The Oblique Interface in the Right Cardiophrenic Angle : Chest Radiographic-CT Correlation[1]

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Purpose: An oblique interface in the right cardiophrenic angle, extending superomedially from right retrocardiac or supradiaphragmatic region inferolaterally to peridiaphragmatic region, is occasionally observed on posteroanterior chest radiograph. The aim of this study was to evaluate the frequency of visualization of the interface on chest radiographs and to elucidate its nature on radiographic-CT correlation.

Materials and Methods: Posteroanterior chest radiographs from 300 consecutive subjects were analyzed to evaluate the frequency and demographic data about an oblique interface in the right cardiophrenic angle. Thin-section CT scans(1-mm collimation and 5-mm intervals) were obtained from the subjects with positive interface on chest radiograph for assessment of the nature of the interface. The demographic data in the subjects with and without the interface were tested statistically to note any difference between two groups.

Results: Oblique interface in the right cardiophrenic angle was present in 29 subjects(9.7%) on chest radiograph. The age of the subjects with positive interface(13 men and 16 women) ranged from 19 to 70 years(mean ± SD, 47 ± 12.7 years) whereas the age of the subjects without the interface from 16 to 82 years (mean ± SD, 50 ± 9.1 years)($p > 0.1$). The body weight of the subjects with the interface ranged from 41 to 72 Kg(mean ± SD, 60 ± 8.0 Kg) whereas the body weight of the subjects without the interface from 41 to 85 Kg(mean ± SD, 63 ± 10.1 Kg)($p > 0.1$). On CT scan, it was formed due to contact between the epipericardial fat and the right middle lobe of the lung in 27 subjects(93%) and between the inferior vena cava and the medial basal segment of the right lower lobe of the lung in two(7%).

Conclusion: Oblique interface in the right cardiophrenic angle is occasionally visualized on chest radiograph. It is formed due to contact between the right middle lobe of the lung and pericardial fat in most cases. The frequency of visualization of the interface has no relationship to age and body weight of the subjects.

Index Words: Mediastinum, anatomy
Mediastinum, CT
Mediastinum, radiography

INTRODUCTION

An oblique interface seen in the right cardiophrenic angle on chest radiographs and referred to as the inferior recess of the anterior junction line(1, 2) has been attributed to different anatomic correlates based on anecdotal information. This interface was regarded to result from contact between the right middle lobe of the lung and the epipericardial fat(1 —5). Differently in several textbooks, it was described as an interface between the right lower lobe and the inferior vena cava (IVC) or the right hepatic vein(6, 7). Because we hypothesize that this interface could be formed from vari-

ous anatomic correlates in the right cardiophrenic angle, we prefer to call it oblique interface in the right cardiophrenic angle(OICPA).

