Overlapping Respiratory Diseases
BE and NTM-PD

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목차

- 기관지확장증 환자에서 NTM-PD 진단하기
  - 진단 후 주의점
- NTM-PD 항생제 시작 시점 판단하기
  - 치료 후 재평가 시점에 대한 고민
- 기관지확장증 통합 장기 관리의 중요성

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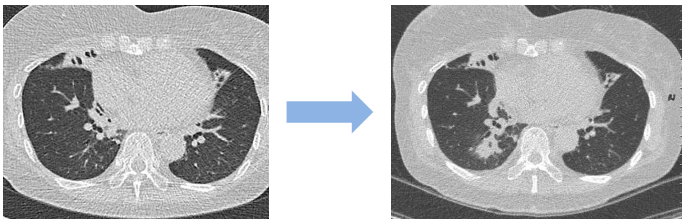
[Case] 경과 관찰 중…

- 객담 검사 결과
  - AFB smear: negative
  - AFB culture: Nontuberculous mycobacteria detected

- 환자의 증상은 변화 없음
  - 가래는 여전히 나오며 잘 뱉음
  - 호흡곤란의 정도는 비슷함

- 영상 변화



[Vote] 가장 적절한 다음 조치는?

1. 기관지내시경을 한다.
2. 객담에서 AFB smear/culture를 다시 한다.
3. 객담에서 NTM PCR 검사를 한다.
4. 결핵 치료를 시작한다.
5. MAC 폐질환으로 판단하 항생제를 시작한다.

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비결핵항산균 폐질환의 진단 기준

임상 소견 + 영상 소견 + 미생물학적 소견

TABLE 2 Clinical and microbiologic criteria for diagnosis of nontuberculous mycobacterial pulmonary disease[#]

Clinical	Pulmonary or systemic symptoms
Radiologic	Nodular or cavitary opacities on chest radiograph, or a high-resolution computed tomography scan that shows bronchiectasis with multiple small nodules
	Appropriate exclusion of other diagnoses
And **Microbiologic**[¶]	1) Positive culture results from at least two separate expectorated sputum samples. If the results are nondiagnostic, consider repeat sputum AFB smears and cultures
	or
	2) Positive culture results from at least one bronchial wash or lavage
	or
	3) Transbronchial or other lung biopsy with mycobacterial histologic features (granulomatous inflammation or AFB) and positive culture for NTM or biopsy showing mycobacterial histologic features (granulomatous inflammation or AFB) and one or more sputum or bronchial washings that are culture positive for NTM

Both clinical and radiologic criteria required

Daley CL et al., Eur Respir J 2020

Radiographic Differentiation

- Inter-observer agreement study
  - Two board-certified pulmonologists + two radiologists
  - CT scans of NTM-PD (n=66), Tbc (n=33), non-CF BE (n=33)

	Sensitivity, % (95 % CI[§])	Specificity, % (95 % CI)	PPV, % (95 % CI)	NPV, % (95 % CI)
NTM-LD	56.4 (149/264) (47.9–64.7)	80.3 (212/264) (73.1–86.0)	66.4 (149/201) (55.9–75.4)	58.2 (212/327) (48.9–67.0)
Pulmonary TB	72.0 (95/132) (60.0–81.5)	87.1 (345/396) (81.6–91.2)	52.8 (95/146) (40.1–65.0)	85.7 (345/382) (78.3–90.8)
Bronchiectasis	81.8 (108/132) (71.8–88.8)	81.6 (323/396) (75.0–86.7)	49.3 (108/181) (37.6–61.0)	89.3 (323/347) (82.6–93.7)

§ Confidence interval

PPV positive predictive value, *NPV* negative predictive value

➔ *영상 소견만으로 기관지확장증과 NTM-PD를 구분하기 어렵다.*
➔ *임상 소견은 이미 비슷하다.*
➔ *결국 미생물학적 소견이 중요하다.*

Kwak N et al., Eur Radiol 2016

미생물학적 기준

- 객담 검사
  - 최소한 2회 이상의 객담에서 배양 양성
  - **같은 균이 나와야 의미 있음 (Species identification/DST 필수!!)**

- 기관지내시경 검사
  - 기관지세척액 1회에서 배양 양성

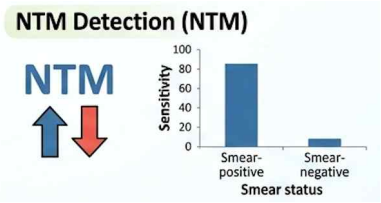
- 조직검사
  - 경기관지 폐생검 등 조직배양이 양성이거나
  - 조직검사에서 육아종(granuloma) 등 마이코박테리아 감염의 병리학적 증거가 있으면서 1회 이상 객담 또는 기관지 세척액에서 배양이 양성

Daley CL et al., Eur Respir J 2020

Role of NTM PCR?

