Dengue fever in a rural hospital: Issues concerning transmission

Ross K Smith
Fifth Year Medicine (Hons) (Undergraduate)
James Cook University

Ross received a certificate of commendation for this report from the Centre for Healthcare Related Infection Surveillance and Prevention (CHRISP). He is passionate about surgery and medical education.

Introduction: Dengue is either endemic or epidemic in almost every country located in the tropics. Within northern Australia, dengue occurs in epidemics; however, the *Aedes aegypti* vector is widespread in the area and thus there is a threat that dengue may become endemic in future years. **Case presentation:** An 18 year old male was admitted to a rural north Queensland hospital with the provisional diagnosis of dengue fever. No specific consideration was given to the risk that this patient posed to other patients, including a 56 year old male with chronic myeloid leukaemia and prior exposure to dengue. **Discussion:** Much media and public attention has been given to dengue transmission in the scope of vector control in the community. Hospital-based dengue transmission from patient-to-patient requires consideration so as to minimise unnecessary morbidity and mortality. Vector control within the hospital setting appears to be an appropriate preventative measure in the context of the presented case. Transfusion and transplantation-related transmission of dengue between patients are important considerations. Vertical dengue infection is also noted to be possible. **Conclusion:** Numerous changes in the management of dengue-infected patients can be made that are economically feasible. Education of healthcare workers is essential to ensure the safety of all patients admitted to hospitals in dengue-affected areas. Bed management in particular is one area that may benefit from increased attention.

Introduction

Dengue is diagnosed annually in more than 50 million people worldwide and represents one of the most important arthropod-borne viral infections. [1-4] Estimates suggest that the potentially lethal complication of dengue haemorrhagic fever occurs in 500 000 people and an alarming 24 000 deaths result from infection annually. [1,2,4] Coupled with the increasing frequency and severity of outbreaks in recent years, dengue has been identified as a major and escalating public health concern. [2,4,5]

Whilst most of the burden of dengue occurs in developing countries, northern Australia is known to have epidemics. Suggestions have been made that dengue may become endemic in this region in future years based on increasing migration, international travel, population growth, climate change and widespread presence of vectors. [6-12] The vast majority of studies have focused on vector control in the community setting. [2,4,5,9] The purpose of this report is to discuss the risks of transmission of dengue in a hospital setting and in particular, patient-to-patient transmission. Transmission of dengue in a hospital is important to consider as immunological responses and health status of hospitalised patients can be poor. Inadequate management of dengue-infected patients may ultimately threaten the lives and complicate treatment of other patients, creating unnecessary economic costs and demands on healthcare. [12-14]

This case report highlights the difficulties of handling a suspected dengue-infected patient from the perspective of an Australian rural hospital. Recommendations are made to improve management of such patients, in particular, embracing technological advancements including digital medical records that are likely to become available in future years.

Case report

An 18 year old male, patient 1, presented to a rural north Queensland hospital emergency department with a four day history of fever, generalised myalgia and headache. He resided in an area that was known to be in the midst of a dengue outbreak. He had no past medical or surgical history and had never travelled. On examination, the patient's tympanic temperature was 38.9°C and he had dry mucous membranes. No rash was observed and no other abnormal findings were noted. Laboratory investigations, which included dengue PCR and dengue serology, were taken. He was admitted for observation and given intravenous fluids. A provisional diagnosis of dengue fever was made.

The patient was subsequently placed in a room with four beds. Whilst two of the beds in the room did not have patients in them, the remaining bed was occupied by patient 2, a 56 year old male with chronic myeloid leukaemia (CML), who had been hospitalised the previous day with a lower respiratory tract infection. The patient's medical history was notable for a past episode of dengue fever five years previously following an overseas holiday.

The patient with presumed dengue fever remained febrile for two days. He walked around the ward and went outside for cigarettes. He also opened the room window, which was unscreened. Tests subsequently confirmed that he had a dengue viral infection.

Whilst no dengue transmission occurred, the incident raised a number of issues for consideration, as no concerns regarding transmission was raised by staff or either patients.