There have been few reports(1, 2), in which the interface was described on CT scans. However, to our knowledge, there have been no reports describing the frequency of visualization of the interface on chest radiograph or detailed radiographic-CT correlation.
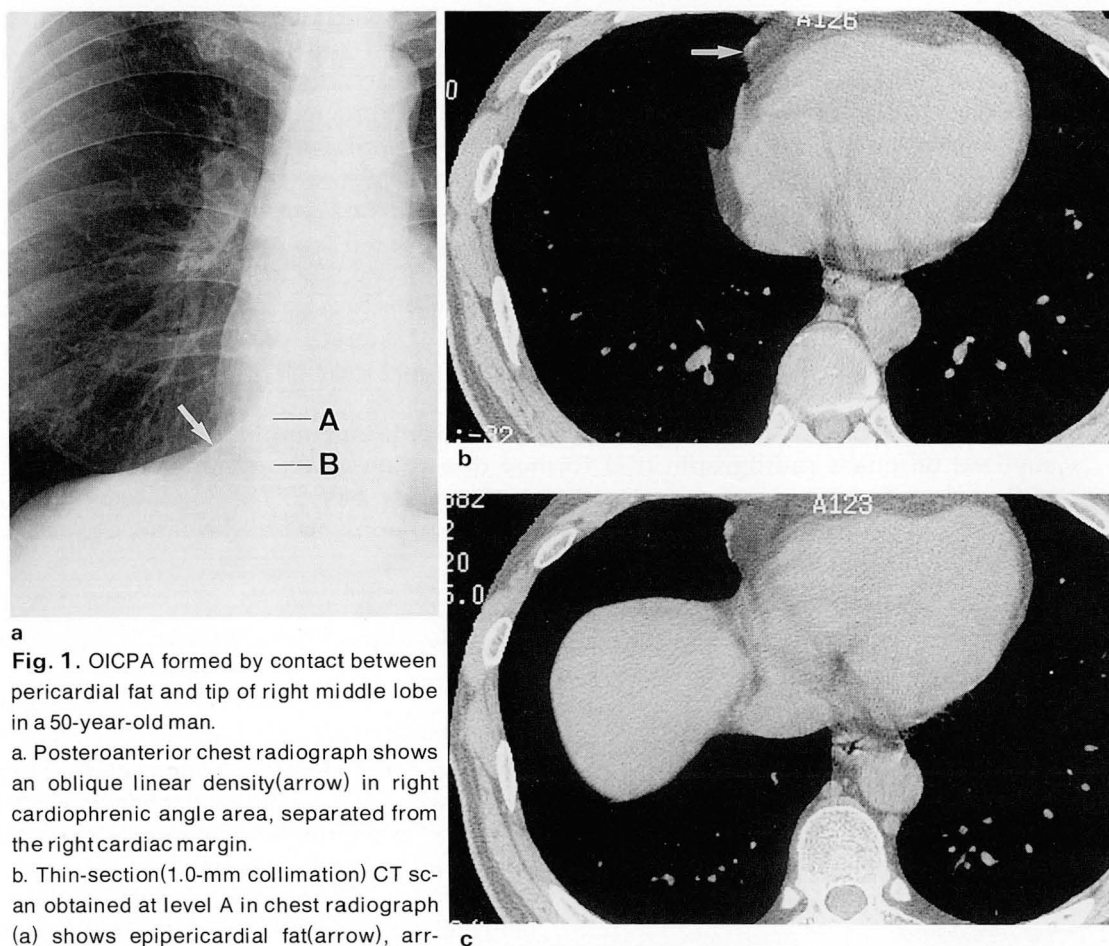
The aim of our study is to evaluate the frequency of visualization of OICPA on chest radiograph and to elucidate the nature with radiographic-CT correlation.

MATERIALS and METHODS

During four months from August to November 1994, posteroanterior(PA) chest radiographs from 318 consecutive subjects were obtained to evaluate the frequency of visualization of OICPA and to assess the demographic data of the subjects with or without OICPA. The subjects visited our hospital for a routine check-up. We excluded the subjects with abnormalities that could obscure the right cardiophrenic angle(n

= 5) or those that had specific medical indications for a chest disease(n = 3) or had history of steroid intake(n = 1). Subjects with kyphosis or scoliosis(n = 5) and with radiographs in rotated or lordotic position(n = 4) were also excluded. Accordingly total of 300 subjects were included in this study.