- Prospective study
  - GENEDIA MTB/NTM Detection kit (Green Cross Science Corp., Korea)
    - Targets IS*6110* (MTB), *rpoB* (NTM)
  - Total 687 sputum samples, Jan ~ Mar 2018
  - PCR performed in culture positive samples

- Main findings regarding NTM
  - Sensitivity: 23.2%
    - Smear-positive: 85.7%
    - Smear-negative: 7.3%
  - Specificity: 99.7%
  - **Association with NTM-PD: not significant (*p* = 0.35)**



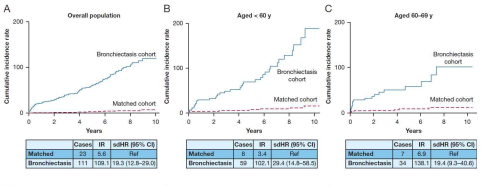
➔ *NTM-PD 진단에 있어 NTM PCR은 믿기 어렵다.*

Shin S et al. Ann Lab Med. 2020

NTM-PD is common in Bronchiectasis Patients

- National claims data, Korea
  - 1:4 matching for age and sex
    - NTM-naïve bronchiectasis (n=16,967)
    - NTM-naïve control (n=67,868)
  - Followed until development of NTM-PD or death

- NTM-PD incidence
  - ***Bronchiectasis: 109.1/100,000 person-years***
  - Controls: 5.6/100,000 person-years



	Cases	IR	sdHR (95% CI)
Matched	33	5.6	Ref
Bronchiectasis	111	109.1	19.3 (12.8–29.0)

	Cases	IR	sdHR (95% CI)
Matched	8	3.4	Ref
Bronchiectasis	59	102.1	29.4 (14.8–58.5)

	Cases	IR	sdHR (95% CI)
Matched	7	5.9	Ref
Bronchiectasis	34	138.1	19.4 (9.3–40.6)

	Cases	IR	sdHR (95% CI)
Matched	8	10.0	Ref
Bronchiectasis	18	93.0	9.0 (4.4–18.4)

	Cases	IR	sdHR (95% CI)
Matched	16	8.4	Ref
Bronchiectasis	42	89.8	10.6 (6.4–17.3)

	Cases	IR	sdHR (95% CI)
Matched	7	5.1	Ref
Bronchiectasis	69	125.5	39.3 (18.8–82.0)

Figure 1 – *Cumulative incidence rates and subdistribution hazard ratios for nontuberculous mycobacterial pulmonary disease (/100,000 person-years) in the bronchiectasis cohort and matched cohort. A, Overall population, B, aged < 60 y, C, aged 60-69 y, D, aged ≥ 70 y, E, male, and F, female. The start of the X-axis indicates the first year of follow-up after a 1-y washout period. IR = incidence rate; Ref = reference; sdHR = subdistribution hazard ratio.*

Yang B et al., Chest 2021

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Radiographic severity Worsens with NTM-PD

- Prospective cohort study (N=221)
  - South Korea, single-center
  - Patients with bronchiectasis, no NTM-PD
- Main findings
  - 14.0% of patients developed NTM-PD during median 37 months of follow-up.
  - Radiographic severity worsened after development of NTM-PD.

Table 4 Changes in CT score of 31 patients between the time of entry into the non-NTM bronchiectasis cohort and the time at the diagnosis of NTM-PD

Mean (SD)	Entry of non-NTM BE cohort	Diagnosis of NTM-PD	*P*-value
Bronchiectasis	3.3 (1.7)	4.0 (1.5)	0.010
Severity	1.5 (0.8)	1.7 (0.7)	0.035
Extent	1.3 (0.6)	1.5 (0.6)	0.059
Mucus plugging	0.6 (0.7)	0.8 (0.8)	0.033
Cellular bronchiolitis	3.5 (1.5)	4.1 (1.1)	0.005
Severity	2.0 (0.8)	2.3 (0.6)	0.007
Extent	1.5 (0.8)	1.8 (0.7)	0.039
Cavity	0.3 (1.3)	0.3 (1.3)	> 0.999
Diameter	0.1 (0.6)	0.1 (0.6)	> 0.999
Wall thickness	0.1 (0.5)	0.1 (0.5)	> 0.999
Extent	0.1 (0.3)	0.1 (0.3)	> 0.999
Nodules	0.3 (0.5)	0.5 (0.5)	0.034
Consolidation	0.2 (0.4)	0.2 (0.4)	> 0.999
Total score	7.6 (2.9)	9.1 (2.4)	0.002

