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SUPPLEMENTARY INFORMATION

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Single-cell landscape of bronchoalveolar immune cells in patients with COVID-19

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Supplementary Information: Single-cell landscape of lung bronchoalveolar immune cells in COVID-19 patients

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Supplementary Table 1. Clinical data of the enrolled COVID-19 patients examined by scRNA-seq

	M1	M2	M3	S1	S2	S3	S4	S5	S6
Severity	Moderate	Moderate	Moderate	Severe	Critical	Critical	Critical	Critical	Critical
Age	36	37	35	62	66	63	65	57	46
Gender	Male	Female	Male	Male	Male	Male	Female	Female	Male
Wuhan exposure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Symptom onset date / First symptom	2020-1-9 Cough	2020-1-11 Fever/Cough	2020-1-9 Fever/ Muscle aches	2020-1-11 Fever/Cough	2020-1-3 Fever/Cough	2020-1-8 Fever/Cough	2020-1-4 Fever/Cough/ Chest distress	2020-1-21 Dizziness/ Fever/ Chest distress	2020-1-21 Fever/Cough
Hospitalization date	2020-1-16	2020-1-16	2020-1-15	2020-1-18	2020-1-11	2020-1-15	2020-1-20	2020-1-23	2020-1-22
BALF sampling date (Assay type)	2020-1-20	2020-1-20	2020-1-22	2020-1-22	2020-1-21 (scRNA-seq/CBA) 2020-1-31 (CBA) 2020-2-4 (CBA)	2020-1-22	2020-1-29	2020-1-29	2020-2-2 (scRNA- seq and CBA) 2020-2-5 (CBA)
Outcome / Date	Cured 2020-1-27	Cured 2020-1-23	Cured 2020-2-3	Cured 2020-2-27	Death 2020-2-16	Death 2020-2-16	Cured 2020-3-9	Cured 2020-3-7	Cured 2020-3-8
Chronic basic disease	None	None	None	None	Hypertension	Sleep apnea	Diabetes	None	None
Medication history	None	None	None	None	Amlodipine Besylate	None	None	None	None
SARS-CoV-2 RT-qPCR (Ct) / Sample / Date	+(33.8) Sputum 2020-01-24	Negative	+(30) Throat swab 2020-01-20	+(29) Throat swab 2020-01-20	+(26) Sputum 2020-01-20	+(28.5) Sputum 2020-1-21	+(24.2) Sputum 2020-1-21	+(22.5) Throat swab 2020-1-21	+(30) Sputum 2020-1-23
RBD-antibody (C.O.I) / Date	+ (6.07) 2020-1-22	+ (25.39) 2020-1-30	+ (2.36) 2020-1-29	Negative (0.55) 2020-1-29	+ (33.59) 2020-1-31	+ (26.1) 2020-1-29	+ (69.49) 2020-1-28	+ (2.72) 2020-1-29	+ (9.36) 2020-2-2
Influenza A /B	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
RSV virus	-	-	-	-	-	-	-	-	-
Adenovirus	-	-	-	-	-	-	-	-	-
Interferon atomization	2020-1-16	No	2020-1-18	2020-1-16	2020-1-14	2020-1-15	2020-1-20	2020-1-23	2020-1-22
Ribavirin	2020-1-16	No	2020-1-18	2020-1-16	2020-1-14	2020-1-15	2020-1-20	No	2020-1-23
Methyl-prednisolone	No	No	No	No	Yes	Yes	Yes	Yes	No

CT findings summary

M1 Multiple lobar segments of the bilateral lung showed scattered ground glass density or small piece of slightly high density shadows (mainly in the upper left lung)

M2 Multiple patchy, slightly high-density shadows and multiple patchy nodules are seen in the left upper lobe and lower tongue, left lower lobe and the right lower lobe and the posterior basal segment. The edge is fuzzy and mainly distributed under the pleura.

M3 Mixed ground glass density shadow was seen under the pleura of the right upper lobe posterior segment and the lower lobe dorsal segment, and the left upper lobe anterior segment, and the boundary is unclear, mainly in the right lung.

S1 Multiple patchy ground glass shadows and bands were found in each lobe of the bilateral lung, mainly ground glass lesions, with low density and unclear boundary

S2 The bilateral lung transparency decreased, the number of bronchovascular bundles in both lungs increased. Patchy ground glass shadows and consolidation shadows were seen in the bilateral lung, and the edge was fuzzy. In some lesions, inflatable bronchograms were seen, mainly distributed under the pleura. In both lungs, multiple cord shadows were seen, adhered to and pulled with the surrounding pleura.

