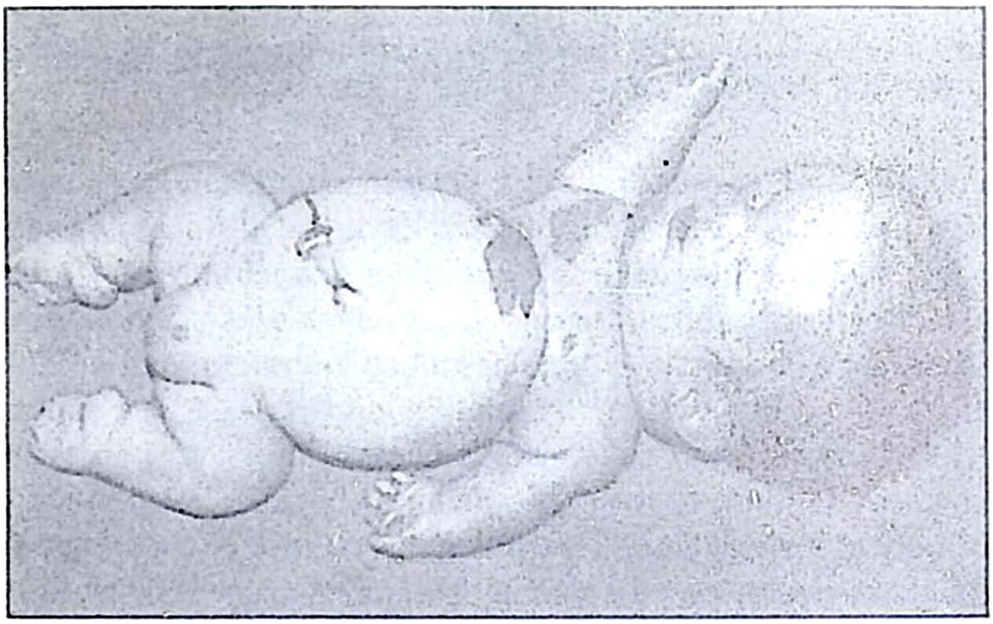


Figure 1.

Radiological examination of the patient disclosed severe shortening of the ribs and all the tubular bones of the extremities (Figure 2). The metaphyses were markedly irregular with multiple notches and spikes producing a frayed appearance. The scapulae and the flat bones of the pelvis displayed squaring and irregular margins. Vertebral bodies showed anterior beak formation in addition to generalized retardation of development (Figure 3). Polydactyly was present, with six fingers and six toes bilaterally (Figure 4).

Examination of the internal organs disclosed hypoplastic and atelectatic lungs (weight 6 gm each, normal 25 gm each) in an extremely small chest, interstitial fibrosis in the pancreas, intestinal malrotation and dilatation of the ureters with polycystic kidneys.

Microscopic examination of the growth plate of the femur disclosed that the chondroblast had failed to mature. There was a thin zone of proliferating cartilage with lack of columnization and small irregular areas of calcifying cartilage (Figure 5). Endochondral ossification was irregular and exceedingly deficient at the junction with the metaphyseal region, and the chondrocytes were disorganized. There were premature ossification centers in the proximal epiphyses of the humeri and femora.