NTM-PD nontuberculous mycobacterial pulmonary disease, *SD* standard devation

Kwak N et al. BMC Pulm Med 2020

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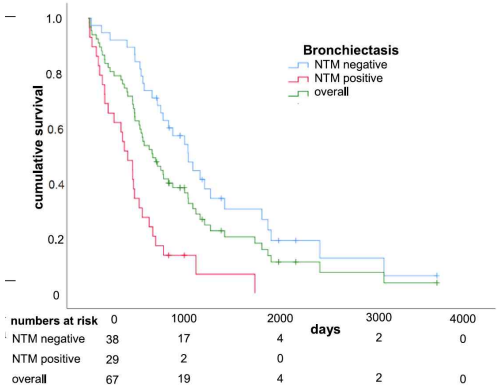
Mortality Increases after Detection of NTM in BE

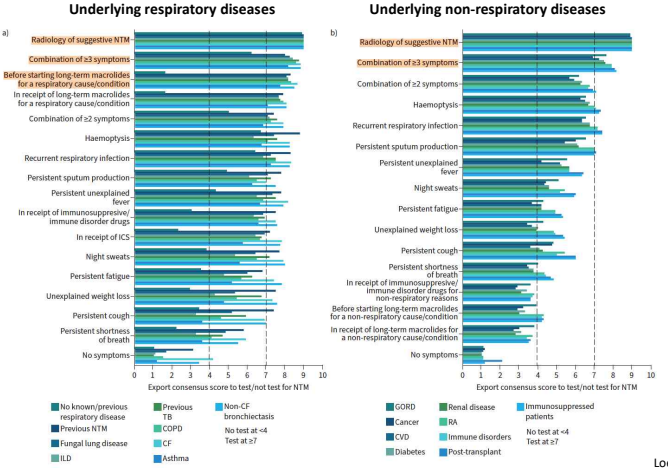
- Retrospective cohort study, Japan
  - BE newly on oxygen therapy (n = 93)
  - NTM(+) *vs.* NTM(-)
- Main findings
  - NTM positive in 35/92 (38.0%)
  - With NTM(+)…
    - Younger age, but..
    - Higher radiographic severity
    - Poor survival



Ono K et al. Resp Med. 2026

언제 NTM 검사를 하는가?

- A Delphi Consensus Study (12 NTM-PD experts from Europe)



Test for NTM when:

- **Radiologic suspicion**
- **≥3 symptoms***
- **Before starting macrolides**

* Symptoms include cough, weight loss, night sweats, hemoptysis, sputum, fatigue, recurrent respiratory infection, fever, dyspnea

Loebinger MR et al., ERJ Open Res 2024

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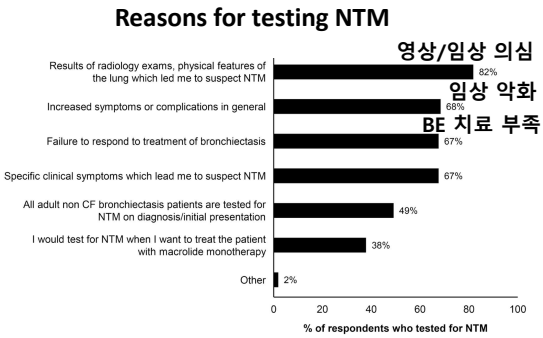
NTM Testing for BE Patients: Real World?

- Physician survey study (N = 280)
  - UK, Germany, Italy, France, Netherlands
  - Hospital-based physicians
  - Managing ≥10 patients with BE over 12 months

- Main findings
  - 51% (range 40~70%) tested for NTM
    - 17% positive for NTM
  - Only 32% tested for NTM prior to initiating macrolide monotherapy



Wagner D et al. BMJ Open Resp Res. 2020

[Case] 미생물학적 검사

순번	AFB smear	AFB culture	Species	DST
1	Negative	NTM	*avium*	Clari S
2	Negative	NTM	*abscessus*	Clari IR
3	Negative	Negative		
4	Negative	NTM	*avium*	Clari S
5	Negative	NTM	*avium*	Clari S
6	Negative	NTM	*avium*	Clari S

[Vote] 다음 중 가장 부적절한 조치는?

1. 객담 배출 교육
2. 유산소 운동에 대한 안내
3. 주변 환경 관리에 대한 조언
4. 체중 관리에 대한 강조
5. 기관지확장증에 대한 Macrolide 단독요법 유지

[Case] 미생물학적 검사

순번	AFB smear	AFB culture	Species	DST
1	Negative	NTM	*avium*	Clari S
2	Negative	NTM	*abscessus*	Clari IR
3	Negative	Negative		
4	Negative	NTM	*avium*	Clari S
5	Negative	NTM	*avium*	Clari S
6	Negative	NTM	*avium*	Clari S

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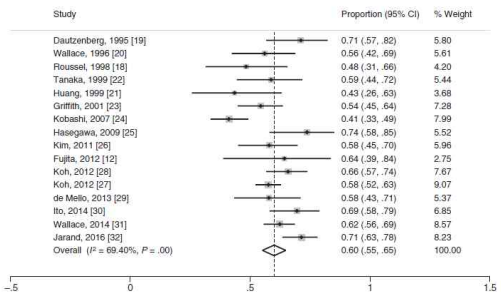
Treatment Success Rate of MAC-PD

