

STRAIGHT LINE SIGN IN PATENT DUCTUS ARTERIOSUS

Harjit Singh
J.C. Chugh
A.H. Shembesh
Abdulla Al Khayat
A.A. Ben-Musa

Even though echocardiography has revolutionized the diagnostic workup in congenital heart disease, the technique is yet not routinely available in most of the developing world. A straight X-ray chest is a routine investigation in such situations.

In patent ductus arteriosus (PDA), the concavity between the aortic knob and the pulmonary artery is filled in to form a straight left border at the base of cardiac silhouette, in a straight X-ray of chest (*Fig. 1*). This, along with plethoric lungs and a large heart, make the classical presentation of PDA(1). The straight border, referred to as the "straight line sign", is not commonly described in pediatric and cardiology texts, as well as in books on pediatric radiology(2-4).

In order to assess the clinical value of the straight line sign in the radiological assessment of children with PDA, the present study was undertaken.

From the Departments of Pediatrics, Al Fatah Children's Hospital, Faculty of Medicine, Al Arab Medical University, Benghazi, Libya, and Al Wasl Hospital for Women and Children, Dubai, UAE.

Reprint requests: Prof. Harjit Singh, P O Box 12836, Dubai UAE

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Material and Methods

Forty children aged 7 days to 5 years, confirmed to have PDA on 2-dimensional echocardiography/surgery, from Al Fatah Children's Hospital, Benghazi, Libya and Al Wasl Hospital for Women and Children, Dubai, UAE, were taken up for the study. A straight X-ray film of the chest was evaluated. A similar number of X-ray films from age-matched children, without cardiac disease, formed the control group. All the eighty X-rays were assigned numbers from 1 to 80 by picking up lots from a pool of patients' names.

The straight line sign was explained to all the participants in the study. The coded X-rays were assessed for the sign by a group of at least three participants, including the principal author. The X-rays were decoded and the results compiled.

Results

Four X-rays, three from the patients' group and one from the control group, were considered unsatisfactory and discarded. Only five of 37 (13.8%) X-rays from patients with PDA had a combination of cardiomegaly, pulmonary plethora and the straight line sign. Overall, the straight line sign (Fig. 1) was noted in 21 X-rays. Out of these 18 were later confirmed to be from the PDA group; three were from the control group. Thus, 18 of 37 (48.6%) of PDA cases, as also 3 of 39 (7.7%) of control group, had the positive sign. The difference between the two groups, using Chi square analysis with Fisher's exact probability, was significant ($p < 0.001$).

In 13 cases the sign was obliterated by a prominent pulmonary conus (Fig. 2), even though one patient showed the straight line sign in spite of a prominent pulmonary conus (Fig. 3). In one 4-month-old infant the area was masked by a large thymic shadow. The

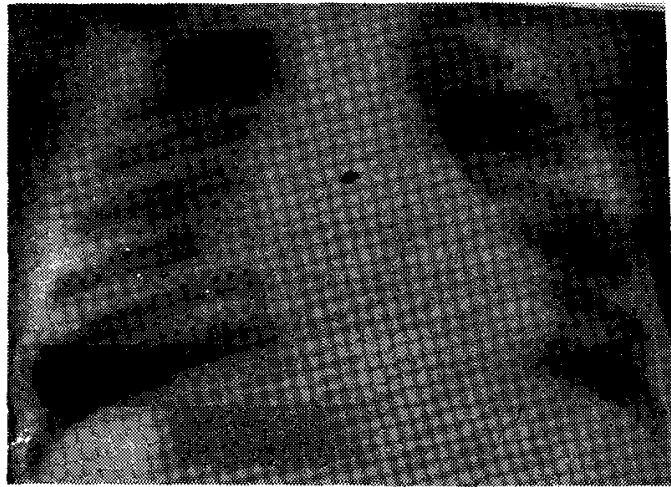


Fig. 1. X-ray chest of a 4-year-old child with PDA showing straight line sign and hilar plethora on right.

