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Imaging of Pfeiffer Syndrome: A Case Report

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Abstract

BACKGROUND: Pfeiffer syndrome (PS) is a rare case in the Asian population, and only a few have been reported in Indonesia. This case report aims to spotlight the identification of PS with its correlated radiological imaging and distinguish it from other syndromes.

CASE REPORTS: The authors report a case of a 5-year-old girl with PS, manifested by brachyturricephally, broad thumbs and big toes, and medially deviated big toes. The patient also had proptosis, midface hypoplasia, and bilateral Syndactyly of the fingers and toes. This report confirms the thorough examination procedures and indexes to identify PS as a literature reference for the research of reported PS in Southeast Asian race patients and as one comprehensive source for identification using index figures.

CONCLUSION: This report provides a detailed radiology interpretation of PS on Southeast Asian race patients. Radiological findings can help in diagnosing and determining adequate treatment as needed.

Introduction

Pfeiffer syndrome (PS) is a rare autosomal dominant congenital disorder, affecting 1 in 100,000 live births [1]. Craniosynostosis, midface hypoplasia, broad, medially deviated thumbs and/or big toes, and partial Syndactyly on hands and feet are distinctive features of PS [1], [2]. PS is divided into three clinical subtypes based on the severity of the phenotypes. Type 1 or "classic" presented by brachycephaly, midface hypoplasia, finger and toes abnormalities, and normal neurological and intellectual development. Type 2 consists of a cloverleaf skull, severe proptosis, finger and toes abnormalities, elbow ankylosis or synostosis, and developmental delay with neurological complications. Type 3 is similar to type 2 but without the cloverleaf skull [1], [2]. This case report aims to spotlight the identification of PS with its correlated radiological imaging and distinguish it from other syndromes.

Case Presentation

A 5-year-old Indonesian girl was admitted to the hospital with a recurrent incident of a runny nose. On examination, the patient demonstrated a tall head, protruding, widely spaced eyes, small nose, small midface, low det ears, and an underbite (Figure 1). The patient also had broad thumbs, and broad, medially deviated big toes. The soft tissue of her 2nd, 3rd, 4th, and 5th fingers is fused on both hands. Partial Syndactyly sparing the 5th toes was noted (Figure 2). Since birth, the patient's clinical appearance has been identified, followed by a delay in speech development and basic motoric skills compared to other children her age, that is, verbal communication, crawling, and walking.

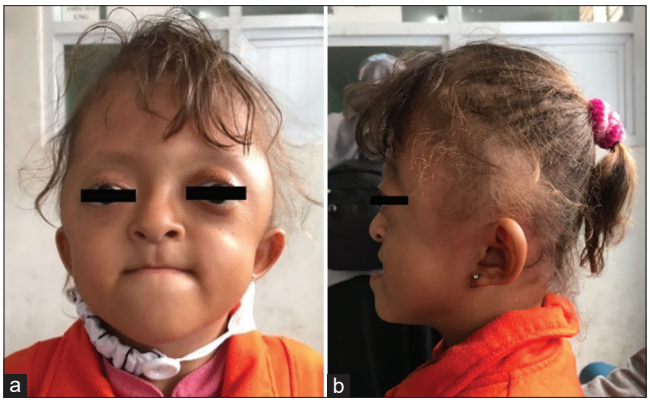

Figure 1: (a) Front photography shows brachyturricephalic head shape, widely spaced eyes, and small midface. (b) Lateral photography shows protruding eyes and an underbite. Written permission to publish autograph had been obtained from subject's parents

Computed tomography (CT) revealed craniosynostosis and signs of hydrocephalus. Three-dimensional reconstruction CT showed three-dimensional virtual images of the fused coronal, sagittal, metopic, and lambdoid sutures with prominent convolutional markings (Figure 3). The cephalic index (CI) was 1.01, and the towering index (TI) was 0.42, according to brachturricephaly with mild cloverleaf head shape (Figure 3).

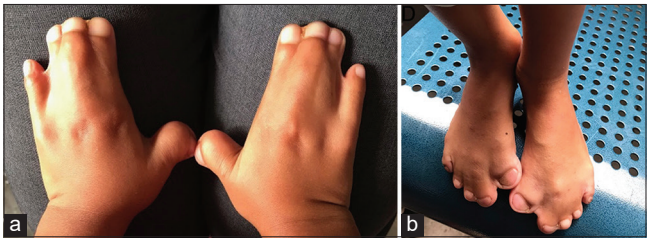

Figure 2: (a) Broad thumbs and partial Syndactyly on both hands. (b) Broad, medially deviated big toes and partial Syndactyly on both feet

The posterior fossa is narrow. An extension of the right cerebellar tonsil through the foramen magnum into the cervical canal is evident. The lateral ventricles and third ventricle are dilated with no evidence of fourth ventricle dilatation, suggesting hydrocephalus due to aqueduct stenosis (Figure 4).