- Systematic review and meta-analysis (16 studies)
- Treatment success defined as:
  - 12 months of sustained culture negativity while on therapy
  - Achievement of culture conversion and completion of the planned treatment without relapse
- **Pooled treatment success rate 60.0%**

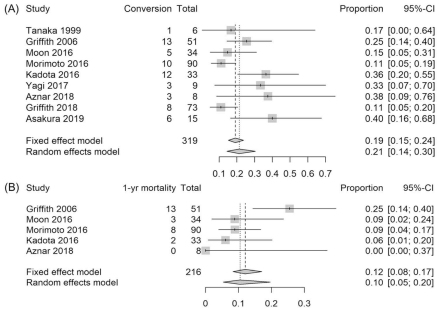


Kwak N et al., Clin Infect Dis. 2017

Macrolide Resistant MAC-PD

- Meta-analysis (9 studies, 319 patients)
  - Macrolide-resistant MAC-PD without HIV infection
  - Clinical studies including ≥5 patients

- Main findings
  - **Pooled sputum culture conversion (including surgical resection): 21%**
  - One-year all-cause mortality: 10% (range 0 to 25%)



➔ ***Macrolide 내성이 생기면 치료가 어렵고 사망률이 높다.***

Park Y et al. Respir Res. 2019

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Can Resistance to CLR Develop?

- Mice study
  - Beige mice inoculated intravenously with *M. avium* (susceptible to CLR)
  - CLR administered 6/wk *vs.* untreated control
  - Mice sacrificed with CLR for 4,8, and 16 weeks
  - Spleen examined for *M. avium* and CLR resistance

- Main findings
  - Rate of CLR resistance increased with time.
  - **All mice showed CLR resistance after eight weeks of CLR monotherapy.**

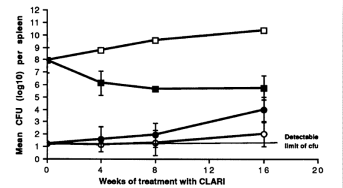

TABLE 1. CLARI-resistant mutants in spleens from untreated control mice and mice treated with 200 mg of CLARI per kg six times weekly

Wks of treatment (days after inoculation)	Proportion of spleens with mutants[a]		Frequency of mutants[b]	
	Untreated control	CLARI treated	Untreated control	CLARI treated
4 (42)	3/5	4/8	$<10^{-(7.60 \pm 0.60)}$	$<10^{-(4.52 \pm 0.92)}$
8 (70)	4/7	8/8	$<10^{-(8.23 \pm 0.55)}$	$10^{-(3.74 \pm 0.57)c}$
16 (126)	5/6	7/7	$<10^{-(8.35 \pm 0.78)}$	$10^{-(1.77 \pm 0.33)c}$

[a] Number of spleens with CLARI-resistant mutants/total number of spleens examined.
[b] Means ± standard deviations.
[c] Significantly greater than corresponding value for untreated control mice ($P < 0.001$).

Ji B et al. Antimicrob Agents Chemother. 1992

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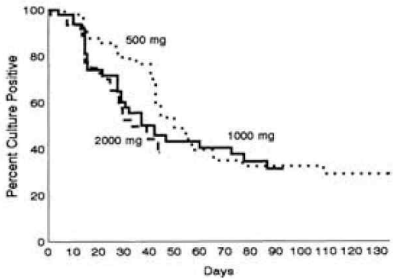
Acquisition of CLR Resistance in Humans

- Randomized double-blind dose-ranging study (N=154)

- PICO
  - Patients: HIV infection with MAC bacteremia
  - Intervention & Comparators: CLR with different dosages
  - Outcomes: CFU in blood

- Main findings
  - CLR decreased CFU of MAC in blood.
  - **CLR resistant isolates of MAC developed in 46% of patients at median of 16 weeks.**



➔ *Macrolide 내성을 막기 위한 노력이 필요하다.*

Chaisson RE et al. Ann Intern Med. 1994

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Prevention of Clarithromycin Resistance in MAC

- Mice study
  - *M. avium* infected intravenously to beige mice
  - Experimental groups
    - Untreated controls
    - CLR only
    - CLR + EMB

Table 3. Comparison of the therapeutic efficacies of clarithromycin, clarithromycin plus ethambutol, and no treatment (controls).

Treatment	Dose (mg/kg/day)	Week of treatment 0	8	12
Clarithromycin	200	—	$3 \pm 0.4 \times 10^{3}$*	$6 \pm 0.7 \times 10^{6}$*
Clarithromycin + ethambutol	200 + 100	—	$1.4 \pm 0.3 \times 10^{3}$*†	$5 \pm 0.4 \times 10^{6}$*†
Untreated control	None	—	$9.8 \pm 0.3 \times 10^{8}$	$1.8 \pm 0.2 \times 10^{9}$
1-week control	None	$1.8 \pm 0.1 \times 10^{7}$	—	—

NOTE. Data are cfu of MAC/g of spleen ± SE.
* $P < .05$ vs. untreated control at 8 or 12 weeks.
† $P < .05$ vs. clarithromycin alone.

