

Online Supplement

Original Research

Low Incidence of High Frequency Chest Wall Oscillation in Bronchiectasis Registry Data Despite Indications and Reimbursement

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Supplement 1: Clinical characteristics of bronchiectasis patients with and without HFCWO therapy among patients enrolled in the U.S. Bronchiectasis and NTM Research Registry (Aim 1)

	Overall (n=5,673)	non-HFCWO therapy (n=5,155)	HFCWO therapy (n=518)	p-value*
Demographics				
Age, median [IQR]	5,634	69 [61-76]	69 [61-76]	68 [58-75]
Female, n (%)	5,663	4,510 (79.6)	4,086 (79.4)	424 (82.0)
Race and ethnicity, n (%)	5,275			
non-Hispanic White		4,591 (87.0)	4,153 (87.0)	438 (87.1)
non-Hispanic Black		156 (3.0)	138 (2.9)	18 (3.6)
Hispanic		175 (3.3)	162 (3.4)	13 (2.6)
Asian		231 (4.4)	204 (4.3)	27 (5.4)
Other		122 (2.3)	115 (2.4)	7 (1.4)
Co-existing conditions				
Asthma, n (%) <i>available n = 5,626</i>	1,457 (25.9)	1,293 (25.3)	164 (31.7)	0.002
COPD, n (%) <i>available n=5,625</i>	922 (16.4)	834 (16.3)	88 (17.0)	0.700
Meets ROSE criteria, n (%)	297 (5.2)	261 (5.1)	36 (6.9)	0.066
GERD, n (%) <i>available n=5,646</i>	2,399 (42.5)	2,148 (41.9)	251 (48.5)	0.004
PCD, n (%) <i>available n=5,634</i>	136 (2.4)	106 (2.1)	30 (5.8)	<0.001
Rheumatologic disease, n (%) <i>available n=5,615</i>	472 (8.4)	425 (8.3)	47 (9.1)	0.566
ABPA, n (%) <i>available n=4,183</i>	79 (1.9)	62 (1.7)	17 (3.3)	0.013
NTM [†] , n (%) <i>available n=4,515</i>	732 (16.2)	628 (15.7)	104 (20.1)	0.011
Clinical Characteristics				
BMI, median [IQR] <i>available n=5,208</i>	22.1 [19.8-25.2]	22.2 [19.8-25.2]	21.5 [19.5-24.7]	0.016
Pre-bronchodilator spirometry, mean (±SD)				
FVC (L) <i>available n=4,718</i>	2.7 (0.9)	2.7 (0.9)	2.6 (0.9)	0.004
FVC %predicted <i>available n=4,721</i>	84.0 (20.3)	84.2 (20.1)	81.7 (21.6)	0.016
FEV1 (L) <i>available n=4,749</i>	1.9 (0.7)	1.9 (0.7)	1.8 (0.7)	<0.001
FEV1 %predicted <i>available n=4,736</i>	74.7 (22.4)	75.2 (22.2)	69.5 (24.1)	<0.001
≥1 exacerbation in the 2 years prior to enrollment, n (%) <i>available n=5,526</i>	3,097 (56.0)	2,753 (54.9)	344 (67.5)	<0.001
Treated for acute exacerbations, n (%) <i>available n=1,614</i>	1,260 (78.1)	982 (77.1)	278 (81.5)	0.082
≥1 pulmonary related hospitalization in the 2 years prior to enrollment, n (%) <i>available n=5,566</i>	1,066 (19.2)	928 (18.4)	138 (27.0)	<0.001
mBSI score, median [IQR] <i>available n=3,079</i>	7 [4-10]	7 [4-10]	8 [5-11]	<0.001

