SARS Coronavirus

Disease Agent:

- SARS coronavirus

Disease Agent Characteristics:

- Family: *Coronaviridae*; Genus: *Coronavirus*
- Virion morphology and size: enveloped, helical nucleocapsid, spherical to pleomorphic, kidney-shaped, or rod-shaped particles, 100-130 nm in diameter
- Nucleic acid: linear, positive-sense, single-stranded RNA, ~29.8 kb in length
- Physicochemical properties: Virions sensitive to treatment with lipid solvents, nonionic detergents, formaldehyde, and oxidizing agents; stable in feces and urine at room temperature for at least 1-2 days, especially if diarrhea is present (high pH); only minimal reduction in infectivity after 21 days at 4°C and reduced by one log only after 48 hours at room temperature; heating to 56°C inactivates the agent quickly

Disease Name:

- Severe acute respiratory syndrome (SARS)

Priority Level:

- Scientific/Epidemiologic evidence regarding blood safety: Theoretical
- Public perception and/or regulatory concern regarding blood safety: Very low as there here have been no cases since 2004. It is likely that reemergence of agent would alter public perception.
- Public concern regarding disease agent: Moderate; it is likely that reemergence of agent would alter public perception.

Background:

- First cases occurred in Guangdong province in November 2002.
- Major outbreaks occurred in various countries in Southeast Asia (China/Hong Kong, Vietnam, and Singapore) from March through June 2003 and ended by July 2003.
- A North American outbreak occurred during the same time frame in Toronto.
- These outbreaks were categorized as having an unusually high level of infectivity through community exposure.
- There were very few well-documented SARS cases in the US.
- A few additional cases were reported in late 2003 and early 2004, and no cases have been reported since May 2004.

Common Human Exposure Routes:

- Bulk of spread is via droplets.
  - Up to 100 million genomes per mL are found in nasopharyngeal secretions detected in 32% of patients at mean 3.2 days after onset of illness and in 68% at Day 14.
  - Aerosol spread may occur during invasive procedures, such as endotracheal intubation.
- Contact with secretions or excretions of SARS-infected patients
  - Viral RNA detected in stool samples from 97% of patients 2 weeks after onset and in 42% of urine samples.
  - Fecal-oral transmission is strongly suspected.

Likelihood of Secondary Transmission:

- Significant by direct contact with symptomatic cases

At-Risk Populations:

- Family members in close contact with cases
- Health-care workers in close contact with cases
- Elderly and immune compromised individuals appear at increased risk.

Vector and Reservoir Involved:

- The civet cat (palm civet) in Southeast Asia is the likely source of introduction of the agent into humans. The SARS CoV RNA sequence found in palm civets is 99% identical to that found in humans. Similar RNA sequences have been found in bats, snakes, and monkeys.

Blood Phase:

- No data on viremia during asymptomatic phase
- Viral RNA is detectable in plasma from 2-16 days after onset of acute illness with one study reporting peak levels at days 5-7 of illness.

Survival/Persistence in Blood Products:

- Unknown

Transmission by Blood Transfusion:

- No cases have been documented.

Cases/Frequency in Population:

- Over 8000 cases and 900 deaths were reported to the World Health Organization, as of August 2003.
- No community acquired cases since May 2004
- Sporadic cases associated with laboratory accidents have occurred.

Incubation Period:

- 2-10 days

Likelihood of Clinical Disease:

- Most cases are thought to be symptomatic.
- Manifestations are shorter and milder in children.

Primary Disease Symptoms:

- Patients usually hospitalized 3-5 days following the onset of symptoms with clinical deterioration in the second week and recovery in the third week. Symptoms include fever, nonproductive cough, myalgia, dyspnea, headache, malaise, diarrhea, nausea/vomiting, high respiratory rate (>35/min), or progressive respiratory failure.
- From 14 to 26% of patients require mechanical ventilation.