Similar therapeutic effectiveness

- Main findings
  - Addition of EMB to CLR did not improve therapeutic effectiveness.
  - **Addition of EMB to CLR decreased frequency of CLR resistance.**

Lower rate of CLR resistance

Table 4. Frequency of clarithromycin-resistant MAC isolated from the spleens of mice infected with MAC 101 and untreated or treated with clarithromycin or clarithromycin plus ethambutol.

Treatment	Week of treatment 0	8	12
None	$10^{-6.9}$	$10^{-6.8}$	$10^{-5.2}$
Clarithromycin	$10^{-6.9}$	10^{-3}	$10^{-2.2}$
Clarithromycin + ethambutol	$10^{-6.9}$	$10^{-4.1}$*	$10^{-3.3}$*

NOTE. Frequency of resistance is ratio of cfu of MAC/g of spleen when grown on Middlebrook 7H11 agar alone to growth on agar with 32 μg/mL clarithromycin.
* $P < .05$ vs. clarithromycin alone.

Bermudez LE et al. J Infect Dis. 1996

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[Case] Decided to Watchfully Wait…

- 증상은 가래만 조금 있는 편
- BMI 19.2kg/m^2
- ESR 10mm/h
- 도말 음성
- CT 상에서 공동 없이 기관지확장증과 결절만 관찰됨

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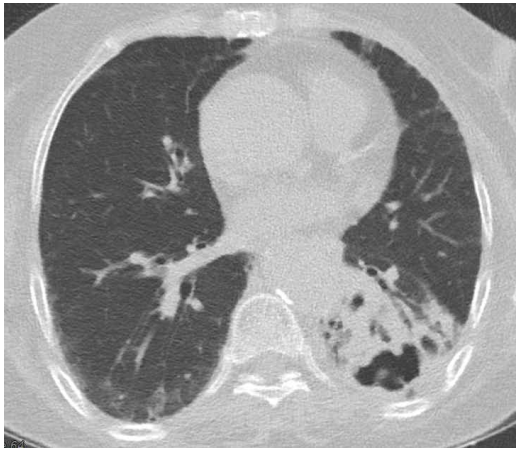
[Case] 경과 관찰 중 변화

- 객담 증상 악화
- BMI 19.2 → 16.5kg/m^2
- ESR 10 → 30mm/h
- 도말 음성
- CT 상 공동 발생



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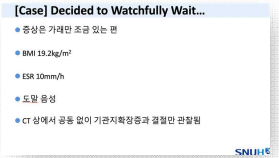
[Vote] 다음 조치는?

1. *M. avium* 폐질환에 대한 항생제를 시작한다.
2. *M. abscessus* 폐질환에 대한 항생제를 시작한다.
3. Macrolide 단독요법을 다시 시작한다.
4. 약물치료 없이 호흡운동 치료만을 강화한다.
5. 기관지내시경을 통한 객담 제거 (toileting) 를 시행한다.



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Watchful Waiting is OK

- Single-center registry study, South Korea (N=712)
  - MAC, M. *abscessus*-PD, treated >6 months
  - Analyzed association between waiting duration and treatment outcomes

TABLE 2] Effect of Watchful Waiting Period on 6-Months or 12-Months Culture Conversion in Patients With NTM-PD

Patient Group	Treatment for ≥ 6 mo (n = 712)[a]	Treatment for ≥ 12 mo (n = 676)[a]
Culture conversion	Within 6 mo (n = 479)	Within 12 mo (n = 516)
HR of watchful waiting period for 6- or 12-mo conversion		
Crude HR (95% CI, *P*)	1.00 (1.00–1.00, .412)[b]	1.00 (1.00–1.00, .746)[c]
Model 1, adjusted HR (95% CI, *P*)	1.00 (0.99–1.00, .242)[b]	0.99 (0.99–1.00, .512)[c]
Model 2, adjusted HR (95% CI, *P*)	1.00 (0.99–1.01, .075)[b]	0.99 (0.99–1.00, .213)[c]
Model 3, adjusted HR (95% CI, *P*)	0.99 (0.99–1.00, .074)[b]	0.99 (0.99–1.00, .211)[c]