S3 The diffuse density of the bilateral lung increased unevenly. Multiple patchy density increased shadows were seen in each lobe. Most of the lesions showed ground glass density and some consolidation. The lesions were located in the subpleural area near the dorsal side. Multiple small cystic low density areas were distributed in the lesions.

S4 The permeability of the bilateral lung fields was excessively reduced, and multiple patchy and ground glass like density increased shadows were seen in both lung fields, some of them were dense shadows, and bronchiectasis was seen inside, especially in the lower lobes of the bilateral lung.

S5 There are many mixed ground glass density shadows with fuzzy boundary and air bronchus sign, especially in the subpleural area of the bilateral lung.

S6 Multiple patchy high-density shadows were seen in the upper and lower lobes of the bilateral lung, mainly distributed in the subpleural area and the right lower lobe of the lung. The inner branch of the right lower lobe of the lung was slightly expanded.

Supplementary Table 2. The scRNA-seq /scTCR-seq protocol and data characteristics in the current study.

Donor	Protocol	Transcript	Cell counts	Median gene/cell	Mean K Reads /cell	Median UMIs/cell	Fraction Reads in cells (%)	Total cell counts	SARS-COV-2 UMI mean	SARS-COV-2 UMI sum	T Cell counts	TRB	TRA / TRB	Clo-nes	TCR typed fraction
HC1	3' - V2	917, 855, 818	8, 466	1, 499	82	5, 126	95.6%		0	0	NA	NA	NA	NA	NA
HC2	3' - V2	921, 018, 693	8, 189	989	89	2, 802	92.5%	19, 221	0	0	NA	NA	NA	NA	NA
HC3	3' - V3	736, 678, 032	2, 566	3, 317	82	14, 042	92.3%		0	0	NA	NA	NA	NA	NA
M1	5' + VDJ	1, 412, 724, 793	3, 542	3, 677	226	15, 843	96.7%		0	0	909	840	794	477	87.3%
M2	5' + VDJ	1, 232, 390, 309	3, 411	3, 145	120	11, 335	95.3%	7, 316	0	0	960	886	818	567	85.2%
M3	5' + VDJ	1, 238, 159, 803	363	1, 578	333	3, 618	63.5%		0	0	139	109	103	75	74.1%
S1	5' + VDJ	1, 309, 990, 564	11, 872	1, 224	73	2, 733	89.6%		0.0859	1,550	579	266	154	136	26.6%
S2	5' + VDJ	1, 417, 686, 317	17, 340	1, 763	68	5, 406	95.7%		0.0070	146	1, 651	1,295	1,049	782	63.5%
S3	5' + VDJ	1, 252, 013, 349	1, 292	1, 035	305	2, 178	72.6%		0.7499	3,083	NA	NA	NA	NA	NA
S4	5' + VDJ	656, 828, 360	1, 718	2, 306	168	8, 497	93.2%	37, 197	0.0026	10	142	117	95	83	66.9%
S5	5' + VDJ	570, 603, 931	2, 071	1, 560	198	4, 136	91.7%		0.4088	1,177	615	296	215	165	35.0%
S6	5' + VDJ	646, 965, 801	2, 904	1, 477	84	4, 194	84.6%		0.0965	746	465	346	257	155	55.3%
Mean		1, 040, 579, 804	5, 311	1, 964	152	6, 659	88.6%	-	-	-	-	-	-	-	-

Supplementary Table 3. The top 20 individual T cell clones in the BALFs of moderate and severe/critical patients

