

And The Bands Played On - Western blot serological test for Lyme disease
<http://www.geocities.com/HotSprings/Oasis/6455/western-blot.txt>

as of 1 March 2001

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The "CDC recommended" bands for Western blot testing - CDC/MMWR 1995.

For more information about the Western blot test and Lyme disease.

Terminology:

Bb Borrelia burgdorferi (the Lyme disease bacteria)

Bdr Borrelia direct repeat

Bmp Bacterial membrane protein

Dbp decorin binding protein

Fla flagellin

Fn-B fibronectin-binding protein

GroEL a chaperonin 60 heat-shock protein isolated from Escherichia coli

Hsp heat shock protein

HSP Heat Stress Protein

kDa kilodaltons (a measurement of size)

Mab monoclonal antibodies

MgtE magnesium transporter protein

Oms outer membrane-spanning

Osp outer surface protein

P protein

p protein

PBP penicillin-binding protein

PMID PubMed ID (identification system for citations)

Tbp transferrin-binding protein

Other terms might be found at:

The Journal of Clinical Investigation - Abbreviations

<http://www.jci.org/misc/abbreviations.shtml>

Borrelia burgdorferi bands mentioned in medical literature (MEDLINE):

Note: Bands preceded with an asterisk are the 11 Western blot bands for the ASTPHLD, CDC, FDA, NIH, CSTE, NCCLS 1994 conference recommendation ("CDC recommendation") for the serologic diagnosis of Lyme disease - see 1995 CDC MMWR link below.

5-kDa
7.5-kDa
11-kDa
13-kDa surface protein - sensu stricto, afzelii
14-kDa internal flagellin fragment [specific for Bb]
15 kDa polypeptide [also for syphilis]
16-kDa
17-kDa Osp 17 [B. afzelii]
*18-kDa p18 flagellin fragment
19-kDa immunogenic integral membrane lipoproteins
cross-reactive with other spirochetes/bacteria
Characterization of antigenic determinants of Bb shared by other
bacteria.
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1372635&form=6&db=m&Dopt=b>
19-kDa decorin-binding protein
20-kDa decorin-binding protein
20.5-kDa
20.7-kDa
*21-kDa OspC [specific for Bb]
22-kDa [specific for Bb or cross-reactive depending on what one reads]
immunogenic integral membrane lipoproteins
[cross-reactive with other spirochetes/bacteria]
Characterization of antigenic determinants of Bb shared by other
bacteria.
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1372635&form=6&db=m&Dopt=b>
22-kDa OspC [specific for Bb]
22-25kDa OspC
23-kDa OspC
*24-kDa OspC
25-kDa OspC [specific for Bb]
26-kDa
27-kDa Osp, Hsp
(Europe burgdorferi strain B29, but not American strain B31)
*28-kDa OspD, Oms28 [specific for Bb]
29-kDa OspA?
30-32-kDa OspA
*30-kDa OspA substrate binding protein
31-kDa OspA [specific for Bb]
32-kDa OspA
33-kDa outer membrane

34-kDa OspB [specific for Bb]
34-36-kDa OspB
35-kDa OspB [specific for Bb]
35.5-kDa
36-37-kDa
37-kDa P37, FlaA gene product, [specific for Bb]
38.0-kDa FlaA
*39-kDa BmpA [specific for Bb]
40-kDa
*41-kDa FlaB
42-kDa
43-kDa
44-kDa
*45-kDa [appeared in IgM in control group in 1998 study done in Poland]
MEDLINE - 9972057 - "...whereas in control group only antibodies
against 45 kDa and 58 kDa were present."
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9972057&form=6&db=m&Dopt=b>
[appears for HGE]
MEDLINE - 9620365 - "...confirmed the importance of the 42- to
45-kDa antigens as early, persistent, and specific markers of HGE
infection."
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9620365&form=6&db=m&Dopt=b>
46-kDa
47-kDa P47 fibronectin-binding protein [specific for Bb]
48-kDa
49-kDa
50-kDa [specific for Bb]
51 kDa MgtE
52-kDa Fn-BA
54-kDa [other Borrelia]
55-kDa
56-kDa
57-kDa PBP
*58-kDa (not GroEL)
59-kDa [a genetically engineered fragment of the 83-kDa protein]
60-kDa Hsp [all Borrelia]
62-kDa Hsp60
63.7-kDa
64-kDa (P64) [cross-reacts to human axonal proteins]
65-kDa
*66-kDa P66 Oms66 Hsp outer/integral membrane protein
67-kDa
68-kDa
70-kDa Hsp
71-kDa
72-kDa Hsp [cross-reactive with other spirochetes]
[cross-reactive with other spirochetes/bacteria]

Characterization of antigenic determinants of Bb shared by other bacteria.