Ocular hypertelorism and proptosis were also observed (Figure 5). Maxillary hypoplasia causing prognathism was seen on the sagittal plane of 3-dimensional reconstruction CT. The middle nasal conchas are absent, and the nasal septum has deviated to the left (Figure 5). Airway restriction in the nasopharynx and sinusitis of bilateral ethmoid, sphenoid, and maxillary sinuses were noted (Figure 6). The opening of Eustachian tubes is absent, and bilateral otitis media were noted (Figure 6). Skull base deforms, plain radiography of her hands and feet revealed no bony fusion between the phalanges (Figure 6). The findings were consistent with PS.

Discussion

PS is a rare autosomal dominant congenital disorder. It affects one in 100,000 live births. PS is a form of acrocephalosyndactyly syndrome (ACS). Craniosynostosis, midface hypoplasia, broad, medially deviated thumbs and/or big toes, and partial Syndactyly on hands and feet are distinctive features of PS. Craniosynostosis is defined as the premature fusion of one or more of the cranial sutures [1], [2], [3]. In PS, the most common craniosynostosis involves coronal and lambdoid sutures and occasionally sagittal sutures. Craniosynostosis in PS leads to abnormal skull shape, with the most severe form being the cloverleaf skull. The presence of cloverleaf skull is unique in type 2 PS and is not found in other ACS [1], [2].

CT scan can provide objective anthropometrical measurement to determine the skull shape. CI is measured by dividing the distance between the lateral extreme of the skull on either parietal bone or upper temporal bone by the distance between the glabella and opisthocranion. In our patient, the CI is 1.01, exceeding the standard value of 0.84 (0.74–0.94), suggesting a brachycephaly head shape. The TI is a novel measurement reflecting the calvaria's abnormal towering and vertical elongation. TI compares the net distance to arc length between the glabella and opisthocranion. On three-dimensional reconstruction CT, we traced glabella's perimeter to opisthocranion and got the arc length of 25.64. The TI in our patient is 0.54 (normal value 0.58–0.70), indicating turricephaly [4]. The early closure of the lambdoid sutures causing diminutive posterior fossa and aqueduct stenosis may lead to chronic tonsillar herniation (Chiary malformations type 1) and hydrocephalus [2], [5], [6]. In the axial plane of head CT of this patient, both lateral ventricles are dilated, the width of the 3rd ventricle exceeded 5 mm. Meanwhile, the 4th ventricle is normal. These findings correspond to triventricular hydrocephalus caused by aqueduct stenosis [5].

Ocular hypertelorism and proptosis are the common features in craniosynostosis. Ocular hypertelorism is measured using three parameters: Soft-tissue intercanthal (IC) distance, bony interorbital (IO) distance, and bony lateral orbital (LO) distance. IC is defined as the distance between medial canthi. IO and LO are the distance between the medial and lateral wall of orbits. IC, IO, and LO are measured in Frankfort horizontal plane (the highest point on the upper margin of the opening of the external auditory canal and the lowest point on the lower margin of the orbit). Our patient's IC, IO, and LO are 2.88 cm, 2.92 cm, and

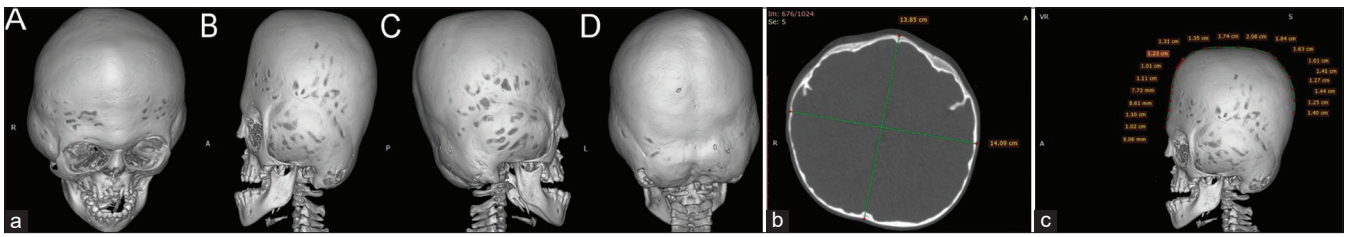

Figure 3: (a) (A-D) Three-dimensional reconstruction computed tomography (CT) showed three-dimensional virtual images of the fused coronal, sagittal, metopic, and lambdoid sutures with prominent convolutional markings. (b) Axial plane of head CT shows anteroposterior length is 13.85 cm and head width 14.09 cm, resulting in CI 1.01. (c) Sagittal plane of three-dimensional reconstruction CT shows arc length between glabella and opisthocranion 25.64. With an anteroposterior length is 13.85 cm, the towering index is 0.54