Posteroanterior chest radiographs were obtained with storage phosphor computed radiography. The radiographs were obtained at deep inspiration. The exposure parameters were as follows ; 120 kVp, 0.6 or 1. 2-mm nominal focus, 183-cm film-focus distance, 10 : 1 oscillating grid and phototimed exposure(Picker, Duratron, Bellwood, IL). The computed radiographs were obtained with storage phosphor image plate(ST-V ; Fuji, Tokyo, Japan) that was digitized with high output semiconductor laser and polygon mirror(FCR 9501, Fuji, Tokyo, Japan) in to a 0.2-mm × 10-bit pixel matrix. Each digital data set was depicted by a 11″ × 14″ laser-printed hard copy. The display parameters for gradation and edge enhancing mode for image processing of the computed radiograph were GA(0.8), GT (E), GC(1.6), GS(−0.2) for contrast and RN(4), RT(R),
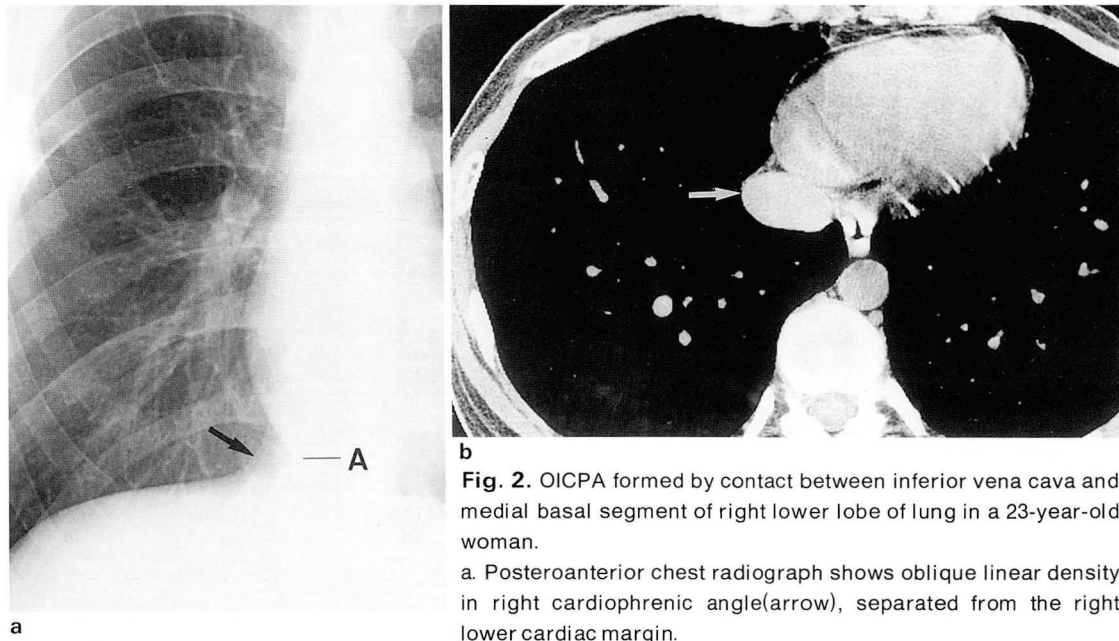

Fig. 1. OICPA formed by contact between pericardial fat and tip of right middle lobe in a 50-year-old man.

a. Posteroanterior chest radiograph shows an oblique linear density(arrow) in right cardiophrenic angle area, separated from the right cardiac margin.

b. Thin-section(1.0-mm collimation) CT scan obtained at level A in chest radiograph (a) shows epipericardial fat(arrow), arranged in anteroposterior direction. This arrangement of fat is parallel to x-ray beam, making the linear density in posteroanterior radiograph.

c. CT scan obtained at level B in(a) shows more prominent epipericardial fat, oriented in anteroposterior direction.

Fig. 2. OICPA formed by contact between inferior vena cava and medial basal segment of right lower lobe of lung in a 23-year-old woman.

a. Posteroanterior chest radiograph shows oblique linear density in right cardiophrenic angle(arrow), separated from the right lower cardiac margin.

b. Thin-section(1.0-mm collimation) CT scan obtained at level A in chest radiograph(a) shows prominent and borderforming inferior vena cava(arrow).

RE(0.5) for spatial resolution. Dynamic range control processing(8), which is a new type of image processing algorithm developed with a view to provide a wide diagnostic range on single-image display without altering the image information, was added in image processing algorithm. In dynamic range control processing, the fine structure of the mediastinal region is clearly delineated. Furthermore, adequate lung field contrast equivalent to that of gradation processed image is retained. The parameters of dynamic range control processing were as follows ; DRN(2), DRT(B), DRE (0.6).

The subjects were 165 men and 135 women. Age ranged from 16 to 82 years(mean ± SD, 49 ± 12.4 years). Informed consent was obtained from all subjects. Body weight of subjects was also evaluated.

