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References

1. Wagner KS, White JM, Neal S, Crowcroft NS, Kuprevičienė N, Paberza R, et al.; Members of the Diphtheria Surveillance Network. Screening for *Corynebacterium diphtheriae* and *Corynebacterium ulcerans* in patients with upper respiratory tract infections 2007–2008: a multicentre European study. *Clin Microbiol Infect*. 2011;17:519–25. <http://dx.doi.org/10.1111/j.1469-0691.2010.03269.x>
2. Meinel DM, Kuehl R, Zbinden R, Boskova V, Garzoni C, Fadini D, et al. Outbreak investigation for toxigenic *Corynebacterium diphtheriae* wound infections in refugees from northeast Africa and Syria in Switzerland and Germany by whole genome sequencing. *Clin Microbiol Infect*. 2016;22:1003.e1–8. <http://dx.doi.org/10.1016/j.cmi.2016.08.010>
3. Belsey MA, LeBlanc DR. Skin infections and the epidemiology of diphtheria: acquisition and persistence of *C. diphtheriae* infections. *Am J Epidemiol*. 1975;102:179–84. <http://dx.doi.org/10.1093/oxfordjournals.aje.a112145>
4. Thaug U, Naung T, Saw Khine K, Khai Ming C. Epidemiological features of skin diphtheria infection in Rangoon, Burma. *Southeast Asian J Trop Med Public Health*. 1978;9:4–10.
5. Institut National de la Statistique et des Etudes Economiques (Insee). Mayotte, France's youngest department. [cited 2017 May 3]. <https://www.insee.fr/en/statistiques/1281385>
6. French Vaccination Schedule [in French] [cited 2017 May 3]. http://social-sante.gouv.fr/IMG/pdf/calendrier_vaccinal_2016.pdf
7. Instruction DGS/RI1 no 2011–348 du 30 août 2011 relative à la conduite à tenir lors de l'apparition d'un cas de diphtérie [cited 2017 May 3]. http://circulaire.legifrance.gouv.fr/pdf/2011/09/cir_33827.pdf
8. Koopman JS, Campbell J. The role of cutaneous diphtheria infections in a diphtheria epidemic. *J Infect Dis*. 1975;131:239–44. <http://dx.doi.org/10.1093/infdis/131.3.239>
9. Solet JL. Enquête de couverture vaccinale à Mayotte en 2010. Saint-Maurice: Institut de veille sanitaire; 2012 [cited 2017 May 3]. <http://invs.santepubliquefrance.fr/Publications-et-outils/Rapports-et-syntheses/Maladies-infectieuses/2012/Enquete-de-couverture-vaccinale-a-Mayotte-en-2010>
10. Expanded Programme on immunization. The immunological basis for immunization series module 2: diphtheria. Geneva: World Health Organization, 1993. WHO/EPI/GEN/93.12 [cited 2017 May 3]. http://www.nccvmtc.org/pdf/1_028.pdf

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Haemophilus influenzae Type a Meningitis in Immunocompetent Child, Oman, 2015

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Meningitis caused by *Haemophilus influenzae* type b (Hib) was eliminated in Oman after the introduction of Hib vaccine in 2001. However, a case of *H. influenzae* type a meningitis was diagnosed in a child from Oman in 2015, which highlights the need to monitor the incidence of invasive non-Hib *H. influenzae* disease.

Haemophilus influenzae can be encapsulated (serotypes a–f) or unencapsulated, nontypeable (NTHi) (1). By the end of 2014, all countries in the Eastern Mediterranean Region had introduced *H. influenzae* type b (Hib) vaccine into their immunization programs; in Oman, where it was introduced in 2001, it led to an elimination of Hib meningitis (2,3). However, Hib vaccine does not cross-protect against other serotypes.

A previously healthy 17-month-old girl with G6PD deficiency was admitted to Nizwa Hospital, Nizwa, Oman, in August 2015 with a 1-day history of fever and lethargy and frequent vomiting and refusal of food for 6–8 hours before admission. She had no history of rash, head trauma, drug ingestion, travel abroad, or contact with animals. Her vaccination record was up to date. Her 3 older siblings were healthy. On examination, she was irritable and febrile (temperature 39°C), with tachypnea, tachycardia, and photophobia. On lung auscultation, a few crackles were heard on the right side. The rest of her physical examination, including a bedside undilated fundoscopic examination, was unremarkable. Blood tests, cerebrospinal fluid examination, and neuroimaging studies were conducted (Table). Results of renal and liver function and metabolic screening tests and serum calcium, troponin T, immunoglobulins, and total complement levels were within reference limits. Diagnostic test results were negative for respiratory viruses including influenza A(H1N1) and Middle East respiratory syndrome coronavirus and for herpes simplex virus types 1 and 2. A chest radiograph showed right middle lobe haziness suggestive of pneumonitis.