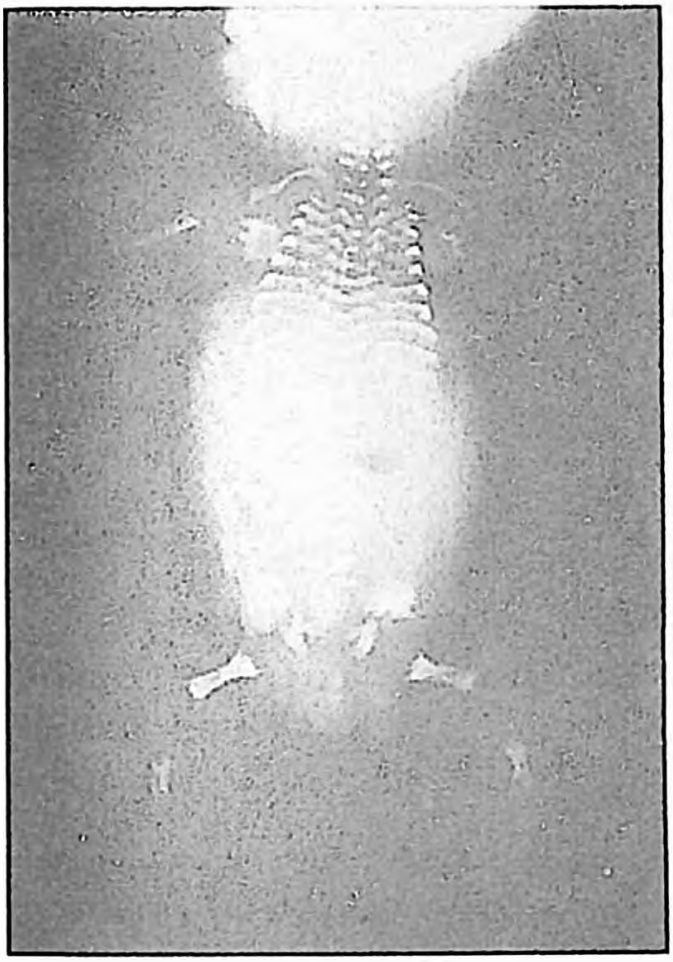
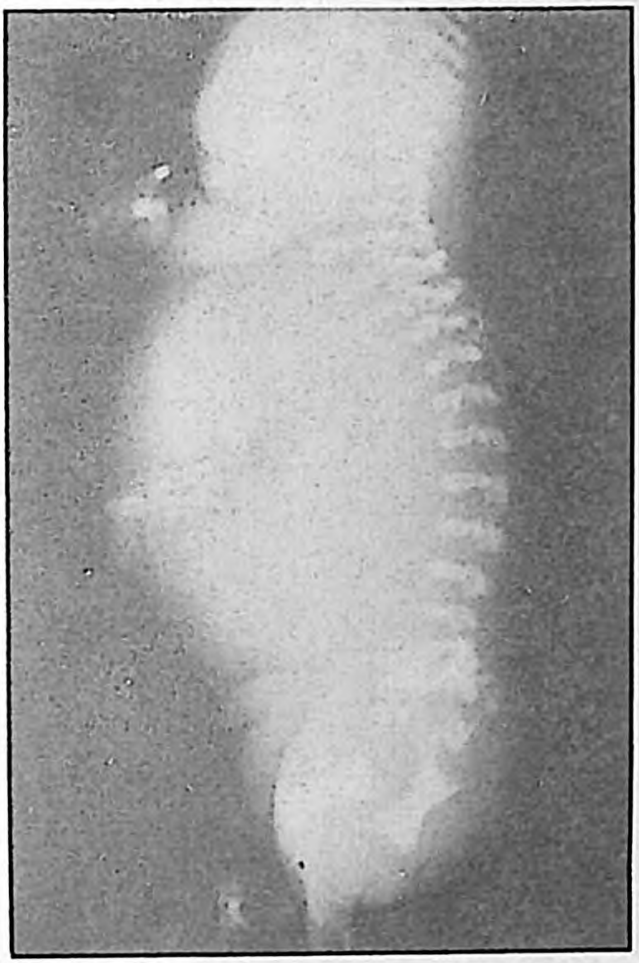


Figure 2.



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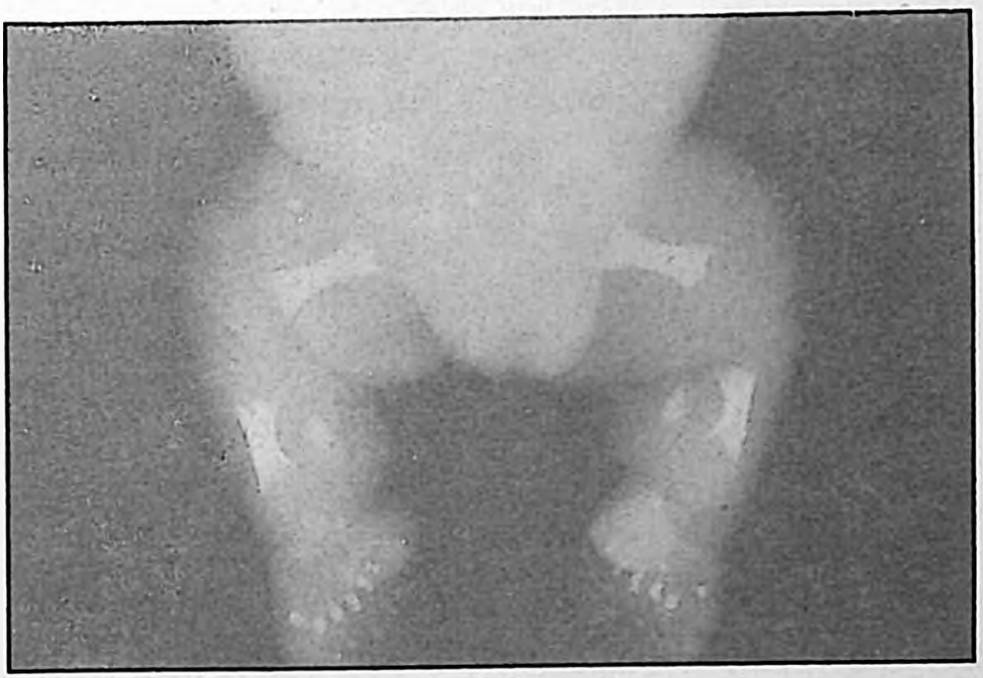

Figure 4.