AFB = acid-fast bacilli; BACES = BMI, age, cavity, erythrocyte sedimentation rate, and sex; HR = hazard ratio; NTM-PD = nontuberculous mycobacterial pulmonary disease.
Model 1: adjusted for smoking, underlying disease, positive sputum AFB smear, BACES severity, etiology, and watchful waiting period.
Model 2: adjusted for BMI (< 18.5), age (≥ 65 years), cavity, erythrocyte sedimentation rate (> 15 mm/h in male and > 20 mm/h in female), and sex (male) instead of BACES in Model 1.
Model 3: adjusted for radiological form (noncavitary nodular bronchiectatic vs cavitary nodular bronchiectatic vs fibrocavitary) instead of cavity in Model 2. Underlying disease included previous pulmonary TB, obstructive pulmonary disease/asthma, chronic pulmonary aspergillosis, pulmonary malignancy, idiopathic pulmonary fibrosis, extrapulmonary malignancy, diabetes mellitus, chronic heart disease, and chronic liver disease.
[a]These data analyzed patients treated for more than 6 months and 12 months, respectively. An event was defined as a culture conversion within [b] months or [c] months after starting treatment, respectively. Multivariable analysis results other than "watchful waiting period" in each model are described in

→ *기다리는 시간과 균 음전은 관련이 없었다.*

Im Y et al. Chest 2022

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Whom should we Treat?

- Poor prognosis
  - Cavitary lung disease
  - Low body mass index
  - Elevated inflammatory markers
- Organisms which are more virulent and/or more responsive to antimicrobial therapy (ex: *M. kansasii*)
- Underlying immune suppression
- Major symptoms

Daley CL et al., Eur Respir J 2020

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Need for Uniform Index - The BACES Score

- 5-integer scoring system to predict all-cause mortality
  - **B**ody mass index, **A**ge, **C**avity, **E**rythrocyte sedimentation rate, male **S**ex
- Also associated with progression-free survival, spontaneous culture conversion, lung function decline, patient symptoms, and nutritional status

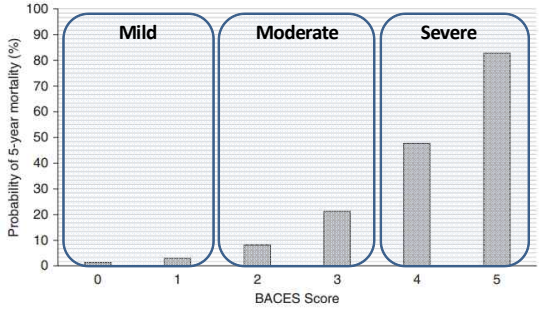

Table 4. BACES score for predicting mortality in nontuberculous mycobacterial pulmonary disease

Variable	Detail	Score
Body mass index	<18.5 kg/m^2	1
Age	≥65 years	1
Cavity	Detected on chest computed tomography	1
Elevated erythrocyte sedimentation rate	Male >15 mm/h, female >20 mm/h	1
Sex	Male	1

BACES, body mass index, age, cavity, elevated erythrocyte sedimentation rate, male sex.

Kim HJ and Kwak N et al., Am J Respir Crit Care Med 2021
Kim HJ et al., Sci Rep 2023
Kim BG et al. J Clin Med 2023
Park HJ et al. Int J Tuberc Lung Dis 2023
Park Y et al. Sci Rep 2025
Par Y et al. Resp Res 2026

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Shared Decision-Making is Needed

- 다양한 질병 경과 및 표현형을 고려하여, 의사-환자 간의 충분한 논의가 중요
  - 비결핵항산균 폐질환은 진단 후에도 50% 가량은 안정적인 경과를 보이고 그 중 50%는 저절로 호전되기도 한다.
  - 치료 여부는 환자의 중증도, 증상, 기저질환 등을 고려하여 결정한다.

Host factors	Disease severity	Disease progression	Clinical relevance
Age Increasing risk of intolerance and adverse events **Comorbidities** **Drug intolerances** Consider dose reduction or thrice-weekly regimens Consider interactions with other drugs, *e.g.* azoles **Patient wishes** **Aim of treatment** Aiming for cure or disease control?	**Radiological** Fibrocavitary disease **Clinical** Weight loss, fever, haemoptysis, respiratory failure Biochemical markers **Microbiological** Smear positivity	**Radiological** Development of cavitation or fibrosis, increasing nodules or tree-in-bud changes **Clinical** Worsening symptoms, development of new symptoms, weight loss **Microbiological** Development of new or increasing smear positivity	**NTM species** Some species more pathogenic than others **Immunosuppression** Primary immunodeficiency HIV infection Immunosuppresive therapy Anti-TNF-α therapy Corticosteroids **Lung transplantation** Need for *M. abscessus* eradication