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1372635&form=6&db=m&Dopt=b>

73-kDa

75-kDa

77-kDa a genetically engineered recombinant hybrid

Use of a hybrid protein consisting of the variable region of the *Borrelia burgdorferi* flagellin and part of the 83-kDa protein as antigen for serodiagnosis of Lyme disease.

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8027303&form=6&db=m&Dopt=b>

78-kDa OspA

79.8-kDa

80-kDa

83-kDa p83 high molecular mass protein [specific for Bb]

84-kDa [*B. garinii*]

88-kDa

92-kDa

*93-kDa an immunodominant protoplasmic cylinder antigen, associated with the flagellum [specific for Bb]

94-kDa PBP [specific for Bb]

95-kDa

97-kDa associated with flagella

100-kDa P100

110-kDa

200-kDa a fusion protein, a hybrid protein

Named bands - the gene names:

BmpA, BmpB, BmpC "the 39 kDa Bmp protein family", PMID: 8978084

BmpD, PMID: 8606088

FlaA, an outer sheath protein of the periplasmic flagella

37-kDa, PMID: 9986810

38-kDa, PMID: 9573194, PMID: 8990312

FlaB, 41-kDa PMID: 9573194

FlgE, protein 40-kDa?, PMID: 8548542

ospAB, 28-34-kDa, PMID: 9596714

OspA = 29-33.5 kDa

Regarding OspA AND Lyme disease the following molecular weights are associated with OspA in the MEDLINE database:

Note: To see the abstract for a particular PMID number, simply insert the number, via copy and paste, in the following URL after the "&list_uids=" term:

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=&dopt=Abstract

Example, using the first number below:

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=10638032&dopt=Abstract

29-31 kDa - PMID: 10638032, 8429231
29.6 kDa - PMID: 1406458
30 kDa - PMID: 7500914
30-32 kDa - PMID: 2461135
31-kDa - PMID: 10030131, PMID: 8005219, PMID: 8406878, PMID: 1520966
 PMID: 1554741, PMID: 10699329, PMID: 8825913
32-kDa - PMID: 8005219, PMID: 1520966
32-kDa/rOspA dog vaccine - PMID: 8567917
32.5 kDa - PMID: 9144917, PMID: 8004045
33 kDa - PMID: 1520966, PMID: 8005219
33.5 kDa - PMID: 8004045, PMID: 1520966

OspB 34-kDa PMID: 10030131
OspC 21-25-kDa, 22-25-kDa - PMID: 8825913,
OspD 28-kDa, PMID: 8825913
OspE 19.2-kDa [calculated], PMID: 8262642
OspF 26.1-kDa [calculated], PMID: 8262642

Bands specific for *Borrelia burgdorferi*:

14-kDa ?
21-kDa
22-kDa OspC
25-kDa OspC
28-kDa OspD
31-kDa OspA
34-kDa OspB
35-kDa
37-kDa
39-kDa
47-kDa
50-kDa
83-kDa
93-kDa
94-kDa

Notes:

14-kDa ? PMID: 9920119, PMID: 1556546

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9920119&form=6&db=m&Dopt=b>
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1556546&form=6&db=m&Dopt=b>

B. burgdorferi: 22 kDa, 31 kDa, 34 kDa, 39 kDa, 83 kDa - PMID: 9440203
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9440203&form=6&db=m&Dopt=b>

p35 and p37 are Borrelia burgdorferi genes - PMID: 9175831
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9175831&form=6&db=m&Dopt=b>

at least one is an apparently specific band (25, 28, 39, 47, 50, or 93 kDa). - PMID: 7791177
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=7791177&form=6&db=m&Dopt=b>

antibodies against the 94 kDa, 31 kDa and 21 kDa proteins are largely species-specific. - PMID: 8223404
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8223404&form=6&db=m&Dopt=b>

Cross-reacting bands:

- 19-kDa
- 22-kDa ??
- 20-kDa
- 30-kDa
- 33-kDa
- 34-kDa ??
- 36-kDa
- 40-kDa
- 41-kDa
- 60-kDa
- 66-kDa
- 72-kDa

Notes:
Search terms:
cross-react*
cross-antigenicity
crossreact

Immunoblot analysis indicated the presence of cross-reacting antibodies directed to B. burgdorferi antigens with apparent molecular weights of 60, 41, 40, 36, 30 and 20 kDa. - PMID: 1385332
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=&form=6&db=m&Dopt=b>

