

가

:
 : barium, gastrografin iotrolan, ioxaglate,
 iopentol 5가 , 5 25
 0.5ml
 (High-resolution CT; HRCT) (n=5), 12
 (n=4), 1 (n=3), 2 (n=2), 1 (n=1) , 12
 , 1 , 2 , 1 1
 3
 1(poor), 2(moderate), 3(good) 가 , HRCT 2
 가
 가 2 가 , , ,
 : barium 45 , gastrografin 33 , iotrolan 28 ,
 ioxaglate 30 , iopentol 28 , 39 , 19 , 25 , 23 ,
 21 barium 가 . HRCT
 가 12
 , 1-2 가 1
 ,
 가 . 12 , 1-2
 , 1 ioxaglate가 가
 1 , barium 1
 : barium 가 ,
 ioxaglate가 가 .

CT
 propylidone (Dionosil; Glaxo, Greenford, UK)

가
 가

¹
² 1998 25 2.5-3 Kg (New Zealand White)

barium sulfate 120% w/v (, ; barium), diatrizoate meglumine and diatrizoate sodium (Gastrografin; Schering, Berlin; gastrografin) , nonionic dimer iotrolan 300 (Schering, Berlin; iotrolan), ionic dimer ioxaglate 320 (Mallinckrodt, St. Louis; ioxaglate), nonionic mono-mer iopentol 300 (Nycomed, Oslo; iopentol) 5가 , 5

Ketamin HCl (,) 2mg/Kg Xylazine HCl(rompun,) 0.15ml/Kg ,

0.5ml 가 가 1 X

CT Somatom Plus 40(Siemens, Erlangen, Germany) , 1mm 3mm , -700 HU 1500 HU , 35 HU 450 HU . (n=5), 12 (n=4), 1 (n=3), 2 (n=2), 1 (n=1) HRCT , 12 , 1 , 2 , 1 HRCT 1

, 10%

hematoxylin & eosin(H & E) Masson's trichrome

HRCT 가

가 (contrast quality) opacity 가 ,

(bronchial coating) opacity 가 가 .

25 , 3

1(poor), 2(moderate), 3(good)

: 가

가 . HRCT 2 가

가 . 2

가 , , , 가 , (가 ;-, 5-20% ;+, 20-50% ;++, 50% ;+++)

barium 3 가 5 3 45 , gastrografin 33 , iotrolan 28 , ioxaglate 30 , iopentol 28 barium (Fig. 1)(Table 1). barium 39 , gastrografin 19 , iotrolan 25 , ioxaglate 23 , iopentol 21 barium 가 , gastrografin 가 가 (Fig. 1)(Table 2). 1 X barium 가 , 가 , iopentol 가 가 . X HRCT

가 . HRCT

Table 1. Scores for Contrast Quality of Bronchography Using Various Contrast Media

	Barium	Gastrografin	Iotrolan	Ioxaglate	Iopentol
Observer 1	15	12	10	12	9
Observer 2	15	12	10	9	10
Observer 3	15	9	8	9	9
Sum of Scores	45	33	28	30	28

Table 2. Scores for Bronchial Coating of Bronchography Using Various Contrast Media

	Barium	Gastrografin	Iotrolan	Ioxaglate	Iopentol
Observer 1	14	6	10	9	7
Observer 2	12	6	7	7	7
Observer 3	13	7	8	7	7
Sum of Scores	39	19	25	23	21

barium 1 가 , gastrografen 12
4 2 , iotrolan 1 3 1
iopentol 12 4 1 , barium
1
. HRCT
. Barium 1
barium
가 . Gastrografen, iotrolan, ioxaglate
가 12 , 1-2
가 1 (Fig. 2). Iopentol
1 가 가 (Table
3).

가 .
HRCT
ioxaglate가 가 .
1
iotrolan
BALT(bronchial as-
sociated lymphoid tissue)
barium
(Fig. 3), 1
(Table
4).