	Overall (n=5,673)	non-HFCWO therapy (n=5,155)	HFCWO therapy (n=518)	p-value*
Demographics				
Age, median [IQR]	5,634	69 [61-76]	69 [61-76]	68 [58-75]
Female, n (%)	5,663	4,510 (79.6)	4,086 (79.4)	424 (82.0)
Race and ethnicity, n (%)	5,275			
non-Hispanic White		4,591 (87.0)	4,153 (87.0)	438 (87.1)
non-Hispanic Black		156 (3.0)	138 (2.9)	18 (3.6)
Hispanic		175 (3.3)	162 (3.4)	13 (2.6)
Asian		231 (4.4)	204 (4.3)	27 (5.4)
Other		122 (2.3)	115 (2.4)	7 (1.4)
Microbiology (≥1 positive culture)				
<i>Haemophilus influenzae</i> , n (%) available n=5,037	322 (6.4)	294 (6.5)	28 (5.6)	0.432
<i>Staphylococcus aureus</i> , n (%) available n=5,037	444 (8.8)	388 (8.6)	56 (11.2)	0.051
<i>Pseudomonas aeruginosa</i> , n (%) available n=5,037	1,171 (23.2)	998 (22.0)	173 (34.5)	<0.001
Respiratory Symptoms				
Dyspnea, n (%) available n =5,662	2,351 (41.5)	1,979 (38.5)	372 (72.1)	<0.001
Fatigue, n (%) available n=5,561	2,678 (48.2)	2,365 (46.8)	313 (61.5)	<0.001
Cough, n (%) available n=5,637	4,392 (77.9)	3,924 (76.6)	468 (90.9)	<0.001
Sputum volume, n (%) available n=1,169	718 (61.4)	604 (65.6)	114 (46.0)	
<15mL	289 (24.7)	210 (22.8)	79 (31.9)	
15-45 mL	162 (13.9)	107 (11.6)	55 (22.2)	
>45 mL	718 (61.4)	604 (65.6)	114 (46.0)	
Hemoptysis, n (%) available n=,5598	1,147 (20.5)	1,008 (19.8)	139 (27.1)	<0.001
Treatment and Therapies				
Received antibiotics for chronic suppression, n (%) available n=3,206	479 (14.9)	331 (12.3)	148 (29.0)	<0.001
Inhaled bronchodilator, n (%) available n=3,330	2,303 (69.2)	1,854 (65.9)	449 (87.0)	<0.001
Hypertonic saline, n (%) available n=4,051	2,465 (60.8)	2,027 (57.3)	438 (85.0)	<0.001
Inhaled corticosteroids, n (%) available n=5,656	1,898 (33.6)	1,688 (32.9)	210 (40.5)	<0.001
Oral corticosteroids, n (%) available n=5,651	955 (16.9)	806 (15.7)	149 (28.8)	<0.001

Abbreviations: ABPA=Allergic Bronchopulmonary Aspergillosis, BMI=body mass index, COPD=chronic obstructive pulmonary disease, FEV1=forced expiratory volume in 1 second, FVC=forced vital capacity, GERD=gastroesophageal reflux disease, HFCWO=high-frequency chest wall oscillation, IQR=interquartile range, mBSI=modified Bronchiectasis Severity Index, NTM=nontuberculous mycobacteria, PCD=primary ciliary dyskinesia, SD=standard deviation

*Wilcoxon-Mann-Whitney test, independent two-sample t-test, chi-square test

†Defined as those meeting ATS/IDSA/ESCMID/ERS guideline criteria for culture positivity and actively being treated

Supplement 2: Demographics and clinical characteristics of bronchiectasis patients without HFCWO therapy among patients enrolled in the U.S. Bronchiectasis and NTM Research Registry, stratified by those who do and do not meet selected CMS symptom/exacerbation criteria† for HFCWO therapy (Aim 2)