The patient was treated with intravenous ceftriaxone. Blood culture revealed *H. influenzae* type a (Hia), which was serotyped by slide agglutination and determined to

Table. Results of sequential laboratory tests and CT scans of the head during the clinical course of Hia meningitis in a child admitted to Nizwa Hospital, Oman, August 2015*

Test type	Hospitalization day								
	1		2	8	10	14	18	26	27
	Adm	Adm + 12							
Blood									
Leukocytes, × 10 ³ cells/μL†	2.24	8.71	10.52	13.08		12.32	8.48	4.56	
Neutrophils, × 10 ³ cells/μL‡	0.78	6.04	7.66	4.92		5.51	2.50	0.82	
Lymphocytes, × 10 ³ cells/μL§	1.22	2.02	2.38	5.98		5.21	5.12	2.89	
Platelets, × 10 ³ /μL¶	158.30	79.12	41.13	419.90		644.70	525.80	279.20	
Hemoglobin, g/dL#	10.18	9.30	9.13	9.06		8.47	9.22	10.38	
CRP, mg/L**	79.30		483.40	248.50			33.70	35.30	
Blood culture	Hia			NG				NG	
CSF									
Leukocytes, cells/mm ³	2,970				390			65	
Neutrophils, %	91				10			12	
Lymphocytes, %	9				90			88	
Protein, mg/dL††	190.79				100.34			27.11	
Glucose, mmol/L‡‡	1.13				2.24			2.83	
Glucose CSF: blood	0.26				0.56			0.70	
Gram stain	NM				NM			NM	
Culture	NG				NG			NG	
CT scan of the head									
	Unremarkable			Mild ventricular dilation with bilateral subdural effusion			Complete disappearance of subdural effusion; persistence of mild ventricular dilation		

*Adm, at admission; Adm + 12, 12 h after admission; CRP, C-reactive protein; CSF, cerebrospinal fluid; CT, computed tomography; Hia, *Haemophilus influenzae* type a; NA, not applicable; NG, no growth; NM, no microorganisms.

†Reference range 4.5–14.5 × 10³ cells/μL.

‡Reference range 1.4–9.0 × 10³ cells/μL.

§Reference range 1.9–9.8 × 10³ cells/μL.

¶Reference range 150–450 × 10³/μL.

#Reference range 11.5–15.5 g/dL.

**Reference range 0–5 mg/L.

††Reference range 15–45 mg/dL.

‡‡Reference range 2.2–3.9 mmol/L.

be β-lactamase negative, with susceptibility to all tested antimicrobial drugs. The patient had a protracted clinical course, characterized by continued photophobia, intermittent fever (38–39°C), and subdural effusion. After 10 days of ceftriaxone treatment, her drug therapy was changed to intravenous ampicillin, administered for 2 weeks. Her condition gradually improved; she became afebrile by day 21 after admission and was well at discharge on day 27. Results of vision and hearing screening tests 1 month after discharge and 1 year later were unremarkable.

Several case studies have documented prolonged clinical courses of Hia meningitis, with sequelae reported in some children (4,5; online Technical Appendix Table, <https://wwwnc.cdc.gov/EID/article/23/7/17-0311-Techapp1.pdf>). Hia meningitis is strikingly reminiscent of Hib meningitis, manifesting as a serious illness mostly in otherwise healthy children 6–24 months of age (1,4,5). Hia has been reported to be the most virulent among encapsulated *H. influenzae* after Hib; the genetic structure of virulent Hia strains closely resembles that of virulent Hib strains with respect to the duplicated arrangement of the

capsule locus and, in some cases, partial deletion of the *IS1016-bexA* gene locus (5–7; online Technical Appendix Table). An active hospital-based surveillance study for meningitis during 1996–2007 in Salvador, Brazil, reported that Hia and Hib meningitis occurred mainly among children <5 years of age; case-fatality rates were higher than those for meningitis caused by types e and f and NTHi strains, which occurred in older age groups and tended to have a better prognosis (6). The study observed an association between *IS1016-bexA* deletion and poor clinical outcome of Hia meningitis.