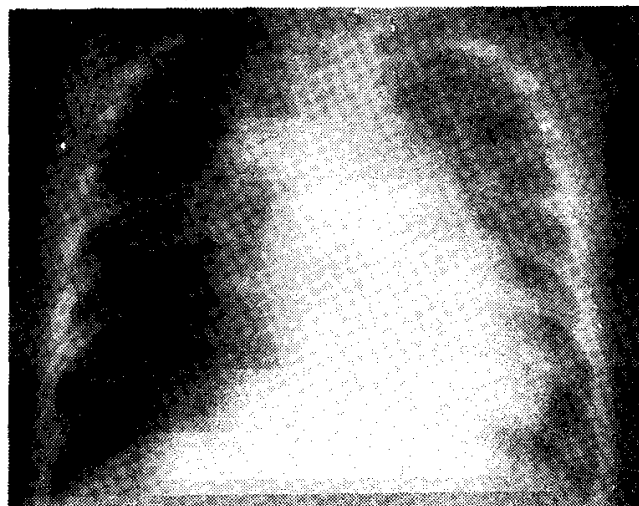


Fig. 2. X-ray chest of a 5-year-old child with PDA showing cardiomegaly, pulmonary plethora and a dilated pulmonary artery; the straight line sign is obliterated.

sign could be visualized even in an infant 7-days-old (Fig. 4).

Discussion

The classical radiological combination of hilar plethora, cardiomegaly and the straight line sign were present in only 13.8% cases of PDA. However, these three signs, singly or in combination, were present in the majority

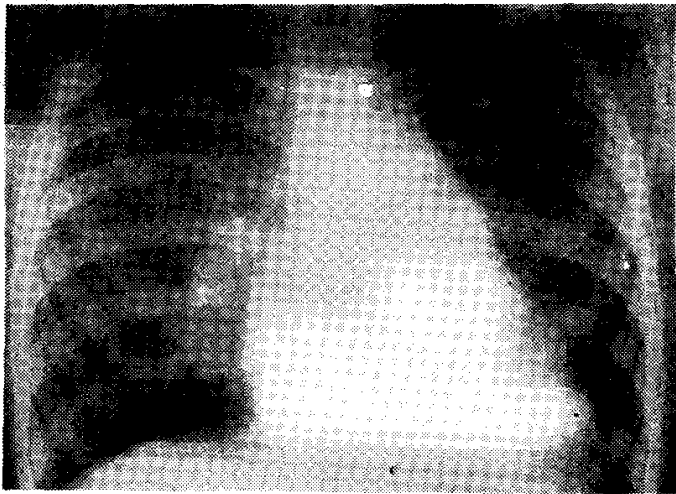


Fig. 3. X-ray chest of a 5-years old child with PDA showing cardiomegaly, pulmonary plethora and the straight line sign; the pulmonary artery is also dilated.

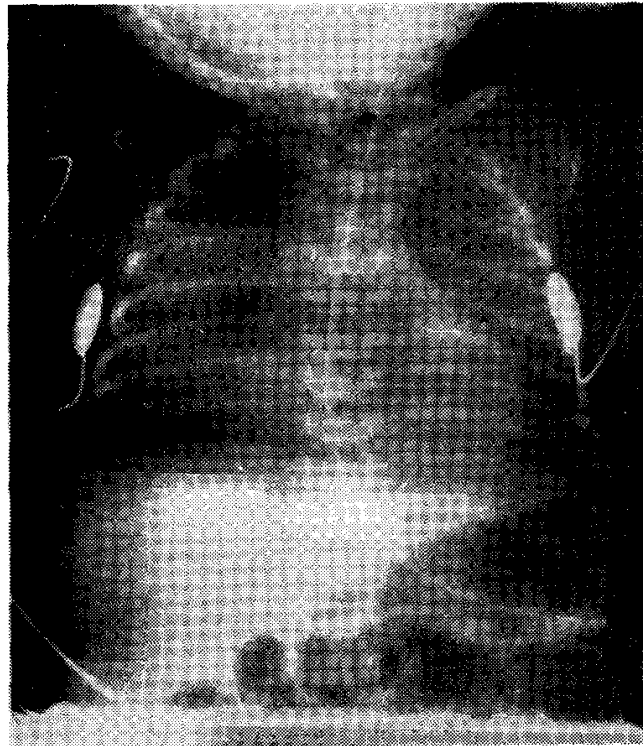


Fig. 4. X-ray chest of a 7-day-old infant with PDA showing cardiomegaly and straight line sign.

of cases. Cardiomegaly and pulmonary plethora are signs common to all cardiac anomalies with a left-to-right shunt; the straight line sign is characteristic of PDA.

Filling in of the normal angle between the aortic arch and the main pulmonary artery in PDA was described by Johnson and Saltzman(5), but is stated to be not often recognizable(6). However, according to Keith *et al.*(7), the angle is filled in over half the cases. This is confirmed by the present study. The straight line sign is constituted by the enlarged left atrium and the aortic knob(8), and possibly a part of the ductus itself(1).

Even though the sign was also present in a small percentage (7.7%) of cases without any cardiac illness, its presence in a patient with suggestive clinical signs, would make the bedside diagnosis of PDA more conclusive. Pediatricians need to be aware of this simple radiological sign.

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