ClonoID	Size	Sample	Group	Chain	V gene	D gene	J gene	C gene	CDR3
C1	18	M2	M	TRB	TRBV10-3	None	TRBJ2-1	TRBC2	CAISEWGEGPNEQFF
C1	18	M2	M	TRA	TRAV17	None	TRAJ10	TRAC	CATVDILTGGGNKLTF
C2	18	M2	M	TRB	TRBV12-4	None	TRBJ2-1	TRBC2	CASSLDVDNEQFF
C2	18	M2	M	TRA	TRAV12-1	None	TRAJ43	TRAC	CVVHDMRF
C3	17	M2	M	TRA	TRAV14/DV4	None	TRAJ29	TRAC	CAMRLNSGNTPLVF
C3	17	M2	M	TRB	TRBV27	None	TRBJ2-1	TRBC2	CASSLTRGLTYNEQFF
C4	15	M2	M	TRA	TRAV5	None	TRAJ6	TRAC	CADAPASGGSYIPTF
C4	15	M2	M	TRB	TRBV5-4	None	TRBJ2-3	TRBC2	CASSPRGENPDTQYF
C5	15	M2	M	TRB	TRBV30	None	TRBJ1-2	TRBC1	CAWSVGGVMNGYTF
C5	15	M2	M	TRA	TRAV12-2	None	TRAJ10	TRAC	CASYTGGGNKLTF
C6	14	M1	M	TRB	TRBV12-4	None	TRBJ1-1	TRBC1	CASSLRATDEAFF
C6	14	M1	M	TRA	TRAV27	None	TRAJ33	TRAC	CAGEGNSNYQLIW
C7	14	M2	M	TRB	TRBV28	None	TRBJ1-5	TRBC1	CASSLYDGEEHSNQPQHF
C7	14	M2	M	TRA	TRAV17	None	TRAJ10	TRAC	CATALLFTGGGNKLTF
C8	14	M3	M	TRA	TRAV12-2	None	TRAJ31	TRAC	CAVNNARLMF
C8	14	M3	M	TRB	TRBV11-2	None	TRBJ2-5	TRBC2	CASSLKPPTDRGRETQYF
C9	13	M1	M	TRA	TRAV25	None	TRAJ42	TRAC	CAGPGGGSQGNLIF
C9	13	M1	M	TRB	TRBV5-1	None	TRBJ1-5	TRBC1	CASSLVGAGGEPQHF
C10	13	M1	M	TRB	TRBV4-1	None	TRBJ2-7	TRBC2	CASSSHPGTSYEQYF
C10	13	M1	M	TRA	TRAV24	None	TRAJ45	TRAC	CAAQGGGADGLTF
C11	12	M1	M	TRB	TRBV19	None	TRBJ2-3	TRBC2	CASSINPDFTDTQYF
C11	12	M1	M	TRA	TRAV13-1	None	TRAJ30	TRAC	CAASPLRGNRDDKIIF
C12	12	M2	M	TRA	TRAV10	None	TRAJ45	TRAC	CVVRGGSGGGADGLTF
C12	12	M2	M	TRB	TRBV9	None	TRBJ2-2	TRBC2	CASSVSRLAGPNTGELFF
C13	11	M1	M	TRB	TRBV19	None	TRBJ1-1	TRBC1	CASKGVGAEDTEAFF
C13	11	M1	M	TRA	TRAV19	None	TRAJ4	TRAC	CALSGFSGGYNKLIF
C14	11	M1	M	TRB	TRBV7-9	None	TRBJ2-5	TRBC2	CASSLSGTIETQYF
C14	11	M1	M	TRA	TRAV14/DV4	None	TRAJ49	TRAC	CAMREGTGNQFYF
C15	11	M1	M	TRB	TRBV9	None	TRBJ1-2	TRBC1	CASSAQDGYTF
C15	11	M1	M	TRA	TRAV12-1	None	TRAJ52	TRAC	CVVTVNAGGTSYGKLTF
C16	11	M2	M	TRB	TRBV5-1	None	TRBJ1-1	TRBC1	CASSLAGGSVNTEAFF
C16	11	M2	M	TRA	TRAV10	None	TRAJ4	TRAC	CVVSGSTMFSGGYNKLIF
C17	10	M1	M	TRA	TRAV12-3	None	TRAJ49	TRAC	CAHRRNQFYF
C17	10	M1	M	TRB	TRBV7-8	None	TRBJ2-1	TRBC2	CASSLGYTEQFF
C18	10	M1	M	TRA	TRAV12-2	None	TRAJ4	TRAC	CAVNLFIGGYNKLIF
C18	10	M1	M	TRB	TRBV15	None	TRBJ2-2	TRBC2	CATSRAGTYNTGELFF
C19	9	M1	M	TRA	TRAV8-2	None	TRAJ42	TRAC	CVGGSQGNLIF
C19	9	M1	M	TRB	TRBV20-1	None	TRBJ2-1	TRBC2	CSARDQTSGLYNEQFF
C20	9	M1	M	TRB	TRBV9	None	TRBJ1-5	TRBC1	CASSPTDRGQPQHF
C20	9	M1	M	TRA	TRAV12-1	None	TRAJ43	TRAC	CVLGGDNNDMRF
C1	21	S5	S	TRA	TRAV12-3	None	TRAJ18	TRAC	CAPNFDRGSTLGRLYF
C1	21	S5	S	TRB	TRBV7-6	None	TRBJ2-7	TRBC2	CASSPETGIHYEQYF
C2	20	S6	S	TRA	TRAV12-3	None	TRAJ49	TRAC	CAMRGGNQFYF