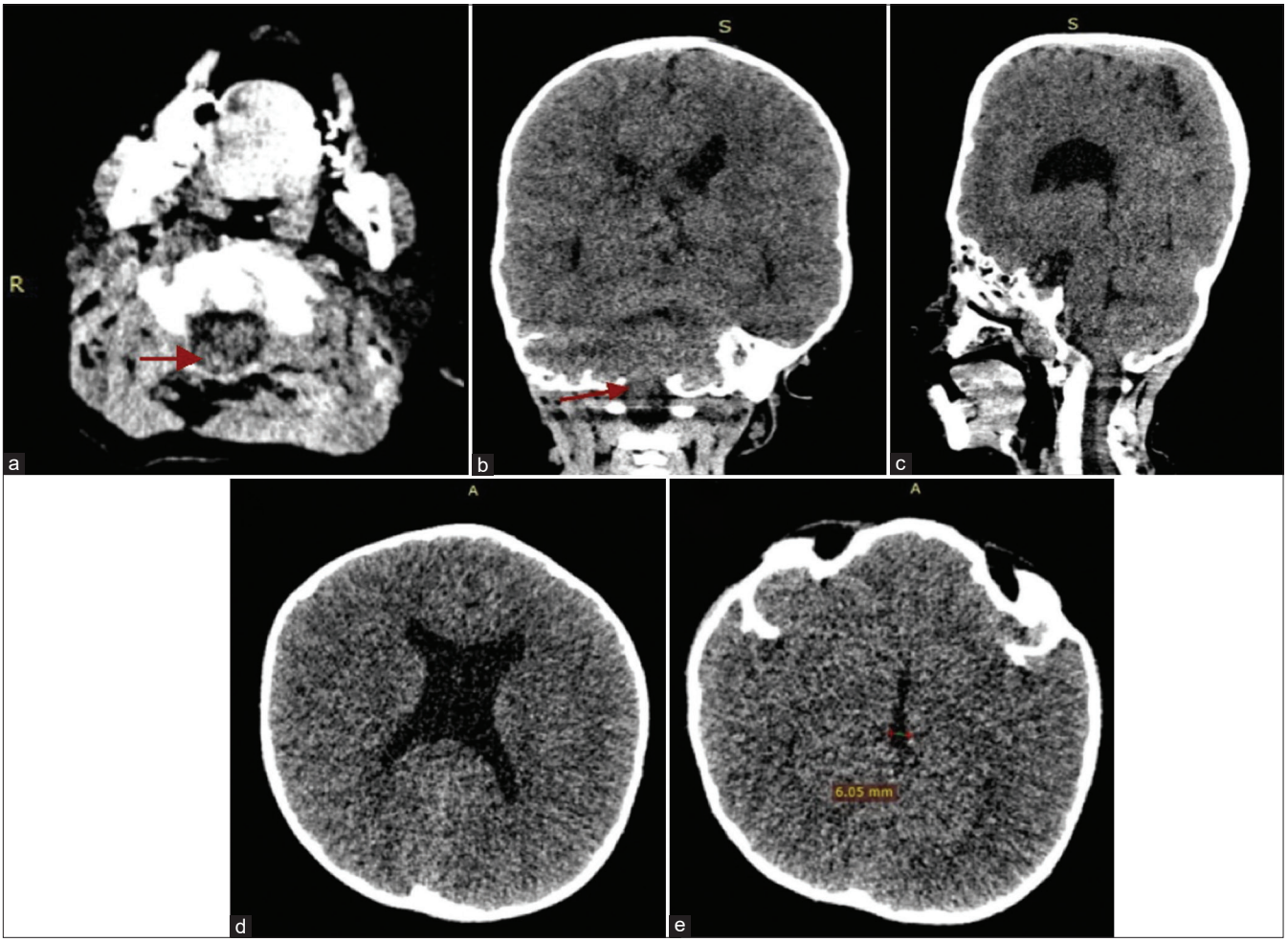

Figure 4: (a) Axial and (b) coronal plane of head computed tomography (CT) shows crowding of foramen magnum and extension of the right cerebellar tonsil into the cervical canal (red arrow). (c) Sagittal plane of head CT shows no dilatation of the fourth ventricle, axial head CT shows marked dilatation of bilateral lateral ventricles, (d) marked dilation the third ventricle, and (e) suggesting triventricular hydrocephalus caused by aqueduct stenosis

