Eight cases of invasive *Klebsiella pneumoniae* infection from a public teaching medical institution in the USA

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**Background:** *Klebsiella pneumoniae* is a common human bacterial pathogen known to cause invasive infections such as primary liver abscesses, necrotizing fasciitis, meningitis and endophthalmitis with bacteraemia among patients in eastern Asia. Over the last decade, geographical spread and emergence of invasive *K. pneumoniae* infection has occurred in the USA. The majority of reported cases involve males with diabetes mellitus, of Asian ethnicity and who have recently travelled to Asia.

**Results:** We identified eight invasive cases with liver abscesses and necrotizing fasciitis at our institution. The most common risk factors associated with invasive infection were male gender and diabetes mellitus, which is consistent with other reported cases. However, Caucasians and Hispanics represented the majority of invasive disease (n=7), and history of recent travel to Asia was not identified in any of the cases.

**Discussion:** Further studies with larger cohorts involving multiple healthcare institutions in the USA are warranted to confirm these two unusual characteristics of infection. Healthcare professionals should be informed of the possible association between *K. pneumoniae* and invasive disease in male diabetic persons of non-Asian descent and without recent travel to Asia in the USA.

**Keywords:** debridement; drainage; invasive *Klebsiella pneumoniae*; liver abscess; necrotizing fasciitis.

**Background**

*Klebsiella pneumoniae* is a common human bacterial pathogen that can cause urinary tract infections, pneumonia, skin and soft-tissue infections, and bacteraemia. The organism is recognized worldwide by the healthcare community as an increasing public health concern due to its highly pathogenic nature, which causes disease in the community and nosocomial settings. Invasive *K. pneumoniae* is most notable in causing primary liver abscesses and necrotizing fasciitis among patients in eastern Asia (Lee et al., 2008; Liu et al., 2005; Rahimian et al., 2004; Wong et al., 2004; Yu et al., 2007). These types of infection are strongly associated with diabetes mellitus, malignancy and dissemination to other organs such as the liver, lungs, kidneys, eyes and brain (Lee et al., 2008; Liu et al., 2005; Persichino et al., 2013; Rahimian et al., 2004; Wong et al., 2004; Yu et al., 2007).

Over the past few decades, invasive infection caused by *K. pneumoniae* has been characterized and defined by bacteraemia associated with liver abscesses, necrotizing fasciitis, meningitis and endophthalmitis (Fang et al., 2005; Frazee et al., 2009; Gunnarsson et al., 2009; Lederman & Crum, 2005; Lee et al., 2008; McCabe et al., 2010; Nadas & Radek, 2007; Pastagia & Arumugam, 2008; Persichino et al., 2012; Shon et al., 2013; Siu et al., 2012; Yu et al., 2007). Although invasive infection occurs predominantly in eastern Asia, an increasing trend of invasive cases has recently been reported in the USA (Fang et al., 2005; Frazee et al., 2009; Gunnarsson et al., 2009; Lederman & Crum, 2005; McCabe et al., 2010; Nadas & Radek, 2007; Pastagia & Arumugam, 2008; Persichino et al., 2012; Rahimian et al., 2004; Siu et al., 2012). Most of these reported cases involve persons of Asian descent or those who have recently travelled to Asia (Fang et al., 2005; Frazee et al., 2009; Lederman & Crum, 2005; McCabe et al., 2010; Nadas & Radek, 2007; Pastagia & Arumugam, 2008; Rahimian et al., 2004; Siu et al., 2012). In contrast, reports of similar cases of invasive infection...
have been rare in non-Asian ethnic groups (Gunnarsson et al., 2009; McCabe et al., 2010; Persichino et al., 2012; Rahimian et al., 2004; Siu et al., 2012). The geographical spread and emergence of invasive *K. pneumoniae* infection in the USA emphasizes the importance of early recognition, diagnosis and treatment by healthcare professionals.

**Results**

A total of eight patients with *K. pneumoniae* invasive infection were identified recently at our institution. Three cases had necrotizing fasciitis and five were associated with liver abscesses. The presenting and pertinent demographic, clinical and microbiological characteristics of the eight invasive cases of *K. pneumoniae* are summarized in Table 1. The mean age was 56 years (range 24–75). Caucasians and Hispanics represented the majority of cases at 88% (*n*=7). Only one patient originated from Laos with Asian ethnicity. The most common risk factors associated with invasive infection were diabetes mellitus at 63% (*n*=5) and male gender at 88% (*n*=7). History of recent travel to Asia was not identified in any of the cases. Dissemination of invasive infection occurred at 88% (*n*=7) with identification of *K. pneumoniae* in urine and sputum cultures. All cases survived after medical intervention with intravenous antibiotics, aspiration of the liver abscess and surgical debridement of infected tissue.