Table 3. Effects on Lungs at High-Resolution CT

	Visible Contrast Media	Changes in Extent of Opacity			
		12 hours	1 day	2 day	1 week
Barium	1 week				
Gastrografen	12 hours (2/4)				
Iotrolan	1 day (1/3)				
Ioxaglate	immediate				
Iopentol	12 hours(1/4)				

; unchanged, ; decreased, ; increased

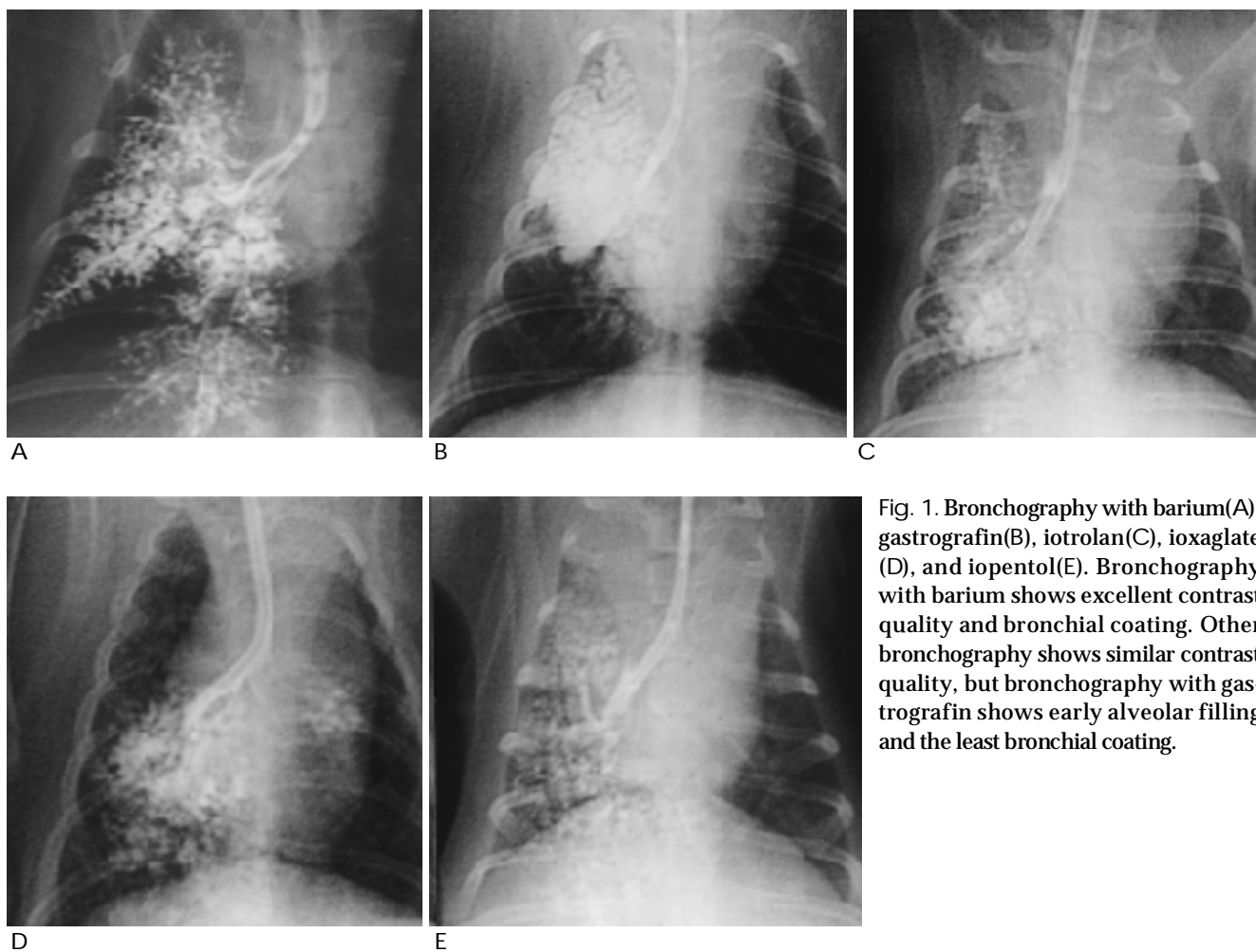


Fig. 1. Bronchography with barium(A), gastrografen(B), iotrolan(C), ioxaglate (D), and iopentol(E). Bronchography with barium shows excellent contrast quality and bronchial coating. Other bronchography shows similar contrast quality, but bronchography with gastrografen shows early alveolar filling and the least bronchial coating.