High Speed Advantage CT scanner(GE Medical Corp, Milwaukee, WI) was used. CT scans were obtained with subjects in the supine position and at end inspiration. Consecutive sections with 1-mm collimation and at 5-mm intervals were obtained from the proximal level of OICPA to the level of liver dome. The entire length of OICPA was included in the CT scans. Imaging parameters were as follows : 120 kVp, 170 mA, and 2.0 second scan time. Bone algorithm was used for image reconstruction without targeting. The images were photographed at standard mediastinal(width, 400 HU : level, 0 HU) and lung parenchymal window settings(width, 1500 HU : level, −700 HU).
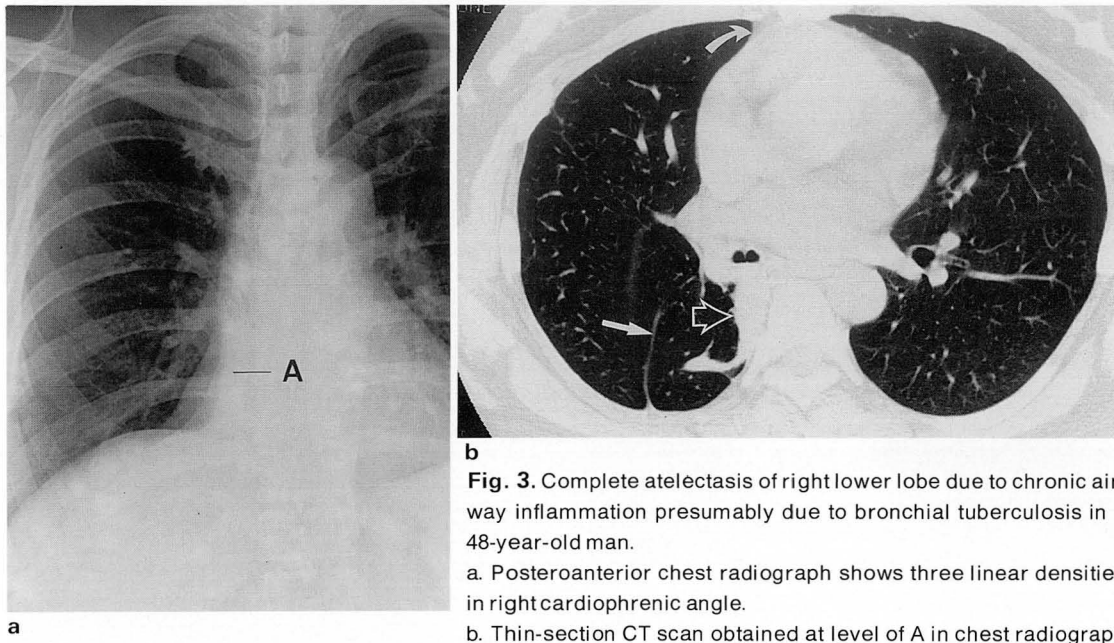
We evaluated the frequency of visualization of OIC-PA on PA chest radiograph. The interface was considered present when there was definite linear density, running obliquely(from medial to lateral) cephalad from the right retrocardiac or paracardiac supradiaphragmatic region caudad to peridiaphragmatic region(Fig. 1). When the interface was less than 1 cm in length or when it was continuous with a linear density of the branch of the right inferior pulmonary vein, it was regarded absent. The conclusion on the presence of the interface was reached by a consensus of two chest radiologists in every subject. When two observers disagree on the presence of the interface(2/300, 0.7%), it was regarded absent. In the subjects with positive OICPA, the length of the interface was measured. The shape was described as straight, convex inward, or convex outward. Radiograph-CT correlation was performed to elucidate the nature of OICPA.

Any statistical significance of demographic data (age, sex and body weight) between the two groups of patients with and without OICPA were tested with paired t-test.

