

Supplementary Online Content

Landgren O, Rachel Zeig-Owens R, Giricz O, et al. Multiple myeloma and its precursor disease among firefighters exposed to the World Trade Center disaster. *JAMA Oncol*. Published online April 26, 2018. doi:10.1001/jamaoncol.2018.0509

eTable 1. Post-9/11 multiple myeloma cases among WTC-exposed FDNY white male firefighters

eTable 2. Myeloma precursor disease screening study: characteristics of MGUS and light-chain-MGUS in WTC-exposed FDNY white male firefighters

This supplementary material has been provided by the authors to give readers additional information about their work.

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eTable 1. Post-9/11 multiple myeloma cases among WTC-exposed FDNY white male firefighters

Patient number	Age at diagnosis	Plasma cell % in the bone marrow	Serum/urine monoclonal protein isotype and free light-chains	CD20 expression on plasma cells
1	58	40-50%	—*	Positive
2	59	10%	Free lambda light-chain	Positive
3	38	—*	Free lambda light-chain	ND
4	55	>15%	Free lambda light-chain	Negative
5	65	50%	Free kappa light-chain	ND
6	46	80-90%	IgG lambda & free lambda light-chain	Negative
7	56	20%	IgG kappa & free kappa light-chain	ND
8	74	80-90%	Free lambda light-chain	ND
9	49	10%	IgG kappa & free kappa light-chain	ND
10	46	—*	—*	ND
11	52	25%	IgG kappa	Positive
12	52	—*	Free kappa light-chain	ND
13	71	60-70%	IgG lambda & free lambda light-chain	Positive
14	60	80-90%	IgG lambda & free lambda light-chain	ND
15	69	>10%	IgG lambda & free lambda light-chain	Positive
16	76	<10%**	Free kappa light-chain	ND

Footnote: The WTC Health Program provide comprehensive physical and mental health services to WTC exposed. All responders from the FDNY databases with a post-9/11 diagnosis of multiple myeloma are included in the above case series population (until 7/1/2017). The information was obtained through review of medical records from the time of diagnosis.

Abbreviations: ND = not done; -* = data missing; **Extramedullary plasmacytoma, plasma cell percentage in the bone marrow <10%

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eTable 2. Myeloma precursor disease screening study: characteristics of MGUS and light-chain-MGUS in WTC-exposed FDNY white male firefighters

Characteristic of MGUS	WTC- exposed FDNY firefighters, (n=781)	
	n	%
MGUS		
Overall MGUS ^a	47	6.01
MGUS	29	3.71
IgG	17	2.18
IgA	6	0.77
IgM	5	0.64
Biclonal ^b	1	0.13
Light-chain-MGUS	18	2.30
Concentration, Median (IQR)		
M-protein g/dL ^c	0.37	0.21-0.59
Free-κ light chain, mg/dL ^d	2.32	2.12-2.74
Free-λ light chain, mg/dL ^d	1.23	1.09-1.38
dFLC, mg/dL ^d	1.15	0.95-1.65
FLC-ratio, median (IQR)^d	1.86	1.70-2.19

Abbreviations:

dFLC: difference between involved and uninvolved free light chains

FLC: free light chain

IQR: Interquartile Range

MGUS: monoclonal gammopathy of undetermined significance

^{a-} Includes MGUS and light-chain-MGUS cases

^{b-} One firefighter had 2 separate bands of IgG

^{c-} Based on 29 firefighters whose M-protein concentration was quantifiable

^{d-} Based on 18 firefighters who had light-chain-MGUS as described in the methods section

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Footnote: To rule out MGUS and light-chain-MGUS, all serum specimens were first analyzed using conventional agarose-gel electrophoresis to determine the occurrence and pattern of M-protein bands, as described previously.¹⁷ Samples observed with an M-protein band, equivocal band pattern, or abnormal free light-chain-(FLC)-ratio, were further analyzed by immunofixation to characterize the heavy- and light-chain isotypes of the M protein. Serum protein electrophoresis and immunofixation were performed using the SPIFE 3000 (Helena Laboratories). The FLC levels in all serum specimens were determined using a turbidimetric assay (Freelite; The Binding Site) performed on a SPAPLUS Automated Analyzer for Specialist Protein Analysis.¹⁶ The Freelite assay (also used for the Olmsted County study that served as our external control) comprises 2 separate measurements: one to detect free- κ light chains (normal range, 3.3-19.4 mg/L), and the other to detect free- λ light chains (normal range, 5.7-26.3 mg/L).¹⁵ We assessed monoclonality based on the κ/λ FLC-ratios.¹⁶ MGUS cases were defined as having M-protein bands on SPEP and an M-protein concentration less than 30g/L.⁵ Light-chain-MGUS was defined as the presence of an FLC band without heavy-chain expression in immunofixation or presence of an abnormal FLC-ratio (normal reference: 0.26-1.65) with an increased level (above the upper limit of normal) of the involved light chain.^{5,15}

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