Discussion

The dengue viruses are single positive-stranded RNA viruses belonging to the *Flaviviridae* family, with four distinct serotypes described. [4,12] Infection can range from asymptomatic, to a mild viral syndrome associated with fever, malaise, headache, myalgia and rash, or an eventual severe presentation characterised by haemorrhage and shock. [3,9] Currently the immunopathogenesis of severe dengue infection, which occurs in less than 5 percent of infections and includes dengue haemorrhagic fever and shock syndromes, is poorly defined. [2,3]

Whilst primary infection in the young and well nourished has been associated with the development of severe infection, the major

aetiology of severe infection is thought to be secondary infection with a different serotype. [3,9] This has been hypothesised to be as a result of an antibody-mediated enhancement reaction, although authors also suggest that other factors are likely to contribute. [3,4,9] Untreated dengue haemorrhagic fever is characterised by increased capillary permeability and haemostatic changes and has a mortality rate of 10-20 percent. [2,3,5] This complication can further deteriorate into dengue shock syndrome. [3] Whilst research shows that the serious complications of dengue infection occurs mainly in children, adults with asthma, diabetes and other chronic diseases may be at increased risk and secondary dengue infections could be life threatening in these groups. [4,5,15]

The most commonly reported route of infection is via the bite of an infected *Aedes* mosquito, primarily *Aedes aegypti.* [2-14] This vector feeds during the day, prefers human blood and breeds in close proximity to humans. [5,12,13] The transmission of dengue has been widely reported in the urban setting and has a geographical distribution including more than 100 countries. [3,13] However, only one study has reported dengue vector transmission from within a hospital. [16] Kularatne *et al.* (2007) recently described a dengue outbreak that started within a hospital in Sri Lanka and was unique such that a building site next to the hospital provided breeding sites for mosquitoes. [16] Dengue infection was noted to cause significant cardiac dysfunction, and of particular note was that medical students, nurses, doctors and other hospital employees were the main targets. [16] The authors report that at the initial outbreak one medical student died due to shock and severe pulmonary oedema as a result of acute viral myocarditis. [16] This case highlights the risk of dengue transmission within a hospital setting.

In addition to the vector-borne transmission, dengue can be also be transmitted by other routes, including transfusion. [17,18] The incidence of blood transfusion-associated dengue infection has been one area of investigation that has primarily been reported in endemic countries. In one study conducted in Hong Kong by Chuang *et al.* (2008) the prevalence of this mode of transmission was 1 in 126. [17] Whilst rare in Australia, an investigation undertaken during the 2004 outbreak in Cairns, Queensland calculated the risk of transfusion-related dengue infection by mathematical modelling and reported the risk of collecting a viraemic donation as 1 in 1028 persons during the course of the epidemic. [18] Donations from the affected areas were not used for transfusion. [18]

Case reports have also been published demonstrating that transplantation can represent a route of dengue infection between hospitalised patients. [19,20] Rigau-Pérez and Laufer (2006) described a six year old child who developed fever four days post-bone marrow transplantation and subsequently died. [19] Dengue virus was isolated from the blood and tissues of the child and the donor was subsequently known to have become febrile with tests for dengue being found to be positive. [19] Dengue infection resulting from solid organ transplantation has also been described in a 23 year old male with end-stage renal failure. [20] The donor of the transplanted kidney had dengue fever six months prior to the transplant and the recipient of the organ had dengue fever five days postoperatively. [20] The recipient had a complicated recovery and required an emergency laparotomy and blood products to ensure survival. [20] The authors of this case report further discuss the fact that the patient in question had resided in a dengue-endemic region and therefore could not exclude the usual mode of infection. [20]

Whilst not applicable to the presented case, vertical transmission of dengue has also been noted to be an important consideration in hospitalised patients. Reports from endemic countries have suggested that transmission can occur if infection of the mother occurs within eight days of delivery. [9,21] One neonatal death has been reported as a result of dengue infection and a number of studies have reported peripartum complications requiring medical treatment in other neonates. [21,22] Interpretation of this result should be viewed with caution due to difficulties cited in the clinical diagnosis of dengue in neonates, as it is possible that vertical transmission may be underreported. [22]

Taking into account the reported case study and presented evidence, it is clear that patient 1 presented a risk to patient 2. It is essential to acknowledge that dengue transmission can occur within a hospital setting. Whilst only one study has reported vector transmission of dengue within a hospital, it does define the real possibility of transmission associated with close contact and a competent vector. [16] There is also a need to emphasise the fact that patient 1 walked outside the hospital on numerous occasions and that unscreened windows were open within the hospital ward room. Consequently, it can be stated that patient-to-patient dengue infection would have been possible not only for patient 2, but also other admitted patients. Additionally, healthcare workers and community members that lived within the area surrounding the hospital were also at risk.