P66, P60, P41 which are dominant immunogens of all types of borrelias
PMID: 9162453
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9162453&form=6&db=m&Dopt=b>

19, 22[??], 72 - PMID: 1372635

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1372635&form=6&db=m&Dopt=b>

60-75 kDa range, p40, p33 and two proteins in the range of 20 kDa. -

PMID: 1597198

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=1597198&form=6&db=m&Dopt=b>

Whereas the 60 kDa, 41 kDa, and 34 kDa[??] constituents reveal a marked cross-antigenicity with other spirochetes and even more distantly related bacteria, ... PMID: 8223404

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8223404&form=6&db=m&Dopt=b>

Bands found, or tested for, in IgM analysis in USA or Mexico.

18-kDa

21-kDa

23-kDa

24-kDa

25-kDa

28-kDa

37-kDa

39-kDa

41-kDa

45-kDa

55-kDa

58-kDa

60-kDa

66-kDa

93-kDa

Notes:

37 - PMID: 9986810

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9986810&form=6&db=m&Dopt=b>

41 kDa and 58 kDa - PMID: 9972057

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9972057&form=6&db=m&Dopt=b>

24 kDa (OspC), 41 kDa, and 37 kDa - PMID: 8748261

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8748261&form=6&db=m&Dopt=b>

39, 58, 60, 66, or 93 kDa - PMID: 8748261

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8748261&form=6&db=m&Dopt=b>

55-kDa - PMID: 7642278

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=7642278&form=6&db=m&Dopt=b>

Recommended criteria for the immunoglobulin M (IgM) immunoblot are the recognition of two of three proteins (24, 39, and 41 kDa). PMID: 7714202
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=7714202&form=6&db=m&Dopt=b>

25-kDa antigens - PMID: 8308100
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8308100&form=6&db=m&Dopt=b>

23-kDa - PMID: 8225587
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8225587&form=6&db=m&Dopt=b>

at least 2 of the 8 most common IgM bands in early disease
(18, 21, 28, 37, 41, 45, 58, and 93 kDa) - PMID: 8380611
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8380611&form=6&db=m&Dopt=b>

Bands found, or tested for, in IgG analysis in USA or Mexico.

- 18-kDa
- 20-kDa
- 21-kDa
- 22-kDa
- 23-kDa
- 24-kDa
- 28-kDa
- 29-kDa
- 30-kDa
- 31-kDa
- 34-kDa
- 35-kDa
- 39-kDa
- 41-kDa
- 45-kDa
- 55-kDa
- 58-kDa
- 88-kDa
- 62-kDa
- 66-kDa
- 93-kDa

Notes:
A serum sample was considered positive by WB [IgG] if at least three of the following protein bands were recognized: 18, 24, 28, 29, 31, 34, 39, 41, 45, 58, 62, 66, and 93 kDa. PMID: 10071428
<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=10071428&form=6&db=m&Dopt=b>

93, 39, 34 or 23 kDa IgG bands - PMID: 9580180

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=9580180&form=6&db=m&Dopt=b>

55-kDa - PMID: 7642278

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=7642278&form=6&db=m&Dopt=b>

The recommended criteria for a positive IgG immunoblot are the recognition of two of five proteins (20, 24 [> 19 intensity units], 35, 39, and 88 kDa). Alternatively, if band intensity cannot be measured, the 22-kDa protein can be substituted for the 24-kDa protein with only a small decrease in sensitivity. PMID: 7714202

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=7714202&form=6&db=m&Dopt=b>

at least 5 of the 10 most frequent IgG bands after the first weeks of infection (18, 21, 28, 30, 39, 41, 45, 58, 66, and 93 kDa)-PMID: 8380611

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=8380611&form=6&db=m&Dopt=b>

66 kDa and 31/34 kDa - PMID: 3819479

<http://www.ncbi.nlm.nih.gov/htbin-post/Entrez/query?uid=3819479&form=6&db=m&Dopt=b>

Other bands found in IgM/IgG in other countries:

Europe/Germany - PMID: 9163458

The following interpretation criteria resulting in specificities of greater than 96% were recommended: for IgG WB, at least one band of p83/100, p58, p56, OspC, p21, and p17a for PKa2; at least two bands of p83/100, p58, p43, p39, p30, OspC, p21, p17, and p14 for PKo; and at least one band of p83/100, p39, OspC, p21, and p17b for PBi; for IgM WB, at least one band of p39, OspC, and p17a or a strong p41 band for PKa2; at least one band of p39, OspC, and p17 or a strong p41 band for PKo; and at least one band of p39 and OspC or a strong p41 band for PBi.