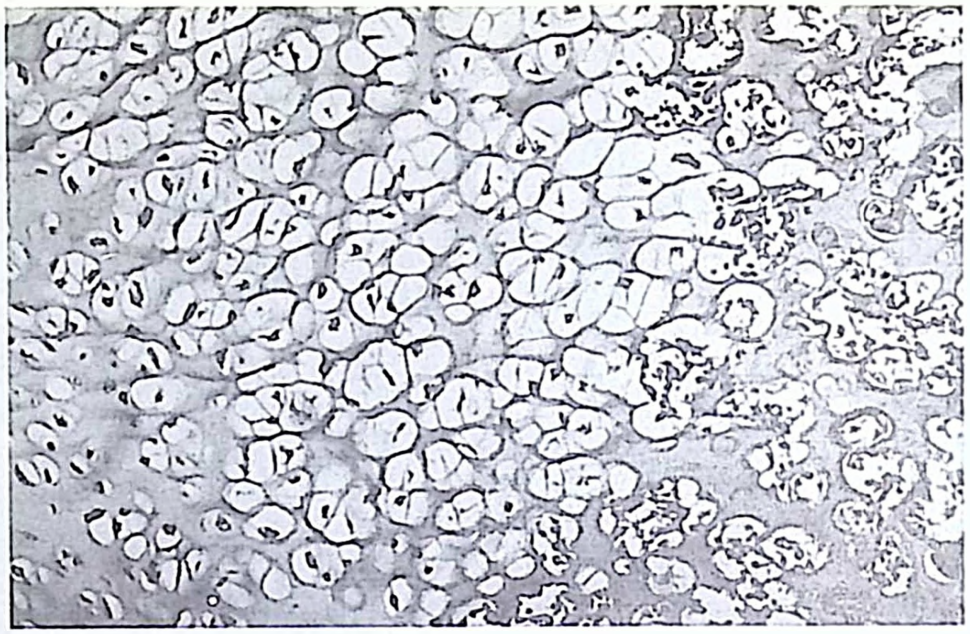

Figure 5.

Discussion

When Saldino and Noonan described two stillborn female siblings with severe micromelic dwarfism, marked thoracic dystrophy and generalized osseous dysplasia, despite the similarity of some features of their patients with asphyxiating thoracic dystrophy and Ellis-van Creveld syndrome[12], they realized that they were dealing with a different entity[5]. The further observation of similar patients with this unique combination of clinical and radiographic findings has since led to the recognition of a distinct syndrome called Saldino-Noonan syndrome or short-rib-polydactyly syndrome, Saldino-Noonan type 1.

Infants with Saldino-Noonan syndrome are either born dead or die shortly after birth from cardio-respiratory insufficiency. Characteristically, they display marked shortening of the ribs and of the long bones of the extremities resulting in a short-limbed type of dwarfism. The thorax is narrow and the abdomen appears protuberant. In addition to the short limbs, the fingers and toes are short and there is post-axial polydactyly. All the features described above have been present in all the reported cases, including the present one. Multiple internal malformations may also co-exist with varying frequency. These include pulmonary hypoplasia, cardiovascular defects; gastrointestinal malformations, mostly in the form of anal atresia, intestinal malrotation or fibrocystic pancreas; renal dysgenesis and cysts; cystic or hypoplastic ureters and genital malformations. Our case had markedly hypoplastic lungs, intestinal malrotation, polycystic kidneys and agenesis of the penis.

Radiological examination of Saldino-Noonan type dwarfs reveals very short and horizontally directed ribs; all the long tubular bones of the extremities are strikingly

short and their metaphyseal ends are pointed and jagged. There is incomplete ossification of the short tubular bones of the hands and evidence of post-axial polydactyly. The iliac bones and scapulae are quite small with marked irregularity of the edges of the latter. Acetabular roofs are flattened. The vertebral bodies are small and irregular in shape.