Cowman S et al., Eur Respir J 2019

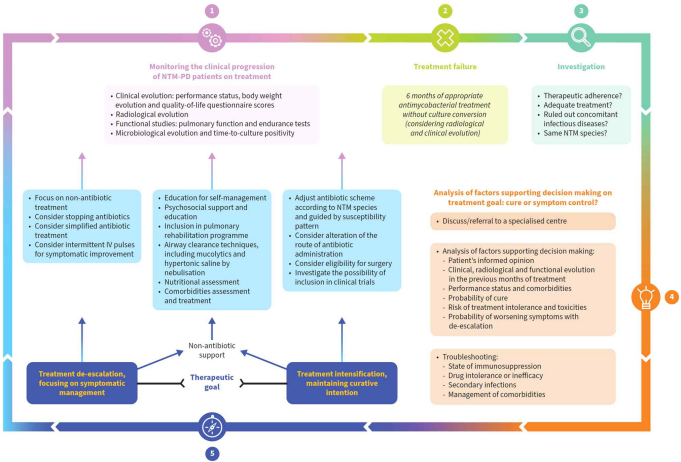
[Vote] 항생제 치료 6개월이 지났는데 여전히 균 배양 양성

- 가장 부적절한 조치는?

1. 약물 부작용이 걱정되므로 현재의 치료를 유지하면서 경과를 본다.
2. 약물을 추가한다 (ex: clofazimine, amikacin, etc).
3. 수술적 절제를 고려한다.
4. 환자의 약물 순응도에 대한 평가를 한다.
5. 영양 상담, 객담 배출, 주변 환경 관리 등 비약물적 치료를 점검한다.

Treatment-Refractory NTM-PD

- 적절한 약물 치료에도 불구, ***6개월*** 이내 균 음전 실패한 경우
- 균 음전 실패에 대한 충분한 고찰이 필요
  - 약물 순응도
  - 약물 조합 평가
  - 동반 감염증 평가
  - NTM species / 약제 감수성 재평가



Moreira-Sousa D et al. Eur Respir J. 2026

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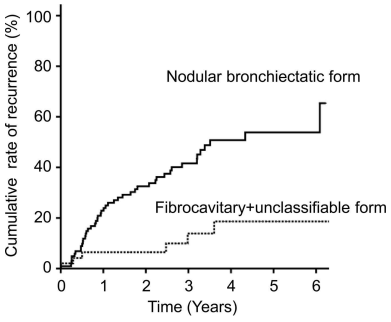
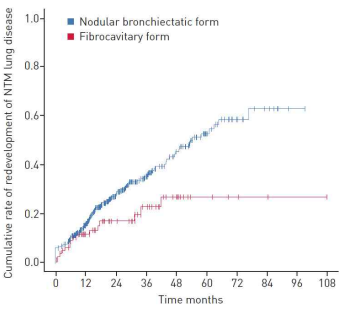
[Case] 완치 후 경과

- 호전되었던 기침과 가래가 다시 악화
- 객담에서 균이 음전되었다가 다시 *M. avium*이 배양

Redevelopment of MAC-PD

- NB type > FC type
- Reinfection > Relapse





Lee BY et al. Antimicrob Agents Chemother. 2015
Koh WJ et al. Eur Respir J. 2017

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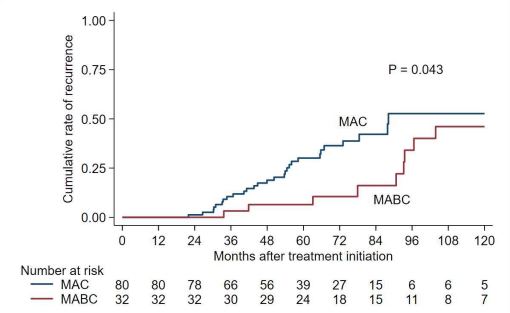
Host Factors Remain, NTM Comes Back



- 125 patients (90 MAC + 35 *M. abscessus*), antibiotics + surgery
  - Previous TB 46%
  - Nodular BE form 66%
- 112 microbiological cure (80 MAC + 32 M. abscessus)
- Recurrence in 37/112 (33%)
  - 18/37 (49%) were by different species

➔ *치료 이후에도 숙주 요인에 대한 끊임없는 고민과 관리가 필요하다.*

Kang N and Jhun BW, Open Forum Infect Dis. 2024

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NTM-PD can Aggravate Bronchiectasis

- South Korea, single center retrospective study (n=96)
- Suspected NTM-PD without initial bronchiectasis/cavity
  - NTM-PD in 43 patients: more bronchiectasis and cavity during follow-up (vs. controls)

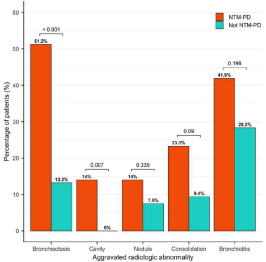


Fig. 3 Percentage of patients with aggravated radiological abnormality

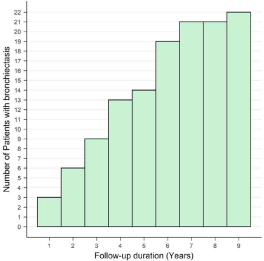
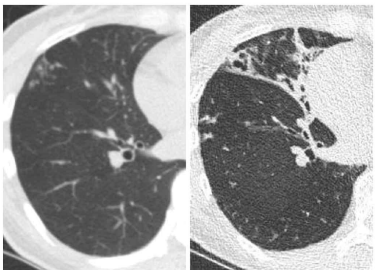