	Overall (n=4,679)	Does not meet criteria (n=1,976)	Meets criteria (n=2,703)	p-value*
Demographics				
Age, median [IQR] available n=4,653	69.0 [61.0-76.0]	70.0 [62.0-77.0]	69.0 [60.0-76.0]	<0.001
Female, n (%) available n=4,672	3,700 (79.2)	1,622 (82.1)	2,078 (77.1)	<0.001
Race and ethnicity, n (%) available n=4,340				0.556
non-Hispanic White	3,782 (87.1)	1,586 (87.1)	2,196 (87.1)	
non-Hispanic Black	133 (3.1)	51 (2.8)	82 (3.3)	
Hispanic	150 (3.5)	64 (3.5)	86 (3.4)	
Asian	186 (4.3)	86 (4.7)	100 (4.0)	
Other	89 (2.1)	33 (1.8)	56 (2.2)	
Co-existing conditions				
Asthma, n (%) available n = 4,641	1,169 (25.2)	416 (21.3)	753 (28.0)	<0.001
COPD, n (%) available n=4,644	758 (16.3)	264 (13.5)	494 (18.4)	<0.001
Meets ROSE criteria, n (%)	242 (5.2)	54 (2.7)	188 (7.0)	<0.001
GERD, n (%) available n=4,659	1,954 (41.9)	792 (40.2)	1,162 (43.2)	0.045
PCD, n (%) available n=4,646	74 (1.6)	10 (0.5)	64 (2.4)	<0.001
Rheumatologic disease, n (%) available n=4,633	393 (8.5)	189 (9.7)	204 (7.6)	0.011
ABPA, n (%) available n=3,365	60 (1.8)	17 (1.2)	43 (2.2)	0.030
NTM‡, n (%) available n=3,666	580 (15.8)	245 (15.7)	335 (15.9)	0.891
Clinical Characteristics				
BMI, median [IQR] available n=4,283	22.1 [19.8-25.2]	22.1 [19.8-25.1]	22.2 [19.7-25.3]	0.740
Pre-bronchodilator spirometry, mean (±SD)				
FVC (L) available n=3,880	2.7 (0.9)	2.8 (0.8)	2.7 (0.9)	0.041
FVC %predicted available n=3,887	84.5 (20.2)	86.5 (19.2)	83.2 (20.7)	<0.001
FEV1 (L) available n=3,907	1.9 (0.7)	1.9 (0.7)	1.9 (0.7)	<0.001
FEV1 %predicted available n=3,901	75.5 (22.1)	78.7 (20.7)	73.5 (22.8)	<0.001
Annualized exacerbation rate	0.7	0.3	0.9	<0.001
Treated for acute exacerbations, n (%) available n=2,574	996 (38.7)	292 (27.1)	704 (47.1)	<0.001
≥1 pulmonary related hospitalization in the 2 years prior to enrollment, n (%) available n=4,648	822 (17.7)	253 (12.9)	569 (21.2)	<0.001
mBSI score, median [IQR] available n=2,548	7.0 [4.0-9.5]	6.0 [4.0-8.0]	7.0 [5.0-10.0]	<0.001
Microbiology (≥1 positive culture)				
<i>Haemophilus influenzae</i> , n (%)	270 (6.6)	90 (5.6)	180 (7.2)	0.042

	Overall (n=4,679)	Does not meet criteria (n=1,976)	Meets criteria (n=2,703)	p-value*
available n=4,110				
<i>Staphylococcus aureus</i> , n (%) available n=4,110	343 (8.3)	105 (6.5)	238 (9.5)	<0.001
<i>Pseudomonas aeruginosa</i> , n (%) available n=4,110	886 (21.6)	212 (13.2)	674 (27.0)	<0.001
Respiratory Symptoms				
Dyspnea, n (%) available n=4,679	1,853 (39.6)	618 (31.3)	1,235 (45.7)	<0.001
Cough, n (%) available n=4,673	3,537 (75.7)	911 (46.1)	2,626 (97.3)	<0.001
Fatigue, n (%) available n=4,616	2,151 (46.6)	754 (38.7)	1,397 (52.4)	<0.001
Hemoptysis, n (%) available n=4,635	916 (19.8)	259 (13.3)	657 (24.5)	<0.001
Treatment and Therapies				
Received antibiotics for chronic suppression, n (%) available n=2,574	319 (12.4)	81 (7.5)	238 (15.9)	<0.001
Inhaled bronchodilator, n (%) available n=2,660	1,753 (65.9)	622 (56.5)	1,131 (72.5)	<0.001
Hypertonic saline, n (%) available n=3,262	1,861 (57.1)	598 (45.8)	1,263 (64.6)	<0.001
Inhaled corticosteroids, n (%) available n=4,672	1,486 (31.8)	503 (25.5)	983 (36.4)	<0.001
Oral corticosteroids, n (%) available n=4,668	739 (15.8)	221 (11.2)	518 (19.2)	<0.001
Received HFCWO at follow-up [¶] , n (%) available n=1,709	220 (12.9)	71 (11.0)	149 (14.0)	0.073

Abbreviations: ABPA = Allergic Bronchopulmonary Aspergillosis, BMI = body mass index, CMS = Centers for Medicare & Medicaid Services, COPD = chronic obstructive pulmonary disease, FEV1 = forced expiratory volume in 1 second, FVC = forced vital capacity, GERD = gastroesophageal reflux disease, HFCWO = high-frequency chest wall oscillation, IQR = interquartile range, mBSI = modified Bronchiectasis Severity Index, NTM = nontuberculous mycobacteria, PCD = primary ciliary dyskinesia, ROSE = radiology, obstruction, symptoms, and exposure, SD = standard deviation