The case presented here manifested all the above radiological findings. Actually, it is the combination of these x-ray changes in the bones which makes the diagnosis of the syndrome possible, and only the analysis of these osseous changes enables one to rule out other entities resembling this syndrome.

In the differential diagnosis one has to consider first, asphyxiating thoracic dystrophy of Jeune et al[13-15], since short ribs and hypoplastic thorax are present in both diseases. However, shortening of the ribs is not so marked in Jeune's disease. The shortness of the limbs is also less pronounced in the latter, and the structure of the long bones and vertebrae remains normal. The absence of any other internal malformations apart from renal malformation also helps to differentiate it from Saldino-Noonan dwarfism.

Another form of short-limbed dwarfism with polydactyly is the Ellis-van Creveld syndrome. However, the limb shortening in this syndrome is again relatively mild with the long tubular bones and vertebrae appearing normal. Apart from occasional cardiac malformations, other visceral anomalies are not present. The added presence of ectodermal abnormalities in the form of hypoplastic nails and anomalous teeth are further aids in differentiating the two entities.

In 1971 Majewski et al[16] described another type of newborn dwarfism with short ribs and polydactyly. In the newborn with this syndrome the rib shortening is not so marked as in the cases under discussion, and concurrent anomalies are confined to cleft lip and palate. The tibiae are characteristically short and ovoid in shape.

The clinical findings of these four types of skeletal dysplasias encountered in the newborn period and all presenting with a narrow thorax and polydactyly are listed in Table I, and the relative radiological findings are given in Table II which should be of assistance in differential diagnosis.

Recently Naumoff et al[9] reported three cases of neonatal dyschondroplasia in two siblings and one unrelated infant. All three of their patients died in the first hour of life and presented radiographic changes identical to the cases under discussion. Although the authors point to the possibility of the presence of a distinct syndrome in their patients as distinguished from the Saldino-Noonan syndrome, we cannot find sufficient evidence in their communication to justify this proposition.

The occurrence of Saldino-Noonan dwarfism in siblings suggests an autosomal recessive genetic transmission. Hence, there is a 25% probability that future children of the same parents will be afflicted with the same disease. Therefore, intrauterine diagnosis of this dysplasia, which is possible by ultrasound or radiological

TABLE I

Clinical Findings in Skeletal Dysplasias Presenting with a Narrow Thorax and Polydactyly

	Saldino-Noonan syndrome	Majewski syndrome	Ellis-van Creveld syndrome (chondroectodermal dysplasia)	Jeune syndrome (asphyxiating thoracic dysplasia)
Genetic transmission	Autosomal recessive	Autosomal recessive	Autosomal recessive	Autosomal recessive
Narrow chest	Severe	Severe	Present	Present
Short extremities	Severe, flipper-like appearance	Mesomelia	Mild, acromelia	Mild, acromelia
Congenital heart disease	Common	Present	Common, 60%	Rare
Polydactyly	Constant (postaxial)	Constant (pre- and postaxial)	Constant	Rare
Other abnormalities	Genital hypoplasia and gastrointestinal anomalies, absence of nails, hydrops, low set ears, rarely cleft lip and palate, renal dysgenesis with severe hypoplasia and/or cysts, polyhydramnios	Cleft lip/palate, hydrops, short tibiae	Severe ectodermal dysplasia, multiple frenula, natal teeth, hypoplastic nails	Mild ectodermal dysplasia, cystic renal disease

TABLE II

Roentgenographic Findings in Skeletal Dysplasias Presenting with a Narrow Thorax and Polydactyly

	Saldino-Noonan syndrome	Majewski syndrome	Ellis-van Creveld syndrome (chondroectodermal dysplasia)	Jeune syndrome (asphyxiating thoracic dysplasia)
Short horizontal rib	Severe	Moderately severe	Present	Present
Vertebral bodies	Deficient ossification	Normal	Normal	Normal
Vertical shortening of ilia	Present	Absent	Present	Present
Abnormal tibia	Very irregular metaphyses	Disproportionate shortening	Deformity of plateau	Absent

means in the 20-24th weeks of gestation, carries practical significance[9]. Severe oligohydramnios and decreased fetal movement are supporting evidence for Saldino-Noonan dwarfism.

Summary

A case of short-rib-polydactyly syndrome of the Saldino-Noonan type is presented. The salient features of three other syndromes most closely resembling this disease, namely asphyxiating thoracic dysplasia, Ellis-van Creveld syndrome and Majewski syndrome are briefly reviewed with the aim of helping in their differential diagnosis.

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