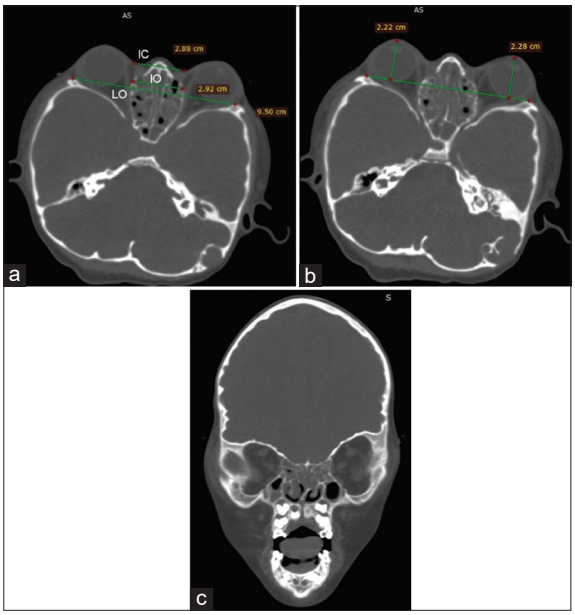

Figure 5: (a) Eye distance measurements show intercanthal, interorbital, and lateral orbital exceeding normal limits yield ocular hypertelorism. (b) The axial plane of head computed tomography (CT) shows proptosis. (c) Coronal plane of head CT shows the absence of both middle nasal conchas and deviated nasal septum. Sinusitis of ethmoid and maxillary sinuses can be observed

9.50 cm. All three exceeded the normal range in the 5–6-year-old age group in a study by Jullabussapa in 2020, suggesting ocular hypertelorism [1], [7]. Proptosis caused by shallow orbits is assessed by measuring the distance between the globe's interzygomatic line and anterior margin. A transverse line between the two zygomatic processes is drawn, then perpendicular lines from the interzygomatic line to the anterior margin of both eye globes are measured. Measurements, above 21 mm, found in our patient, suggest proptosis [2], [8]. Hypertelorism is not a common finding in other ACS such as Saethre-Chotzen syndrome [9].

Midface hypoplasia results in receded maxilla and zygomatic bone, restricted airway at various locations, and absence of some nasal structures. In our patient, the nasopharynx is restricted, seen in the axial and sagittal plane of head CT. Both nasal conchas are absent following the features of midface hypoplasia [2], [10], [11]. Recurrent ear infections are other common features of PS, favored by Eustachian tubes narrowing due to craniosynostosis. Our patient's head CT shows opacification in middle ears, suggestive of bilateral otitis media[12]. A distinctive feature of PS is broad thumbs and big toes. The thumbs and/or big

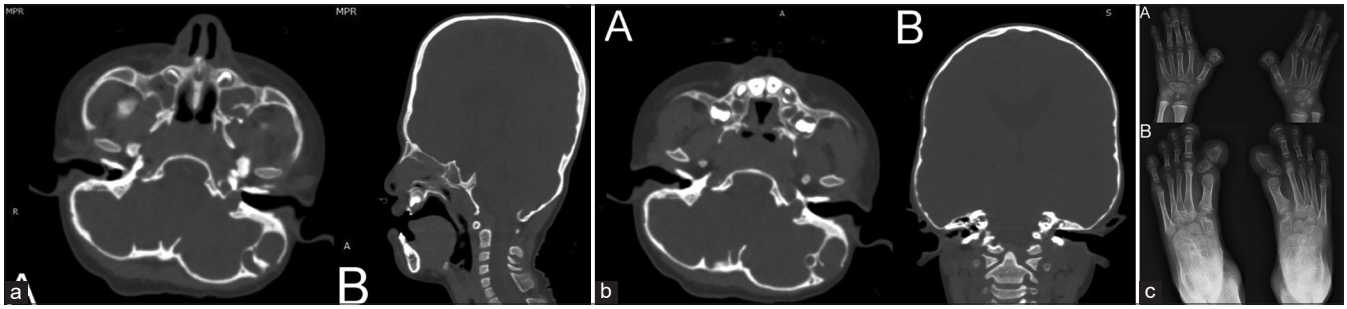

Figure 6: (a) (A) Axial; (B) sagittal planes of head CT show restricted airway at nasopharynx. (b) (A) Axial plane of head CT shows no evidence of patent Eustachian tubes; (B) Coronal plane of head CT shows opacification in the middle ear cavities, suggesting bilateral otitis media; and (c) Plain radiography revealed no bony fusion on both (A) hands and (B) feet

toes are also medially deviated. With no bony fusion in plain radiography, Syndactyly of the hands and feet may be found [2]. In other cases of ACS such as Apert's syndrome, there is a bony fusion marked by the lack of metacarpal cartilage segmentation which is not present in this patient. The presence of syndactyly also differentiates from Crouzon syndrome, where digital abnormalities are not found[13].