Fig. 4 Cumulative incidence of bronchiectasis in patients with NTM-PD. NTM-PD, nontuberculous mycobacterial pulmonary disease



➔ ***NTM-PD가 거꾸로 기관지확장증을 유발할 수 있다.***

➔ ***다시 기관지확장증에서 NTM-PD로 가는 악순환을 유발할 수 있다.***

Yoon SH et al. BMC Pulm Med 2024

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Bronchiectasis and NTM

- Although NTM-PD can be cured, bronchiectasis is a permanent condition.

- Patients with NTM-PD will require life-long attention to their bronchiectasis, whether or not their NTM infection has been cured.

McShane PJ. Clin Chest Med. 2023

Comprehensive Approach to Airway Clearance

1. Allow the patient to try available techniques
2. Trial of muco-active agent to hydrate the airway and aid in sputum clearance.
3. Add devices (ex: OPEP) to further alter sputum properties and enhance clearance.
4. If available, refer to a respiratory therapist for one-on-one coaching.
5. Increase airway clearance during exacerbations.

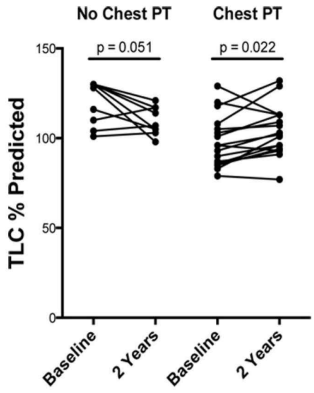
McShane PJ. Clin Chest Med. 2023

Airway Clearance Techniques in NTM-PD

- Retrospective review of patients with NTM-PD (n = 77)
- OPEP or HFCWO (VEST) vs. Control
- ACT was associated with improvement of:
  - Cough
  - Sputum production
  - Total lung capacity

OPEP

HFCWO



Basavaraj A, et al. Int J Respir Pulm Med 2017

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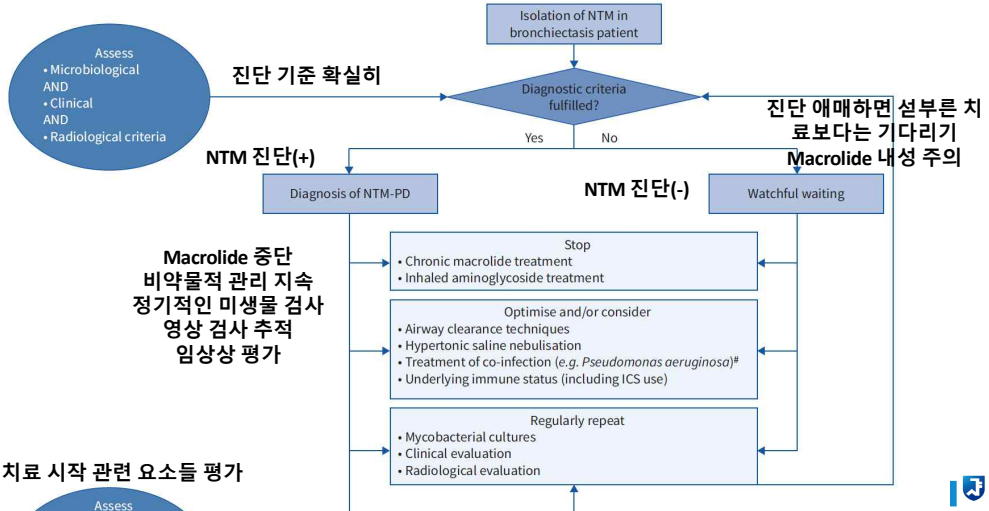
Decision Tree for Management of NTM in Bronchiectasis



총정리

- 기관지확장증 환자에서 NTM-PD가 발병할 가능성이 높으며, 발병 후 임상상의 악화를 보인다.
- 진단을 위해 균 배양검사를 수행하며, 배양된 뒤에 종(species) 구분, 항생제 감수성 검사를 반드시 시행해야 한다.
- NTM-PD가 진단된 경우 Macrolide 약물 내성 발생에 주의하여야 한다.
- 환자의 중증도, 기저 면역 상태, 균의 종(species), 항생제 부작용의 정도, 환자의 치료 의향 등을 종합적으로 고려하여 약물 치료를 시작한다.
- NTM-PD가 거꾸로 기관지확장증을 악화시킬 수 있으며, NTM이 완치되더라도 기저 기관지확장증은 남아 있다. 따라서 기관지확장증에 대한 비약물적 관리는 유지해야 한다.

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