가

(5). Gastrografin 6

Gastrografin

(5,6), (surfactant)

(7).

propylidone 가

Barium 가

Nelson (1)

barium 가

, Thompson (2)

barium

가

barium

(3).

(4). iotrolan 11

Barium

barium

Non-ionic dimer iotrolan-300 (4, 8-12).

iotrolan

(8). Morcos (9) iotrolan 20

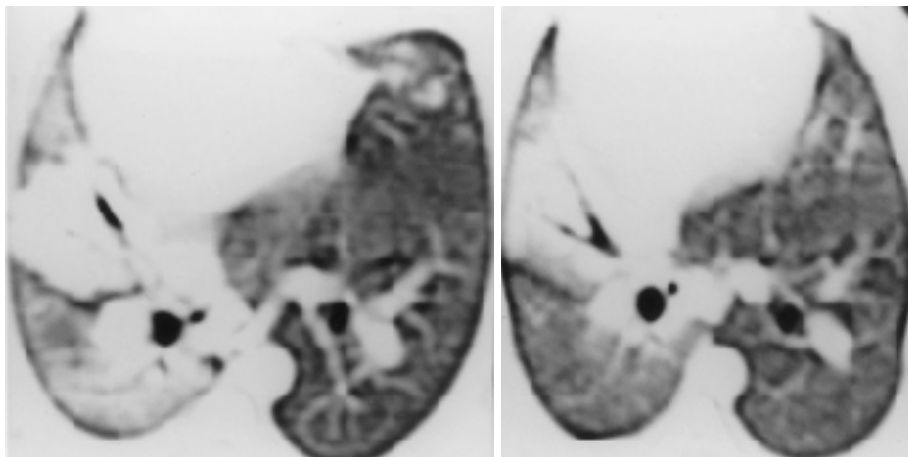
, 7

, 13

, 5 1

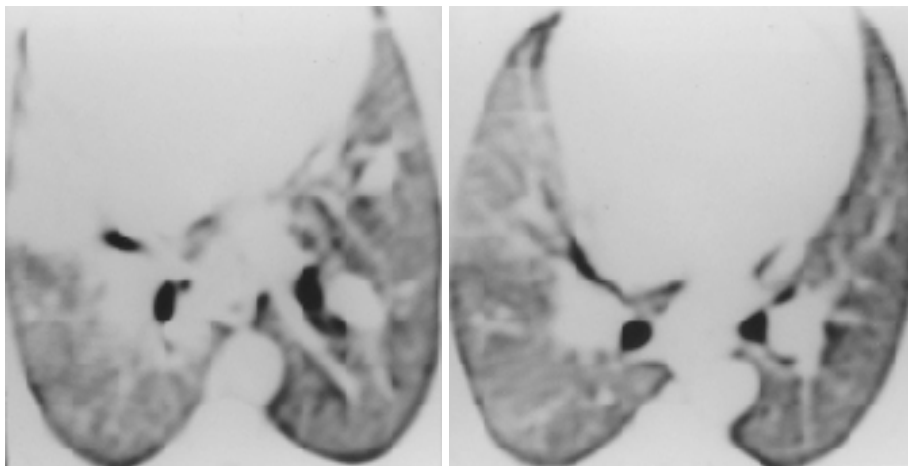
. Reibel (10) iopromide

iotrolan iopromide



A

B



C

D

Fig. 2. Sequential HRCT scans after bronchography with ioxaglate in a rabbit. Scan taken Immediately(A) after bronchography shows extensive airspace consolidation in right lung(arrows). Scans at 1(B) and 2(C) days after bronchography, consolidation is more increased in extent. But consolidation has almost been disappeared leaving diffuse ground-glass attenuation after 1 week(D).