Severity of Clinical Disease:

- Severe
- 20% of patients required ICU admission in a case series of 144 cases.
- Asymptomatic infection as evidenced by seropositivity in case-contacts has been reported.

Mortality:

- Case fatality rates range from 6.6 to 17.1%.

Chronic Carriage:

- No

Treatment Available/Efficacious:

- Supportive care
- Several antiviral drugs that have in vitro activity are available, but clinical efficacy has not been proven and resistance is a major concern.

Agent-Specific Screening Question(s):

- The FDA recommended a series of questions in the spring of 2003 when the SARS epidemic occurred.
  - In the past 28 days, have you been ill with SARS or suspected SARS?
  - In the past 14 days, have you cared for, lived with, or had direct contact with body fluids of a person with SARS or suspected SARS?
  - In the past 14 days, have you traveled to, traveled through, or resided in areas affected by SARS?
- Subsequently, with cessation of new SARS cases, the FDA removed the recommendation for these questions.

Laboratory Test(s) Available:

- No FDA-licensed blood donor screening test exists.
- Diagnostic assays include virus culture, NAT, and virus detection by immunofluorescense in tissue samples.

Currently Recommended Donor Deferral Period:

- The FDA recommended the following deferral criteria in conjunction with the agent-specific screening questions, while new cases were being identified.
  - 14 days from last exposure or 14 days after arrival in the US following travel/residence exposure
  - 28 days after complete symptom resolution and the cessation of any treatment

Impact on Blood Availability:

- Exposure to diagnosed SARS cases had minimal impact, but deferral based on travel/residence had moderate local impact during the outbreak period with loss of a large number of prospective donors dependent on the magnitude and location of the epidemic.
- Laboratory test(s) available: Not applicable

Impact on Blood Safety:

- Agent-specific screening question(s): Unknown, as transfusion transmission has not yet been proven.
- Laboratory test(s) available: Not applicable

Leukoreduction Efficacy:

- Unknown

Pathogen Reduction Efficacy for Plasma Derivatives:

- Multiple pathogen reduction steps used in the fractionation process have been shown to be robust in removal of enveloped viruses.

Other Prevention Measures:

- Developmental pathogen reduction methods (psoralens, riboflavin) have been shown to be effective.

Suggested Reading:

1. Booth CM, Matukas LM, Tomlinson GA, Rachlis AR, Rose DB, Dwosh HA, Walmsley SL, Mazzulli T, Avendano M, Derkach P, Ephtimios IE, Kitai I, Mederski BD, Shadowitz SB, Gold WL, Hawryluck LA, Rea E, Chenkin JS, Cescon DW, Poutanen SM, Detsky AS. Clinical features and short-term outcomes of 144 patients with SARS in the greater Toronto area. JAMA 2003;289:2801-9.
2. Che XY, Di B, Zhao GP, Wang YD, Qiu LW, Hao W, Wang M, Qin PZ, Liu YF, Chan KH, Cheng VC, Yuen KY. A patient with asymptomatic severe acute respiratory syndrome (SARS) and antigenemia from the 2003-2004 community outbreak of SARS in Gangzhou, China. Clin Infect Dis 2006;43:e1-5.
3. Dodd RY, Leiby DA. Emerging infectious threats to the blood supply. Annu Rev Med 2004;55:191-207.
4. Drosten C, Gunthers S, Preiser W, van der Werf S, Brodt HR, Becker S, Rabenau H, Panning M,

Kolesnikova L, Fouchier RA, Berger A, Burguière AM, Cinatl J, Eickmann M, Escriou N, Grywna K, Kramme S, Manuguerra JC, Müller S, Rickerts V, Stürmer M, Vieth S, Klenk HD, Osterhaus AD, et al. Identification of a novel coronavirus in patients with severe acute respiratory syndrome. N Engl J Med 2003;348:1967-76.