**Discussion**

Whilst invasive *K. pneumoniae* infections are common in eastern Asia, they are rare in the USA. However, recent studies and case reports have shown that the incidence of this disease, particularly with liver abscesses, is increasing in the USA (Gunnarsson et al., 2009; McCabe et al., 2010; Persichino et al., 2012; Rahimian et al., 2004; Siu et al., 2012). Some of our observations are consistent with prior case reports and series in the USA (Fang et al., 2005; Frazee et al., 2009; Lederman & Crum, 2005; McCabe et al., 2010; Nadas et al., 2007; Pastagia & Arumugam, 2008; Siu et al., 2012). We noted similar rates of male gender and diabetes mellitus. Invasive infection commonly occurred in middle-age adults aged 55–60 years, and in men, whose risk was twice as high compared with that of women (McCabe et al., 2010; Rahimian et al., 2004; Siu et al., 2012).

The majority of reported invasive infections of *K. pneumoniae* were found in eastern Asia and in Asian patients living in or travelling to other countries outside of Asia (Lee et al., 2008; Liu et al., 2005; Rahimian et al., 2004; Wong et al., 2004; Yu et al., 2007). It is not clear whether this is due to a genetic predisposition to infection among Asians or a higher prevalence of virulent *K. pneumoniae* strains in Asia. In previous reports from the USA, invasive infections also occurred predominantly in persons of Asian descent who had recently travelled to Asia (Fang et al., 2005; Frazee et al., 2009; Lederman & Crum, 2005; McCabe et al., 2010; Nadas et al., 2007; Pastagia & Arumugam, 2008; Siu et al., 2012).
et al., 2005; Frazee et al., 2009; Lederman & Crum, 2005; McCabe et al., 2010; Nadasy et al., 2007; Pastagia & Arumugam, 2008; Rahimian et al., 2004; Siu et al., 2012). The two most important and intriguing findings of our cases were the high incidence rate of invasive infection among Hispanics and Caucasians without any recent travel to Asia. Interestingly, the racial and ethnicity makeup of our cases closely reflect the population represented in the county of Riverside where these patients reside (US Census Bureau, 2014). In an analysis of two large case series of invasive K. pneumoniae infection in the USA, 25 and 9 % of patients were of Hispanic and Caucasian origin, respectively, and an 8 % mortality rate was reported among all cases (Siu et al., 2012). No mortality occurred in our cases. Our cases without any history of travel to Asia raise the possibility of acquisition of K. pneumoniae in the USA. Globalization resulting in greater migration and travelling of Asians into the USA may be possible contributors to the rising infection rates. Bacterial strains of this organism from Asia may spread by colonization through direct contact by migrating immigrants and travellers to other persons in the USA. Faecal-to-oral transmission from gastrointestinal colonization of K. pneumoniae has been suspected on the basis of similar consistent molecular typing of isolates among infected patients and their siblings, family members and the environment (Nadasy et al., 2007). Further research is warranted to identify and eradicate potential host sources or environmental reservoirs of K. pneumoniae.

Healthcare professionals should be adequately informed of the various presentations of invasive K. pneumoniae infection, as well as the known major risk factors such as male gender, diabetes mellitus and recent travel to Asia. The diagnosis of K. pneumoniae should be confirmed by culture of infected material, as well as identifying the major virulence profiles of the isolated strains. Particularly with invasive disease, clinicians should be vigilant in screening for disseminated infection. Our case presentations corroborate the dissemination of K. pneumoniae to multiple organs such as the blood, kidneys and lungs.

An unusual presentation of invasive K. pneumoniae infection was observed in our single hospital in the southwestern USA, which may be indicative of a new and different predisposition of this organism. Although patients of Asian descent traditionally are at higher risk of invasive infection, the incidence of disease can also present in other ethnicities, particularly in Caucasians and Hispanics. Our cases may also provide early evidence for a new and increasing trend of disease in non-Asians without travel to Asia. Further studies with larger cohorts involving multiple healthcare institutions in the USA are warranted to confirm our observations for greater public health awareness.

References