This report confirms the thorough examination procedures and indexes to identify PS as a literature reference for the research of reported PS in Southeast Asian race patients and as one comprehensive source for identification using index figures.

Challenge in this case report was the delay in MRS for a faster identification and intervention due to cultural issues (parents permit) was somewhat difficult to obtain. The patient hoped that the reconstruction procedure and intervention could improve her condition by removing the inconvenience she previously had, such as runny nose, imbalance, and motoric issues.

Conclusion

PS is a rare case that has not been studied enough, especially in Indonesia. Distinguished physical features have to be recognized to differentiate PS with other craniocystoses syndromes. Several ACS may present with similar physical abnormalities. Radiologists should be able to characterize imaging features between these syndromes to help in diagnosing and determining adequate treatment as needed.

References

1. Ko JM. Genetic syndromes associated with craniosynostosis. J Korean Neurosurg Soc. 2016;59(3):187-91. https://doi.org/10.3340/jkns.2016.59.3.187
   PMid:27226847
2. Vogels A, Fryns JP. Pfeiffer syndrome. Orphanet J Rare Dis. 2006;1:19. https://doi.org/10.1186/1750-1172-1-19
   PMid:16740155
3. Pindrik J, Molenda J, Uribe-Cardenas R, Dorafshar AH, Ahn ES. Normative ranges of anthropometric cranial indices and metopic suture closure during infancy. J Neurosurg Pediatr. 2016;25(6):667-73. https://doi.org/10.3171/2016.5.PEDS14336
   PMid:27589596
4. Dlouhy BJ, Menezes AH. Hydrocephalus in chiari malformations and other craniovertebral junction abnormalities. In: Cinalli G, Ozek MM, Sainte-Rose C, editors. Pediatric Hydrocephalus. Cham: Springer International Publishing; 2018. p. 1119-32.
5. Tan AP, Mankad K. Apert syndrome: Magnetic resonance imaging (MRI) of associated intracranial anomalies. Childs Nerv Syst. 2018;34:205-16. https://doi.org/10.1007/s00381-017-3670-0
   PMid:29198073
6. Jullabussapa N, Khwanngern K, Pateekhum C, Angkurawaranon C, Angkurawaranon S. CT-based measurements of facial parameters of healthy children and adolescents in Thailand. AJNR Am J Neuroradiol. 2020:41(10):1937-42. https://doi.org/10.3174/ajnr.A6731
   PMid:32855189
7. Burns NS, Iyer RS, Robinson AJ, Chapman T. Diagnostic imaging of fetal and pediatric orbital abnormalities. AJAR Am J Roentgenol. 2013:201(6):W797-808. https://doi.org/10.2214/AJR.13.10949
   PMid:24261386
8. Mathijssen IM. Guideline for care of patients with the diagnoses of craniosynostosis: Working group on craniosynostosis. J Craniofac Surg. 2015:26(6):1735-807. https://doi.org/10.1097/SCS.0000000000002016
   PMid:26355968
9. Šebová I, Vyrvová I, Barkociová J. Nasal cavity CT imaging contribution to the diagnosis and treatment of choanal atresia. Medicina (Kaunas). 2021:57(2):93. https://doi.org/10.3390/medicina57020093
   PMid:33494264
10. Couloigner V, Ayari Khalfallah S. Craniosynostosis and ENT. Neurochirurgie. 2019:65(5):318-21. https://doi.org/10.1016/j.neuchi.2019.09.015
    PMid:31568777
11. Šebová I, Vyrvová I, Barkociová J. Nasal Cavity CT Imaging Contribution to the Diagnosis and Treatment of Choanal Atresia. Medicina (Kaunas). 2021;57(2):93. https://doi.org/10.3390/medicina57020093
    PMid: 33494264
12. Couloigner V, Ayari Khalfallah S. Craniosynostosis and ENT. Neurochirurgie. 2019;65(5):318-21. https://doi.org/10.1016/j.neuchi.2019.09.015
    PMid: 31568777
13. Cohen MM. Apert, crouzon, and pfeiffer syndromes. Monogr Hum Genet. 2011;19(1):67-88. https://doi.org/10.1159/000320211