In acknowledging that vector transmission within a hospital is the most important hazard in regards to transmission of dengue from patient-to-patient, numerous control measures can be implemented to decrease the risk of transmission. Infrastructure plans within hospitals are important, as screened windows would decrease the ability of mosquitoes to enter hospitals. In those hospitals where such changes may not be economically feasible, studies have reported that having patients spend as much time as possible under insecticide treated mosquito nets, limiting outdoor time for infected patients, wearing protective clothing and applying insecticide numerous times throughout the day may decrease the possibility of dengue infection within hospitals. [23-25]

Educational programs for healthcare professionals and patients also warrant consideration. Numerous programs have been established primarily in the developing world and have proven to be beneficial. [26,27] It is important to create innovative education programs aimed at educating those healthcare workers that care for suspected dengue-infected patients as well as members of the public. This is one area that needs to be explored in future years.

Additionally, this case study demonstrates that current protocols in bed management do not consider a past medical history of dengue infection when assigning patients to beds. This report draws attention to the importance of identifying those patients at risk of secondary infection with dengue. As electronic patient records are implemented in many countries throughout the world, a past history of confirmed dengue infection needs to be considered. This may mean when resources are available, that patients are not placed in the same room thereby avoiding unnecessarily placing patients at risk. Whilst this would not completely exclude the possibility of dengue transmission in a hospital, it may set the trend for improved protocols in infection control particularly when secondary infection is associated with poorer outcomes. [2-5,9]

Conclusion

Infection control is often targeted in tertiary referral centres. This report clearly highlights the importance of appreciating infection control within a rural setting. Dengue infection between patients is a possibility with available evidence suggesting that this is most likely to be from exposure of an infected individual to a competent vector. Numerous changes have the potential to decrease the likelihood of dengue infection. Healthcare worker education is a critical component of these changes so that suspected dengue infected patients may also be educated regarding the risk that they represent to members of the public. The utilisation of screened windows, insecticide treated mosquito nets, and patient measures such as wearing protective clothing and applying insect repellents are all preventative measures that need to be considered. Future research is likely to develop technological aides for appropriate bed assignment. This will ensure that unnecessary morbidity and mortality associated with dengue infection are avoided.

Consent declaration

Informed consent was obtained from the patients for publication of this report.

Conflict of interest

None declared.