. Ionic dimer ioxaglate . Thomsom (2) barium sulfate, io-
 2 hexol 350, propyliodone oily, propyliodone aqueous, perflubron
 Ginai (5,13) ionic dimer ioxaglate propyliodone 가
 , barium iohexol perflubron .
 , 24 1 가
 가 (4) gastrografen, , hytrast, isovist-
 300
 saline barium, hytrast, isovist-300, gastrografen
 (6). Non-ionic monomer iohexol, iopamiro, iopromide , barium 1 가
 2 . Ginai (8) iotrolan 300 iopamidol 370
 (10,14,15). Lee (14) iopamiro 300 10 iopamidol 150
 , 8 . 1 8
 X
 Deutsch (15) iohexol 22 barium gastrografen,
 ioxaglate, iotrolan iopentol ,
 , Ginai (6) barium iotrolan, ioxaglate, iopentol, gastrografen
 sulfate, micropaque, gastrografen, dionosil, hytrast, amipaque, barium 가
 hexabrix barium sulfate, micropaque, (2,4,6) barium
 dionosil, hytrast gastrografen, 1 가
 hexabrix, amipaque Gastrografen, iotrolan, ioxaglate, iopentol
 , 24 X , gastrografen

Table 4. Histopathologic Findings of the Lung on Various Contrast Media

		Acute Inflammation	Necrosis	Congestion, Edema	Hemorrhage	Interstitial Pneumonia
Barium	Immediately	+	-	++	+	-
	12 hours	+	+	+	+	+
	1 day	+	+	+	-	+
	2 days	+++	+++	++	-	+++
	1 week	+	-	+	+	++
Gastrografen	Immediately	++	-	++	+	++
	12 hours	++	-	+	+	+++
	1 day	++	-	+++	+	+
	2 days	++	-	+	-	+++
	1 week	++	+	++	+	++
Iotrolan	Immediately	+	-	+++	++	++
	12 hours	++	-	++	+	+
	1 day	+	-	+++	+++	++
	2 days	+++	+++	++	+	++
	1 week	++	-	+	+	+++
Ioxaglate	Immediately	+	-	+++	+++	+
	12 hours	+	-	+	+	+
	1 day	+++	+	++	+	++
	2 days	+++	+	+	+	++
	1 week	+	-	+	-	++
Iopentol	Immediately	+	-	++	++	++
	12 hours	++	-	+	-	+++
	1 day	++	-	+	+	+++
	2 days	+++	-	+	+	+++
	1 week	++	+++	-	+	+++

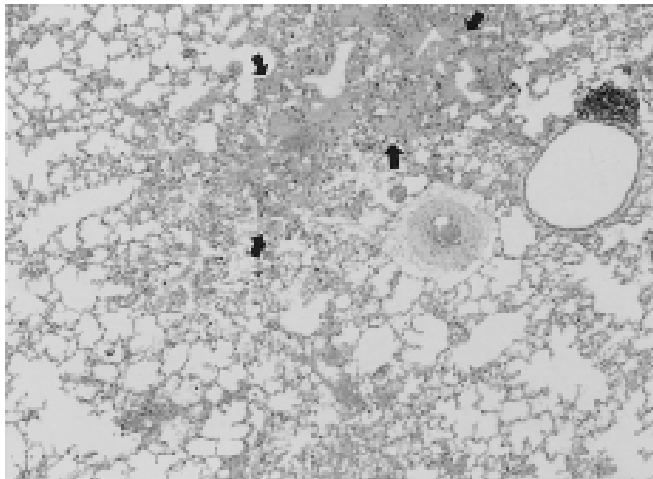
Note:

-; no significant reaction, +; mild reaction with 5-20% of area involved,

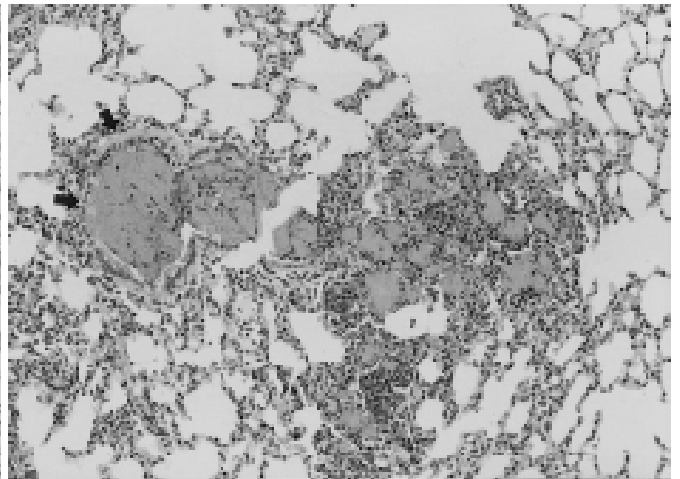
++; moderate reaction with 20-50% of area involved,

+++; severe reaction with over 50% of area involved,

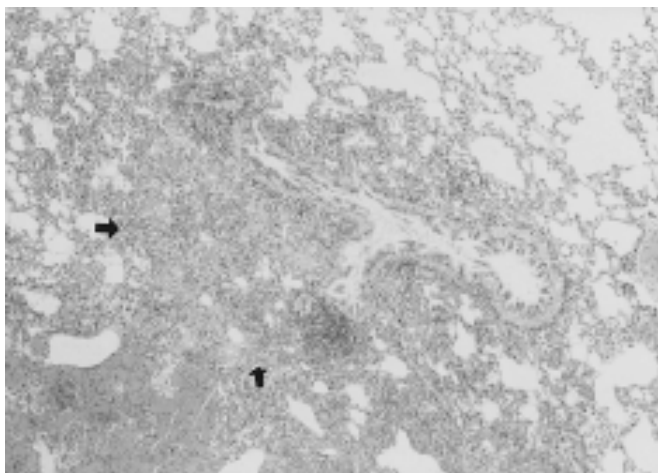
가 : 가 um , , 가 , 4 , 8 , 42 , Ginai (6) bari- 24 48



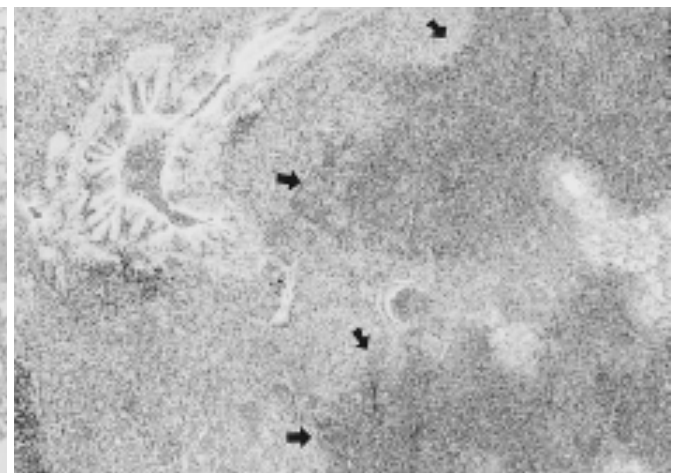
A



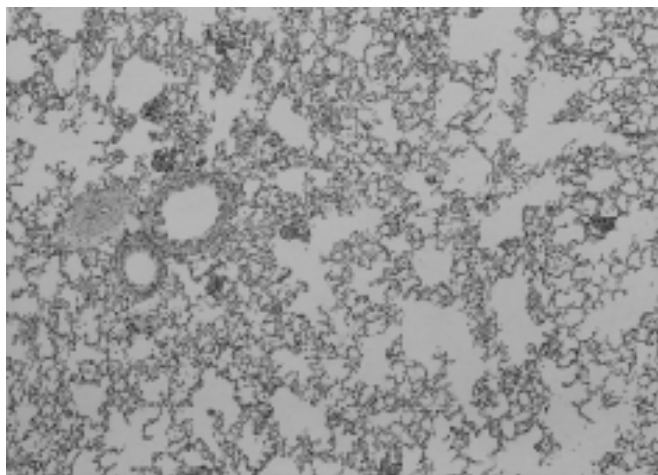
B



C



D



E

Fig. 3. Histopathologic findings after bronchography with barium.