RESULTS

OICPA(Fig. 1) was present in 29 subjects(9.7%) on PA chest radiograph. The subjects consisted of 13 men and 16 women. The length of the interface ranged from 2.3 to 4.2 cm(mean ± SD, 3.2 ± 0.52 cm). The age of the subjects with OICPA ranged from 19 to 70 years(mean ± SD, 47 ± 12.7 years) whereas the age of the subjects without it ranged from 15 to 82 years(mean ± SD, 50 ± 9.1 years)(p>0.1). The interface was straight in 15 subjects(52%) and convex inward in 14(48%). None of the subjects showed a convex outward interface. The body weight of the subjects with the interface ranged from 41 to 72 Kg(mean ± SD, 60 ± 8.0 Kg) whereas the

Fig. 3. Complete atelectasis of right lower lobe due to chronic air-way inflammation presumably due to bronchial tuberculosis in a 48-year-old man.

a. Posteroanterior chest radiograph shows three linear densities in right cardiophrenic angle.

b. Thin-section CT scan obtained at level of A in chest radiograph (a) shows posteriorly displaced right minor fissure(arrow) and completely atelectatic right lower lobe marginated by right major fissure(open arrow). From lateral to medial, three linear densities in right car-diophrenic angle are formed by interface between lung and heart, between lung and atelectatic right lower lobe, and between lung and epipericardial fat(curved arrow), respectively. Although right minor fissure is parallel to x-ray beam, it cannot form interface on chest radiograph because it does not extend downward.

body weight of the subjects without the OICPA ranged from 41 to 85 Kg(mean ± SD, 63 ± 10.1 Kg)(p>0.1).

In radiographic-CT correlation, the OICPA was for-med by contact between the pericardial fat and the me-dial extent of the right middle lobe in 27 subjects(93%) (Fig. 1) and between the IVC and the medial basal seg-ment of the right lower lobe in two subjects(7%)(Fig. 2). Both subjects in whom OICPA were formed by contact between the right lower lobe and the IVC were slender women. There was no sexual difference(13 men and 14 women) in the subjects in whom OICPA was formed due to contact between pericardial fat and the right middle lobe.

DISCUSSION

When a linear density in the mediastinum results from contact of mediastinal structures with the adjacent lung, it might be called mediastinal interface. Medias-tinal line results from contact between the two lungs across the midline. OICPA has been attributed to a con-tact between the epipericardial fat and the right middle lobe of the lung(1 –5). In several textbooks, the inter-face was described as contact between the right lower lobe and the IVC or the right hepatic vein(6, 7). Our study showed that OICPA on PA chest radiograph was visualized occasionally(in 9.7% of subjects) and it re-sulted most commonly from contact between the epi-pericardial fat and the medial extension of the right middle lobe of the lung. There was no significant stat-

istical difference in sex, body weight, and age between the subjects with and without OICPA.

Proto et al(2) suggested that OICPA caused by con-tact between the epipericardial fat and the right middle lobe of the lung could be differentiated from an OICPA caused by contact between the right lower lobe of the lung and the IVC. The former may be higher and more medially extended than the latter. Although the OICPA resulting from contact between the right middle lobe of the lung and epipericardial fat was usually longer than that from contact between the right lower lobe of the lung and the IVC in our study, difference was not signifi-cant statistically. Higher position of the former than lat-ter could not be detected in this study. This obser-vational difference between the two studies might be due to the small number of cases with OICPA caused by contact between the lung and the IVC in our study.

Though large amount of fat in the right cardiophrenic angle can simulate a mass(4, 5), in our series the OI-CPA was either straight or convex inward. The lateral margin may help to differentiate the OICPA from poten-tial look-alike such as pericardial cyst, Morgagni her-nia, or mass lesions of mediastinal, pleural or nodal origin(5). These abnormalities in the right cardioph-renic angle usually obliterate the right lower heart bor-der whereas OICPA usually does not. Furthermore, lesions cast considerably larger opacity.

Complete atelectasis of the right lower lobe or combined right middle lobe and lower lobes of the lung may mimic OICPA with linear densities in the right

cardiophrenic angle area on PA chest radiograph. However, close scrutiny of the PA chest radiograph in case of atelectasis may show a secondary sign of lobar atelectasis such as reorientation of hilar pulmonary vessels and hyperinflation of the remaining lobes. Furthermore, in cases where both complete atelectasis and OICPA coexist, double linear densities in the right cardiophrenic angle may be shown as did in our case (Fig. 3).

Although our study showed that OICPA was formed by contact between epipericardial fat and the medial extension of right middle lobe of lung, the presence of epipericardial fat does not ensure the presence of OICPA. In the patients with prominent epipericardial fat in the right cardiophrenic angle area, OICPA is not always visualized on PA chest radiograph. OICPAs are only visualized when pericardial fat present along the sagittal plane of the x-ray beam.