Correspondence

R Smith: ross.smith@my.jcu.edu.au

References

[1] World Health Organization. Dengue haemorrhagic fever: diagnosis, treatment, prevention and control. 2nd ed. Geneva: WHO; 1997 [cited 2012 June 28].
[2] Gibbons RV, Vaughn DW. Dengue: an escalating problem. BMJ. 2002; 324(7353):1563-6.
[3] Ranjit S, Kissoon N. Dengue hemorrhagic fever and shock syndromes. Pediatr Crit Care Med. 2011;12(1): 90-100.
[4] Guzman MG, Halstead SB, Artsob H, Buchy P, Farrar J, Gubler DJ, et al. Dengue: a continuing global threat. Nat Rev Microbiol. 2010;8(12 Suppl):S7-16.
[5] Mackenzie JS, Gubler DJ, Petersen LR. Emerging flaviviruses: the spread and resurgence of Japanese encephalitis, West Nile and dengue viruses. Nat Med. 2004;10(12 Suppl):S98-109.
[6] Hanna JN, Ritchie SA, Richards AR, Taylor CT, Pyke AT, Montgomery BL et al. Multiple outbreaks of dengue serotype 2 in north Queensland, 2003/04. Aust N Z J Public Health. 2006;30(3):220-5.
[7] Hanna JN, Ritchie SA, Hills SL, Pyke AT, Montgomery BL, Richards AR, et al. Dengue in north Queensland, 2002. Commun Dis Intell. 2003;27(3):384-9.
[8] Hanna JN, Ritchie SA. Outbreaks of dengue in north Queensland, 1990-2008. Commun Dis Intell. 2009;33(1):32-3.
[9] Whitehorn J, Farrar J. Dengue. Br Med Bull 2010;95:161-73.
[10] Gubler DJ. The changing epidemiology of yellow fever and dengue, 1900 to 2003: full circle? Comp Immunol Microbiol Infect Dis 2004; 27(5):319-30.
[11] Hsieh YH, Chen CW. Turning points, reproduction number, and impact of climatological events for multi-wave dengue outbreaks. Trop Med Int Health 2009;14(6):628-38.
[12] Murrell S, Wu SC, Butler M. Review of dengue virus and the development of a vaccine. Biotechnol Adv. 2011;29(2):239-47.
[13] Gubler DJ. Epidemic dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21st century. Trends Microbiol. 2002;10(2):100-3.
[14] McBride WJ. Deaths associated with dengue haemorrhagic fever: the first in Australia in over a century. Med J Aust. 2005;183(1):35-7.
[15] Lee MS, Hwang KP, Chen TC, Lu PL, Chen TP. Clinical characteristics of dengue and dengue hemorrhagic fever in a medical center of southern Taiwan during the 2002 epidemic. J Microbiol Immunol Infect. 2006;39(2):121-9.
[16] Kularatne SAM, Pathirage MMK, Kumarasiri PVR, Gunasena S, Mahindawanse SI. Cardiac complications of a dengue fever outbreak in Sri Lanka, 2005. Trans R Soc Trop Med Hyg. 2007; 101(8):804-8.
[17] Chuang VW, Wong TY, Leung YH, Ma ES, Law YL, Tsang OT, et al. Review of dengue fever cases in Hong Kong during 1998 to 2005. Hong Kong Med J. 2008;14(3):170-7.
[18] Seed CR, Kiely P, Hyland CA, Keller AJ. The risk of dengue transmission by blood during a 2004 outbreak in Cairns, Australia. Transfusion. 2009;49(7):1482-7.
[19] Rigau- Pérez JG, Laufer MK. Dengue-related deaths in Puerto Rico, 1992-1996: diagnosis and clinical alarm signals. Clin Infect Dis. 2006;42(9):1241-6.
[20] Tan FL, Loh DL, Prabhakaran K, Tambyah PA, Yap HK. Dengue haemorrhagic fever after living donor renal transplantation. Nephrol Dial Transplant. 2005;20(2):447-8.
[21] Chye JK, Lim CT, Ng KB, Lim JM, George R, Lam SK. Vertical transmission of dengue. Clin Infect Dis. 1997;25(6):1374-7.
[22] Sirinavin S, Nuntnarumit P, Supapannachart S, Bonnkasidecha S, Techasaensiri C, Yoksarn S. Vertical dengue infection: case reports and review. Pediatr Infect Dis J. 2004; 23(11):1042-7.
[23] Shuaib F, Todd D, Campbell-Stennett D, Ehiri J, Jolly PE. Knowledge, attitudes and practices regarding dengue infection in Westmoreland, Jamaica. West Indian Med J. 2010;59(2):139-46.
[24] Katz TM, Miller JH, Hebert AA. Insect repellents: historical perspectives and new developments. J Am Acad Dermatol. 2008;58(5):865-71.
[25] Rajatileka S, Burhani J, Ranson H. Mosquito age and susceptibility to insecticides. Trans R Soc Trop Med Hyg. 2011;105(5):247-53.
[26] Khun S, Manderson L. Community and school-based health education for dengue control in rural Cambodia: a process evaluation. PLoS Negl Trop Dis. 2007;1(3):e143.
[27] Ibrahim NK, Abalkhail B, Rady M, Al-Bar H. An educational programme on dengue fever prevention and control for females in Jeddah high schools. East Mediterr Health J. 2009;15(5):1058-67.