C2	20	S6	S	TRB	TRBV6-5	None	TRBJ2-2	TRBC2	CASSYLLGAGELFF
C3	14	S2	S	TRB	TRBV7-9	None	TRBJ2-1	TRBC2	CASSFGTGAREQFF
C3	14	S2	S	TRA	TRAV12-2	None	TRAJ20	TRAC	CAVRDDYKLSF
C4	13	S2	S	TRA	TRAV38-2/DV8	None	TRAJ56	TRAC	CAYHNSTGANSKLTF
C4	13	S2	S	TRB	TRBV20-1	None	TRBJ1-2	TRBC1	CSARTTRGYTF
C5	13	S2	S	TRB	TRBV11-2	None	TRBJ1-2	TRBC1	CASSLGTGGRDGYTF
C5	13	S2	S	TRA	TRAV21	None	TRAJ37	TRAC	CAVRPGSGNTGKLIF
C6	13	S2	S	TRB	TRBV11-2	None	TRBJ2-1	TRBC2	CASGGPGGRPYNEQFF
C6	13	S2	S	TRA	TRAV20	None	TRAJ9	TRAC	CAVQARSRLGGFKTIF
C7	10	S6	S	TRB	TRBV7-2	None	TRBJ1-6	TRBC1	CASSSGLLMGSPLHF
C7	10	S6	S	TRA	TRAV22	None	TRAJ6	TRAC	CAVPSGGSYIPTF
C8	9	S2	S	TRB	TRBV7-8	None	TRBJ2-2	TRBC2	CASRRGTGGHTGELFF
C8	9	S2	S	TRA	TRAV12-1	None	TRAJ53	TRAC	CVVNTPGDSGGSNYKLTF
C9	8	S5	S	TRA	TRAV21	None	TRAJ32	TRAC	CAVRPSGATNKLIF
C9	8	S5	S	TRB	TRBV7-6	None	TRBJ1-2	TRBC1	CASSSEPGWAYGYTF
C10	8	S6	S	TRA	TRAV12-3	None	TRAJ32	TRAC	CAMHYGGATNKLIF
C10	8	S6	S	TRB	TRBV6-6	None	TRBJ1-1	TRBC1	CASRSGEMNTEAFF
C11	7	S2	S	TRB	TRBV28	None	TRBJ1-5	TRBC1	CASSPMWGGTSLSNQPQHF
C11	7	S2	S	TRA	TRAV12-1	None	TRAJ5	TRAC	CVVNYYGDTGRRALTF
C12	7	S2	S	TRA	TRAV13-2	None	TRAJ17	TRAC	CAENSEAAGNKLTF
C12	7	S2	S	TRB	TRBV20-1	None	TRBJ1-5	TRBC1	CSARPLKGGLQPQHF
C13	7	S2	S	TRB	TRBV29-1	None	TRBJ2-1	TRBC2	CSVEVIGYNEQFF
C13	7	S2	S	TRA	TRAV5	None	TRAJ5	TRAC	CAESDADTGRRALTF
C14	7	S6	S	TRA	TRAV9-2	None	TRAJ9	TRAC	CALRGGAGGFKTIF
C14	7	S6	S	TRB	TRBV13	None	TRBJ2-1	TRBC2	CASSLAGQGSYNEQFF
C15	7	S6	S	TRA	TRAV26-1	None	TRAJ34	TRAC	CIVSRRSYNTDKLIF
C15	7	S6	S	TRB	TRBV27	None	TRBJ1-5	TRBC1	CASRTGASQPQHF
C16	6	S2	S	TRB	TRBV11-2	None	TRBJ2-7	TRBC2	CASSLGTGGVYEQYF
C16	6	S2	S	TRA	TRAV13-1	None	TRAJ41	TRAC	CASGYALNF
C17	6	S2	S	TRA	TRAV17	None	TRAJ54	TRAC	CATDAAQKLVF
C17	6	S2	S	TRB	TRBV20-1	None	TRBJ2-1	TRBC2	CSARTSGRVRSYNEQFF
C18	6	S2	S	TRA	TRAV1-2	None	TRAJ39	TRAC	CAVSLNNAGNMLTF
C18	6	S2	S	TRB	TRBV4-2	None	TRBJ2-1	TRBC2	CASSQETAGVNEQFF
C19	5	S2	S	TRA	TRAV13-2	None	TRAJ13	TRAC	CAENILGGYQKVTF
C19	5	S2	S	TRB	TRBV5-1	None	TRBJ2-1	TRBC2	CASSLETPYNEQFF
C20	5	S2	S	TRB	TRBV27	None	TRBJ2-1	TRBC2	CASSSLAGGKWNEQFF
C20	5	S2	S	TRA	TRAV9-2	None	TRAJ20	TRAC	CALRGSNDYKLSF