The frequency of OICPA visualization in our study(9.7%) may have been higher because due to our parameter of storage phosphor computed radiograph in which the mediastinal structures were enhanced(dynamic range control). In literature, however, we could not find any data on the frequency of OICPA visualization on PA chest radiograph which is comparable to our study.

In this study, we correlated the findings observed on chest radiograph with subjects erect with those observed on CT scan with subjects supine. These differ-

ent position of subjects may have changed mediastinal configuration. With subjects erect, mediastinal structures will be elongated and epipericardial fat may be attenuated further with deep inspiration. Thus epipericardial fat on chest radiograph may have appeared smaller than it may on CT scan. However, the overall volume of epipericardial fat pad and its relationship to the heart, the chest wall and the adjacent lung should remain relatively stable as Paling et al pointed out(3).

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우측 심횡격막각 부위의 사행 경계면:단순흉부촬영상의 빈도 및 전산화단층촬영과의 연관[1]

[1]삼성서울병원 진단방사선과

김정숙 · 이경수 · 주성욱 · 주인욱

목　적:단순흉부촬영상 우측 심횡격막각 부위에, 우측 심연부위에서 시작하여 비스듬히 아랫쪽 및 바깥쪽으로 주행하는 경계면을 드물지 않게 관찰할 수 있다. 이 연구의 목적은 단순흉부촬영에서 이 경계면이 보이는 빈도를 관찰하고 전산화단층촬영상 어떤 구조물이 이 경계면의 원인이 되는가를 알아보고자 하였다.

대상 및 방법:상기 경계면의 관찰빈도 및 인구통계학을 구하기 위하여 정상인 300명을 대상으로 후. 전 단순흉부촬영을 얻었고 이 경계면 양성을 보인 환자에서는 고해상 전산화단층촬영을 횡격막 부위에서 얻어 경계면의 원인을 밝혀 보았다. 이 경계면을 보인 사람과 보이지 않은 사람의 인구통계학적 차이를 분석해 보았다.

결　과:우측 횡격막각 부위의 사행경계면은 단순흉부촬영상 29명(9.7%)에서 관찰되었다. 경계면 양성을 보인 29명(남자 : 13, 여자 : 16)의 나이는 19-70세(평균 ± 표준편차, 47 ± 12.7세)까지였고 경계면 음성의 나이는 16-82세(50 ± 9.1세)(p> 0.1)로 양군간 차이는 없었다. 경계면 양성을 보인 29명의 체중은 41-72kg(60 ± 8.0kg)였고 음성환자 41-85kg(63 ± 10.1 kg)(p>0.1)로 역시 양군간 차이는 없었다. 전산화단층촬영상 27명(93%)에서 이 경계면은 우중엽과 심낭막 외측 지방과의 경계면에 의해 기인했고 2명에서는 우하엽과 하대정맥의 경계면에 의해 기인했다.

결　론:우측 심횡격막각 부위의 사행경계면은 정상인 약 10%정도에서 관찰되며 주로 심낭막 외측 지방과 우중엽과의 경계면에 의해 기인하고 나이와 체중과는 무관하게 관찰된다.

호암상 수상 후보자 추천 안내

1. 시상부문 : 의학부분

2. 수상후보자의 업적 및 자격
   · 업적기준
     − 창조·탐구·봉사정신으로 국가 및 인류발전에 탁월한 업적을 남긴 자
     − 연구업적이 사회의 귀감이 되고 해당분야 및 사회적으로 평가 를 받고 있는 자
     − 공공의 이익에 현저히 공허한 자
   · 수상후보자의 자격
     − 한국인 및 한국계 인사로서 추천일 현재 생존해 있는자

3. 후보자 추천인 자격
   · 호암상위원회 위원
   · 본 위원회에서 추천인으로 위촉한 분(단체장 및 전문인사)
   · 국제적인 권위를 지닌 상의 수상자
   · 호암상 수상자 및 심사위원을 역임한 자

4. 구비서류
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