Since Hib vaccine implementation, concerns have arisen about serotype replacement and emergence of virulent non-b *H. influenzae* (5,6; online Technical Appendix Table). With documentation of 3 cases (including the case reported here) of Hia meningitis in the Eastern Mediterranean Region within <2 years (8), more than a decade after Hib vaccine implementation, it is crucial to monitor meningitis in children within the region, complemented by laboratory characterization of incoming specimens by molecular methods for rapid, accurate information on all

H. influenzae serotypes and NTHi (1; <https://www.cdc.gov/meningitis/lab-manual/full-manual.pdf>; online Technical Appendix Table). In Oman, it is mandatory to report cases of Hib meningitis within 24 hours of laboratory diagnosis, and those caused by other serotypes and NTHi within 1 week, to the Department of Communicable Disease Surveillance and Control, Ministry of Health. Evidence of capsule-deficient variants of Hia that cannot be differentiated from NTHi by conventional methods (7) and recurrent invasive diseases (9,10) and outbreaks caused by Hia (9; online Technical Appendix Table) emphasize the necessity for continued surveillance, strong laboratory support, and local epidemiologic studies on non-b *H. influenzae* disease.

Hia meningitis has been reported mainly in the indigenous peoples of Canada, Alaska (USA), and Australia; in the Navajo and White Mountain Apache tribes in the southwestern United States; and in Utah (USA), Brazil, the Gambia, East Africa, and Papua New Guinea. Sporadic cases have been reported in the rest of the world (1,10; online Technical Appendix Table). The reasons behind the high rates of invasive Hia disease among indigenous children remain unclear (1). In Canada, where invasive non-b *H. influenzae* disease has been included in the list of nationally reportable diseases (<http://diseases.canada.ca/notifiable/diseases-list>) since 2007, a public health-driven initiative has been established to provide a better characterization of the epidemiology of invasive Hia disease and develop a candidate vaccine against Hia (online Technical Appendix Table).

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References

1. Ulanova M, Tsang RS. *Haemophilus influenzae* serotype a as a cause of serious invasive infections. *Lancet Infect Dis*. 2014;14:70–82. [http://dx.doi.org/10.1016/S1473-3099\(13\)70170-1](http://dx.doi.org/10.1016/S1473-3099(13)70170-1)
2. World Health Organization Regional Office for the Eastern Mediterranean. *Haemophilus influenzae* vaccine introduced in all national immunization programmes. Vaccine-preventable diseases and immunization. 2014 Nov 20 [cited 2017 Feb 22] <http://www.emro.who.int/vpi/vpi-news/hib-vaccine.html>
3. Communicable Disease Surveillance and Control, Ministry of Health, Sultanate of Oman. Communicable diseases in Oman: passive surveillance data 2001–2011. [cited 2017 Feb 22] <http://www.cdscoman.org/uploads/cdscoman/Notified%20cases%202001%20-%202011.pdf>
4. Antony S, Kaushik A, Mauriello C, Chatterjee A. Non-type b *Haemophilus influenzae* invasive infections in North Dakota and South Dakota, 2013–2015. *J Pediatric Infect Dis Soc*. 2016; pii053. <http://dx.doi.org/10.1093/jpids/piw053>
5. Adderson EE, Byington CL, Spencer L, Kimball A, Hindiyeh M, Carroll K, et al. Invasive serotype a *Haemophilus influenzae* infections with a virulence genotype resembling *Haemophilus influenzae* type b: emerging pathogen in the vaccine era? *Pediatrics*. 2001;108:E18. <http://dx.doi.org/10.1542/peds.108.1.e18>
6. Lima JB, Ribeiro GS, Cordeiro SM, Gouveia EL, Salgado K, Spratt BG, et al. Poor clinical outcome for meningitis caused by *Haemophilus influenzae* serotype A strains containing the IS1016-bexA deletion. *J Infect Dis*. 2010;202:1577–84. <http://dx.doi.org/10.1086/656778>
7. Ohkusu K, Nash KA, Inderlied CB. Molecular characterisation of *Haemophilus influenzae* type a and untypeable strains isolated simultaneously from cerebrospinal fluid and blood: novel use of quantitative real-time PCR based on the cap copy number to determine virulence. *Clin Microbiol Infect*. 2005;11:637–43. <http://dx.doi.org/10.1111/j.1469-0691.2005.01203.x>
8. Roaa Z, Abdulsalam A, Shahid G, Kamaldeen B, Tariq AF. Pediatric invasive disease due to *Haemophilus influenzae* serogroup a in Riyadh, Saudi Arabia: case series. *J Infect Dev Ctries*. 2016;10:528–32. <http://dx.doi.org/10.3855/jidc.6687>
9. Hammitt LL, Block S, Hennessy TW, Debye C, Peters H, Parkinson A, et al. Outbreak of invasive *Haemophilus influenzae* serotype a disease. *Pediatr Infect Dis J*. 2005;24:453–6. <http://dx.doi.org/10.1097/01.inf.0000160954.90881.29>
10. Whyte K, Levett PN, Horsman GB, Chokani K, Hayden K, Shuel M, et al. Recurrent invasive *Haemophilus influenzae* serotype a infection in an infant. *Microbiology Discov*. 2015;3:4. <http://dx.doi.org/10.7243/2052-6180-3-4>