Supplementary Table 4. Clinical data of other enrolled subjects

	S7	S8	S9	S10	HC1	HC2	HC3
Severity	Severe	Critical	Critical	Critical	-	-	-
Age	52	73	67	65	38	24	22
Gender	Male	Male	Male	Male	Female	Male	Male
Wuhan exposure	No	Yes	Yes	Yes	-	-	-
Symptom onset day	2020-2-8	2020-1-20	2020-1-17	2020-1-20	-	-	
First symptom	Fever	Fever	Fever / diarrhea	Bloating / Fever	-	-	-
Hospitalization date	2020-2-11	2020-1-22	2020-1-22	2020-1-30	-	-	-
BALF sampling date (Assay type)	2020-2-13 (CBA)	2020-2-2, 2-8 & 2-21(CBA)	2020-1-29 & 2-21 (CBA)	2020-2-21 (CBA)	2019-1-29 (scRNA-seq)	2019-2-14 (scRNA-seq)	2019-9-12 (scRNA-seq)
Outcome / Date	Cured /2020-3-4	Cared in ICU	Cared in ICU	Cared in ICU	-	-	-
Chronic basic disease	None	Hypertension	Hypertension	Diabetes & Hypertension	None	None	None
Medication history	None	None	L-amlodipine & Bisoprolol	None	None	None	None
SARS-CoV-2 RT-qPCR (Ct)/ Assay date	+ (26) Nasal swab 2020-2-15	+ (23) Nasal swab 2020-1-23	+ (30.9) Throat swab 2020-1-24	+ (30.44) Throat swab 2020-1-30	ND	ND	ND
RBD-antibody (C.O.I) / Date	+ (5.98) 2020-2-20	+ (1.19) 2020-2-2	+ (48.92) 2020-1-28	+ (46.16) 2020-2-20	ND	ND	ND
Influenza A / B virus	-/-	-/-	-/-	-/-	ND	ND	ND
RSV virus	-	-	-	-	ND	ND	ND
Adenovirus	-	-	-	-	ND	ND	ND
Interferon atomization	2020-2-11	2020-1-22	2020-1-22	2020-1-30	-	-	-
Ribavirin	2020-2-11	2020-1-22	no	no	-	-	-
Methylprednisolone	No	Yes	Yes	Yes	-	-	-

CT findings summary

S7 In each lobe of the bilateral lung, there are multiple high-density patchy shadows with decreased transparency. The corresponding vascular and bronchial bundles are

thickened and blurred, and the boundary is blurred, especially in the right lung.

S8 The bilateral lung field permeability is excessively reduced, and the right upper lung can be seen as a local non wall circular density reduction shadow with a diameter of about 5-8mm; multiple ground glass density increase shadows can be seen in multiple segments of the bilateral lung, some of which are solid shadows, and most of the lesions are located under the pleura; multiple cystic transparent shadows can be seen under the pleura of the right lower lung, which are "honeycomb" changes; the interlobular space of bilateral lower lung lesions is slightly thickened, which is "paver stone" like changes.

S9 There is multiple patchy ground glass density shadows in the bilateral lung, mainly in the subpleural area. There are multiple cystic transparency shadows in the bilateral lung mainly in the upper lobes.

S10 Multiple patchy, large ground glass shadow and solid density shadow were seen in each lobe of the bilateral lung, with unclear boundary and air filled bronchogram.