IgG titers to P35 and P37 Mice/Northern blot - PMID: 9175831

Italy - PMID: 8809552

The overall reactivity of the three Borrelia strains in IgG immunoblots indicated that ten protein bands were significant, with a different prevalence of some of them in the two groups of patient sera: bands at 60-58, 30-33, 36-37 and 28-27 kDa were markers for neuroborreliosis sera; proteins at 100-83, 72-70 and 18-17 kDa behaved like markers for Lyme arthritis. The IgM Immunoblots revealed significant bands at 100-83, 72-70, 51, 24- 21 and 18-17 kDa only with neuroborreliosis sera.

Russia - PMID: 7791165

IgG reactivity with > or = 5 spirochetal proteins, particularly the 37, 39, 41, 60, and 93 kDa antigens

Germany - PMID: 8167425
IgG - 95 and 19-17 kDa

France - PMID: 8405312
[IgG] Reactions with specific protein bands (94, 73, 30 and 21 kDa)

The "CDC recommended" bands for Western blot testing - CDC/MMWR 1995.

The ASTPHLD, CDC, FDA, NIH, CSTE, NCCLS 1994 conference recommendation ("CDC recommendation") for the serologic diagnosis of Lyme disease - CDC/MMWR 1995:

ASTPHLD - Association of State and Territorial Public Health Laboratory Directors
CDC - Centers for Disease Control and Prevention
FDA - Food and Drug Administration
NIH - National Institutes of Health
CSTE - Council of State and Territorial Epidemiologists
NCCLS - National Committee for Clinical Laboratory Standards

According to CDC's Morbidity and Mortality Weekly Report (MMWR) 1995; 44 (31):590-591, an IgM immunoblot is considered positive if two of the following three bands are present:

24 kDa (OspC)*
39 kDa (BmpA)
41 kDa (Fla)

An IgG immunoblot is considered positive if five of the following 10 bands are present:

18 kDa
21 kDa (OspC)*
28 kDa
30 kDa
39 kDa (BmpA)
41 kDa (Fla)
45 kDa
58 kDa (not GroEL)
66 kDa
93 kDa

* The apparent molecular mass of OspC is dependent on the strain of

B. burgdorferi being tested. The 24 kDa and 21 kDa proteins referred to are the same.

Recommendations for Test Performance and Interpretation from the Second National Conference on Serologic Diagnosis of Lyme Disease, CDC MMWR, August 11, 1995 / 44(31);590-591
<http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/00038469.htm>
or
<http://wonder.cdc.gov/wonder/prevguid/m0038469/entire.htm>

For more information about the Western blot test and Lyme disease, see:

The National Lyme Disease Network LymeNet Newsletter
Volume 4 - Number 13 - 9/23/96
SPECIAL ISSUE - Understanding the Western Blot
<http://www2.lymenet.org/domino/nl.nsf/UID/4-13>

Explanation of the Lyme Disease Western Blot by Carl Brenner
<http://www.lymealliance.org/Medical/MedCategory4/Lab4/lab4.html>

Laboratory Tests by Tom Grier - Part 2 - Western Blot and ELISA
<http://www.lymealliance.org/Medical/MedCategory4/Med12A/med12a.html>

IGeneX, Inc. - Lyme Disease Western Blot
<http://www.igenex.com/lymeset2.htm>

MRL Diagnostics' Lyme Disease B. burgdorferi Genogroup 1
Western Blot IgG test
<http://www.mrldiagnostics.com/insert/wb0400g.htm>

Immuno-Biological Laboratories (IBL) - Hamburg [Germany] -
Borrelia burgdorferi/Lyme IgG Western Blot
http://www.ibl-hamburg.com/prod/re_97228.htm

The western immunoblot for Lyme disease: determination of sensitivity, specificity, and interpretive criteria with use of commercially available performance panels.
Tilton RC, Sand MN, Manak M
BBI Clinical Laboratories, Inc., New Britain, Connecticut 06053, USA.
Clin Infect Dis 1997 Jul;25 Suppl 1:S31-S34
http://www.x-l.net/Lyme/BBI_TEST.htm

SIMULTANEOUS ELISA AND WESTERN BLOT TESTING IN EVALUATION OF PATIENTS FOR SUSPECTED LYME DISEASE
Janice M. Kochevar, FNP-C, Kenneth B. Liegner, M.D.
LDF 10th Annual International Scientific Conference on Lyme Borreliosis