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Importation of Zika Virus from Vietnam to Japan, November 2016

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We report a case of Zika virus infection that was imported to Japan by a traveler returning from Vietnam. We detected

Haemophilus influenzae Type a Meningitis in Immunocompetent Child, Oman, 2015

Technical Appendix

Technical Appendix Table. Additional research on non-serotype b *Haemophilus influenzae* (Hi)

Authors	Year published	Location of study	Subject	Reference
Sadeghi-Aval P, et al.	2013	Northwestern Ontario, Canada	Non-Hib pediatric meningitis	1
de Pádua RA, et al.	2009	Paraná, Brazil	Hia meningitis	2
Kroll JS, et al.	1994	The Gambia	Virulence-enhancing mutation in Hia	3
Kapogiannis BG, et al.	2005	United States of America	IS1016-bexA partial deletion in Hia	4
Mulder DC, et al.	2002	The Netherlands	Hia meningitis in infant	5
Wang X, et al.	2011	Mongolia	A new real-time PCR to detect Hi	6
WHO, CDC	2011		Laboratory methods	7
Bruce MG, et al.	2013	Alaska, USA	Invasive Hia disease	8
Boisvert AA, et al.	2015	North Canada	Invasive Hia disease in children	9
Greenhill AR, et al.	2015	Papua New Guinea	Pre-vaccine serotype distribution	10
Gounder PP, et al.	2015	North American Arctic	Bacterial meningitis	11
Desai S, et al.	2015	Ontario, Canada	Invasive non-Hib disease	12
Wan Sai Cheong J, et al.	2015	Queensland, Australia	Invasive <i>H. influenzae</i> disease	13
Tsang RS, et al.	2016	Nunavut, Canada	Invasive <i>H. influenzae</i> disease	14
Tuyama M, et al.	2017	Rio de Janeiro, Brazil	Invasive <i>H. influenzae</i> disease	15
Tsang RS, et al.	2017	Nunavik, Canada	Invasive Hia disease	16
Whittaker R, et al.	2017	Europe	Invasive <i>H. influenzae</i> disease	17
Efron AM, et al.	2013	Argentina	Post-vaccine serotype distribution	18
Desai S, et al.	2014	Canada	Vaccine development initiative	19

References

1. Sadeghi-Aval P, Tsang RS, Jamieson FB, Ulanova M. Emergence of non-serotype b encapsulated *Haemophilus influenzae* as a cause of pediatric meningitis in northwestern Ontario. *Can J Infect Dis Med Microbiol.* 2013;24:13–6. <http://dx.doi.org/10.1155/2013/828730>
2. de Pádua RA, de Lima Scodro RB, Ghiraldi LD, Siqueira VL, Yamashita YK, Helbel C, et al. *Haemophilus influenzae* serotype a meningitis. *Ann Clin Lab Sci.* 2009;39:405–8.
3. Kroll JS, Moxon ER, Loynds BM. Natural genetic transfer of a putative virulence-enhancing mutation to *Haemophilus influenzae* type a. *J Infect Dis.* 1994;169:676–9. <http://dx.doi.org/10.1093/infdis/169.3.676>
4. Kapogiannis BG, Satola S, Keyserling HL, Farley MM. Invasive infections with *Haemophilus influenzae* serotype a containing an IS1016-bexA partial deletion: possible association with virulence. *Clin Infect Dis.* 2005;41:e97–103. <http://dx.doi.org/10.1086/498028>