5. Food and Drug Administration Guidance for Industry. Revised recommendations for the assessment of donor suitability and blood product safety in cases of suspected severe acute respiratory syndrome (SARS) or exposure to SARS. [cited 2009 June]. Available from: http://www.fda.gov/BiologicsBloodVaccines/GuidanceComplianceRegulatoryInformation/Guidances/Blood/ucm075016.htm
6. Hon KL, Leung CW, Cheng WT, Chan PK, Chu WC, Kwan YW, Li AM, Fong NC, Ng PC, Chiu MC, Li CK, Tam JS, Fok TF. Clinical presentations and outcome of severe acute respiratory syndrome in children. Lancet 2003;361:1701-3.
7. Lee N, Hui D, Wu A, Chan P, Cameron P, Joynt GM, Ahuja A, Yung MY, Leung CB, To KF, Lui SF, Szeto CC, Chung S, Sung JJ. A major outbreak of severe acute respiratory syndrome in Hong Kong. N Engl J Med 2003;348:1986-94.
8. Leung GM, Chung PH, Tsang T, Lim W, Chan SK, Chau P, Donnelly CA, Ghani AC, Fraser C, Riley S, Ferguson NM, Anderson RM, Law YL, Mok T, Ng T, Fu A, Leung PY, Peiris JS, Lam TH, Hedley AJ. SARS-CoV antibody prevalence in all Hong Kong patient contacts. Emerg Infect Dis 2004;10:1653-6.
9. Ng ML, Lee JW, Leong ML, Ling AE, Tan HC, Ooi EE. Topographic changes in SARS coronavirus-infected cells during late stages of infection. Emerg Infect Dis 2004;10:1907-14.
10. Peiris JS, Lai ST, Poon LL, Guan Y, Yam LY, Lim W, Nicholls J, Yee WK, Yan WW, Cheung MT, Cheng VC, Chan KH, Tsang DN, Yung RW, Ng TK, Yuen KY; SARS Study Group. Coronavirus as a possible cause of severe acute respiratory syndrome. Lancet 2003;361:1319-25.
11. Poutanen SM, Low DE, Henry B, Finkelstein S, Rose D, Green K, Tellier R, Draker R, Adachi D, Ayers M, Chan AK, Skowronski DM, Salit I, Simor AE, Slutsky AS, Doyle PW, Krajden M, Petric M, Brunham RC, McGeer AJ; National Microbiology Laboratory, Canada; Canadian Severe Acute Respiratory Syndrome Study Team. Identification of severe acute respiratory syndrome in Canada. N Engl J Med 2003;348:1995-2005.
12. Seto WH, Tsang D, Yung RW, Ching TY, Ng TK, Ho M, Ho LM, Peiris JS; Advisors of Expert SARS Group of Hospital Authority. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). Lancet 2003;361:1519-20.
13. Tai DYH. SARS: how to manage future outbreaks? Ann Acad Med Singapore 2006;35:368-73.
14. Tsang KW, Ho PL, Ooi GC, Yee WK, Wang T, Chan-Yeung M, Lam WK, Seto WH, Yam LY, Cheung TM, Wong PC, Lam B, Ip MS, Chan J, Yuen KY, Lai KN. A cluster of cases of severe acute respiratory syndrome in Hong Kong. N Engl J Med 2003;348:1977-85.
15. Wang WK, Fang CT, Chen HL, Yang CF, Chen YC, Chen ML, Chen SY, Yang JY, Lin JH, Yang PC, Chang SC; Members of the SARS Research Group of National Taiwan University College of Medicine-National Taiwan University Hospital. Detection of severe acute respiratory syndrome coronavirus RNA in plasma during the course of infection. J Clin Microbiol 2005;43:962-5.
16. Wilder-Smith A, Teleman MD, Heng BH, Earnest A, Ling AE, Leo YS. Asymptomatic SARS coronavirus infection among healthcare workers, Singapore. Emerg Infect Dis 2005;11:1142-5.