Microscopic view(A) shows contrast media(arrows), pulmonary congestion and edema with little inflammation at specimen obtained immediately after bronchography (H&E, × 40). At specimen obtained 12 hours after bronchography(B), contrast media within airways(arrows) and peribronchial inflammation are seen (H&E, × 100). At specimen obtained 1 day after bronchography(C), inflammation has been progressed and areas of necrosis(arrows) are noted (H&E, × 40). Severe inflammation and necrosis (arrows) are seen in the specimen obtained 2 days later(D, H&E, × 40). After 1 week(E), inflammation has mostly been resolved leaving only residual inflammation, mainly in interstitium (H&E, × 40).

. Gastrografen 1-2 , 4 , 8 , 42 , Hexabrix 1 가 2-8 42 가 Thompson(2) , iohexol, propylidone, perflubron barium , iohexol , propylidone perflubron (4) gastrografen , barium , 1 . Hytrast . Isovist-300 가 , Ginai (3) iotrolan 300, iopamidol 370, iopamidol 150 iotrolan 300 가 , Ginai(6), (4) iopentol 1 , 1-2 HRCT ioxaglate 가 Ginai(6) (4) barium Ginai (6) 가 가가 가 3 가 HRCT 가 barium 가 , gastrografen, iotrolan, ioxaglate, iopentol gastrografen 가가 , barium 1 가 , ioxaglate가 가

1-2 가 , iopentol 1 HRCT , HRCT 가 가 , ioxaglate iotrolan .

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Radiologic and Histopathologic Evaluation of Various Contrast Media for Bronchography¹

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Purpose : To determine which contrast media are both efficient and safe for the imaging of airways.

Materials and Methods : We evaluated five contrast media (barium, gastrografin, iotrolan, ioxaglate, iopentol) in terms of image quality and their effects on the lungs of 25 white rabbits. For bronchography 0.5ml of contrast media was used. In each contrast group, HRCT scans were obtained immediately (n= 5), 12 hours (n= 4), 1 day (n= 3), 2 days (n= 2), and 1 week (n= 1) after bronchography. Histopathologic specimens were obtained immediately, 12 hours, 1 day, 2 days, and 1 week later. Bronchograms were evaluated for image quality by three radiologists working independently, and were scored as 1(poor), 2(moderate), or 3(good) in terms of contrast quality and bronchial coating. HRCT was evaluated by two radiologists who reached a consensus; they determined the presence of contrast media, and then the pattern and extent of pulmonary opacity, and any related changes. Histopathologic specimens were evaluated by two pathologists who sought consensus as to the extent of inflammation, pulmonary edema, and hemorrhage, and any changes in these aspects.

Results : Bronchography indicated that the sum of scores for contrast quality was 45 for barium, 33 for gastrografin, 28 for iotrolan, 30 for ioxaglate, and 28 for iopentol, while for each of these media, the sum of scores for bronchial coating was 39, 19, 25, 23, and 21, respectively. Barium showed the best image quality. In all rabbits, HRCT demonstrated the variable extent of ground-glass attenuation and/or consolidation. Lesions were most extensive at 1-2 days and then regressed at 1 week; these HRCT findings correlated well with histologic findings. In histologic studies of all five contrast media groups, variable severe inflammatory reactions were observed, with or without necrosis, congestion, edema, and hemorrhage. It was noted that ioxaglate appeared to cause least tissue reaction.

Conclusions : The imaging results of this experimental study indicate that for bronchography, barium is the best available contrast media, On the basis of the histologic and HRCT results, however, ioxaglate is the best.

Index words : Bronchography

Lung, drug effects

Contrast media

Contrast media, effects

Contrast media, experimental studies

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