5. Mulder DC, Padberg RD, Westra M, Fijen CA. *Haemophilus influenzae* type a as the causative agent of meningitis in an infant [in Dutch]. *Ned Tijdschr Geneeskd*. 2002;146:1651–3.
6. Wang X, Mair R, Hatcher C, Theodore MJ, Edmond K, Wu HM, et al. Detection of bacterial pathogens in Mongolia meningitis surveillance with a new real-time PCR assay to detect *Haemophilus influenzae*. *Int J Med Microbiol*. 2011;301:303–9. <http://dx.doi.org/10.1016/j.ijmm.2010.11.004>
7. World Health Organization, Centers for Disease Control and Prevention. Laboratory methods for the diagnosis of meningitis caused by *Neisseria meningitidis*, *Streptococcus pneumoniae* and *Haemophilus influenzae*. WHO Manual. 2nd ed. 2011 [cited 2017 March 5]. <https://www.cdc.gov/meningitis/lab-manual/full-manual.pdf>
8. Bruce MG, Zulz T, DeByle C, Singleton R, Hurlburt D, Bruden D, et al. *Haemophilus influenzae* serotype a invasive disease, Alaska, USA, 1983–2011. *Emerg Infect Dis*. 2013;19:932–7. <http://dx.doi.org/10.3201/eid1906.121805>
9. Boisvert AA, Moore D. Invasive disease due to *Haemophilus influenzae* type a in children in Canada's north: a priority for prevention. *Can J Infect Dis Med Microbiol*. 2015;26:291–2. <http://dx.doi.org/10.1155/2015/613820>
10. Greenhill AR, Phuanukoonnon S, Michael A, Yoannes M, Orami T, Smith H, et al. *Streptococcus pneumoniae* and *Haemophilus influenzae* in paediatric meningitis patients at Goroka General Hospital, Papua New Guinea: serotype distribution and antimicrobial susceptibility in the pre-vaccine era. *BMC Infect Dis*. 2015;15:485. <http://dx.doi.org/10.1186/s12879-015-1197-0>
11. Gounder PP, Zulz T, Desai S, Stenz F, Rudolph K, Tsang R, et al. Epidemiology of bacterial meningitis in the North American Arctic, 2000–2010. *J Infect*. 2015;71:179–87. <http://dx.doi.org/10.1016/j.jinf.2015.04.001>
12. Desai S, Jamieson FB, Patel SN, Seo CY, Dang V, Fediurek J, et al. The epidemiology of invasive *Haemophilus influenzae* non-serotype b disease in Ontario, Canada from 2004 to 2013. *PLoS One*. 2015;10:e0142179. <http://dx.doi.org/10.1371/journal.pone.0142179>
13. Wan Sai Cheong J, Smith H, Heney C, Robson J, Schlebusch S, Fu J, et al. Trends in the epidemiology of invasive *Haemophilus influenzae* disease in Queensland, Australia from 2000 to 2013: what is the impact of an increase in invasive non-typable *H. influenzae* (NTHi)? *Epidemiol Infect*. 2015;143:2993–3000. <http://dx.doi.org/10.1017/S0950268815000345>

14. Tsang RS, Li YA, Mullen A, Baikie M, Whyte K, Shuel M, et al. Laboratory characterization of invasive *Haemophilus influenzae* isolates from Nunavut, Canada, 2000–2012. *Int J Circumpolar Health*. 2016;75:29798. <http://dx.doi.org/10.3402/ijch.v75.29798>
15. Tuyama M, Corrêa-Antônio J, Schlackman J, Marsh JW, Rebelo MC, Cerqueira EO, et al. Invasive *Haemophilus influenzae* disease in the vaccine era in Rio de Janeiro, Brazil. *Mem Inst Oswaldo Cruz*. 2017;112:196–202. <http://dx.doi.org/10.1590/0074-02760160391>
16. Tsang RS, Proulx JF, Hayden K, Shuel M, Lefebvre B, Boisvert AA, et al. Characteristics of invasive *Haemophilus influenzae* serotype a (Hia) from Nunavik, Canada and comparison with Hia strains in other North American Arctic regions. *Int J Infect Dis*. 2017;57:104–7. <http://dx.doi.org/10.1016/j.ijid.2017.02.003>
17. Whittaker R, Economopoulou A, Dias JG, Bancroft E, Ramliden M, Celentano LP; European Centre for Disease Prevention and Control Country Experts for Invasive Haemophilus influenzae Disease. Epidemiology of invasive *Haemophilus influenzae* disease, Europe, 2007–2014. *Emerg Infect Dis*. 2017;23:396–404. <http://dx.doi.org/10.3201/eid2303.161552>
18. Efron AM, Moscoloni MA, Reijtman VR, Regueira M. Surveillance of *Haemophilus influenzae* serotypes in Argentina from 2005 to 2010 during the *Haemophilus influenzae* type b conjugate vaccine era [in Spanish]. *Rev Argent Microbiol*. 2013;45:240–7. [http://dx.doi.org/10.1016/S0325-7541\(13\)70030-0](http://dx.doi.org/10.1016/S0325-7541(13)70030-0)
19. Desai S, Tsang R, St. Laurent M, Cox A. Collaboration on a public health–driven vaccine initiative. *Can Commun Dis Rep*. 2014;40:365–8.