*Wilcoxon-Mann-Whitney test, independent two-sample t-test, chi-square test

†Defined as those with a usually productive cough during the 2 years prior to enrollment and >2 exacerbations per year

‡Defined as those meeting ATS/IDSA/ESCMID/ERS guideline criteria for culture positivity and actively being treated

¶Defined as ≥1 follow-up visit in a 3 year period

Supplement 3: Clinical characteristics of patients with and without incident HFCWO therapy within the first 3 annual follow-up visits among patients with no HFCWO therapy at baseline (Aim 3)

		Overall	non-HFCWO	Incident HFCWO	p-value
	N	1,709	1,489	220	
Annual follow-up years since baseline, mean (SD)	1,709	1.4 (0.7)	1.3 (0.6)	1.6 (0.8)	<0.001
Meets selected CMS criteria, n (%)	1,709	1,064 (62.3)	915 (61.5)	149 (67.7)	0.073
Baseline Demographics					
Age, median [IQR]	1,702	69.0 [62.0-76.0]	69.0 [62.0-76.0]	68.0 [62.0-76.0]	0.674
Female, n (%)	1,706	1421 (83.3)	1241 (83.5)	180 (81.8)	0.529
Baseline Microbiology (≥1 positive culture)					
<i>Haemophilus influenzae</i> , n (%)	1,592	105 (6.6)	91 (6.6)	14 (6.7)	0.949
<i>Staphylococcus aureus</i> , n (%)	1,592	129 (8.1)	110 (8.0)	19 (9.1)	0.574
<i>Pseudomonas aeruginosa</i> , n (%)	1,592	366 (23.0)	304 (22.0)	62 (29.7)	0.014
Baseline Respiratory Symptoms					
Dyspnea, n (%)	1,709	737 (43.1)	626 (42.0)	111 (50.5)	0.019
Fatigue, n (%)	1,689	817 (48.4)	710 (48.2)	107 (49.8)	0.661
Cough, n (%)	1,709	1,347 (78.8)	1,158 (77.8)	189 (85.9)	0.006
Sputum volume, n (%)	379				0.099
<15 mL		229 (60.4)	202 (61.2)	27 (55.1)	
15-45 mL		95 (25.1)	85 (25.8)	10 (20.4)	
>45 mL		55 (14.5)	43 (13.0)	12 (24.5)	
Hemoptysis, n (%)	1701	387 (22.8)	334 (22.5)	53 (24.2)	0.584
Baseline Treatment					
Received antibiotics for chronic suppression, n (%)	523	157 (30.0)	98 (24.6)	59 (47.2)	<0.001
Inhaled bronchodilator, n (%)	1,115	719 (64.5)	593 (62.8)	126 (73.7)	0.006
Hypertonic saline, n (%)	1,334	792 (59.4)	649 (57.9)	143 (66.8)	0.015
Airway clearance, n (%)	1,709	1,240 (72.6)	1,080 (72.5)	160 (72.7)	0.952
Inhaled corticosteroids, n (%)	1,706	526 (30.8)	459 (30.9)	67 (30.5)	0.897
Oral corticosteroids, n (%)	1,706	270 (15.8)	231 (15.5)	39 (17.7)	0.408
Follow-up clinical characteristics					
FEV1 (L), median [IQR]	737	1.8 [1.4-2.2]	1.9 [1.5-2.2]	1.7 [1.3-2.3]	0.082
FEV1 %predicted, mean (SD)	732	79.0 (21.2)	80.3 (20.4)	73.3 (23.7)	0.002
≥1 exacerbation reported during the visit window, n (%)	1,399	434 (31.0)	336 (28.1)	98 (47.8)	<0.001
Treated for acute exacerbation, n (%)	1,263	402 (31.8)	312 (29.7)	90 (42.1)	<0.001
≥1 pulmonary related hospitalization reported during the visit window, n (%)	1,690	204 (12.1)	159 (10.8)	45 (20.5)	<0.001
Received antibiotics for chronic suppression, n (%)	1,263	157 (12.4)	98 (9.3)	59 (27.6)	<0.001

Abbreviations: FEV1=forced expiratory volume in 1 second, HFCWO=high-frequency chest wall oscillation, SD=standard deviation

*Wilcoxon-Mann-Whitney test, independent two-sample t-test, chi-square test

