



Factors associated with farm-level infection of porcine epidemic diarrhea during the early phase of the epidemic in Japan in 2013 and 2014

Haruya Toyomaki^a, Satoshi Sekiguchi^b, Yosuke Sasaki^b, Masuo Sueyoshi^b, Kohei Makita^{a,*}

^a Veterinary Epidemiology Unit, School of Veterinary Medicine, Rakuno Gakuen University, 582, Bunkyo-dai-Midorimachi, Ebetsu, Hokkaido, Japan

^b Center for Animal Disease Control, University of Miyazaki, 1-1 Gakuenkibanadai Nishi, Miyazaki, Japan

ARTICLE INFO

Keywords:

Biosecurity
Case-control study
Japan
Porcine epidemic diarrhea
Risk factor
Survival analysis

ABSTRACT

The objective of this study was to investigate factors that caused rapid spread during the early phase of the porcine epidemic diarrhea (PED) epidemic in Japan in 2013 and 2014. Anonymized datasets from all pig farms were provided by Kagoshima (709 farms) and Miyazaki Prefectures (506 farms). Semi-parametric survival analysis was conducted using the first 180 days from the first case on December 3, 2013 in Kagoshima Prefecture. To compare the hazard between different farm management types, univariable survival analysis was conducted. As farm sizes varied among different farm types, bivariable survival analysis was conducted for farm size categories and farm density per km² for each management type. A case-control study using a postal questionnaire survey was conducted in September 2014, and risk factor analysis was performed using generalized linear models with binomial errors.

The hazard was significantly higher in farrow-to-finish farms than fattening farms [hazard ratio (HR) = 1.6, $p < 0.01$], but was not significantly different between reproduction and fattening farms (HR = 1.3, $p = 0.16$). In separate bivariable survival analyses for each farm type, large- and middle-scale farms had higher hazard than small-scale farms in fattening (HR = 5.8 and 2.6, respectively, both $p < 0.01$) and reproduction farms (HR = 4.0 and 3.6, respectively, both $p < 0.01$). In farrow-to-finish farms, large-scale farms had higher hazard than small-scale farms (HR = 2.8, $p < 0.01$), and higher farm density per km² was also a risk factor (HR = 7.6, $p < 0.01$).

In the case-control study, questionnaires were returned from 78 PED virus-infected and 91 non-infected farms. The overall response rate was 34%. Risk factors of the final model were occurrence of porcine reproductive and respiratory syndrome in the past 5 years [odds ratio (OR) = 1.97, 95% confidence interval (CI): 0.97–4.00, $p = 0.054$], use of a common compost station (OR = 2.51, 95%CI: 1.08–5.83, $p = 0.03$), and use of a pig excrement disposal service (OR = 2.64, 95%CI: 1.05–6.63, $p = 0.04$).

High hazard in farrow-to-finish farms suggested transmission from slaughterhouses to susceptible suckling piglets. Hazard associated with large-scale farms and high density might be due to frequent vehicle entrance and transmission by roads. Improvement of farm hygiene management and avoidance of risky practices associated with contact with pig excrement were keys in preventing invasion of PED virus to a farm.

1. Introduction

Porcine epidemic diarrhea virus (PEDv), a member of the family *Coronaviridae*, genus *alphacoronavirus*, is an enveloped, single-stranded, positive-sense RNA virus. PEDv infection has a substantial detrimental effect on the swine industry because the mortality rates are high, especially in suckling piglets (Pensaert and de Bouck, 1978; Li et al., 2012).

Since 2010, strains of PEDv have caused epidemics in China (Li et al., 2012). In 2013, a global pandemic occurred in countries

previously believed to be PEDv-free: The United States of America (USA), Canada, Mexico, Korea, Taiwan, and Japan (Cima, 2013; Mole, 2013; Stevenson et al., 2013; Chen et al., 2014; Park et al., 2014; Hanke et al., 2015; Song et al., 2015; Sasaki et al., 2016).

In Japan, PEDv emerged after an interval of 7 years in Okinawa in October 2013 and rapidly spread throughout Japan. The incidence peaked in 2014 and up to September 9, 2017, 1232 farms in 39 of 47 prefectures were infected and 543,902 piglets died (Fig. 1, MAFF, 2016). The epidemic subsequently subsided but continued to persist in 2017.

* Corresponding author at: Veterinary Epidemiology Unit, School of Veterinary Medicine, Rakuno Gakuen University, Japan.

E-mail addresses: [yahuhuhru@gmail.com](mailto:yahahuhru@gmail.com) (H. Toyomaki), sekiguchi@cc.miyazaki-u.ac.jp (S. Sekiguchi), yskssk@cc.miyazaki-u.ac.jp (Y. Sasaki), a0d802u@cc.miyazaki-u.ac.jp (M. Sueyoshi), kmakita@rakuno.ac.jp (K. Makita).

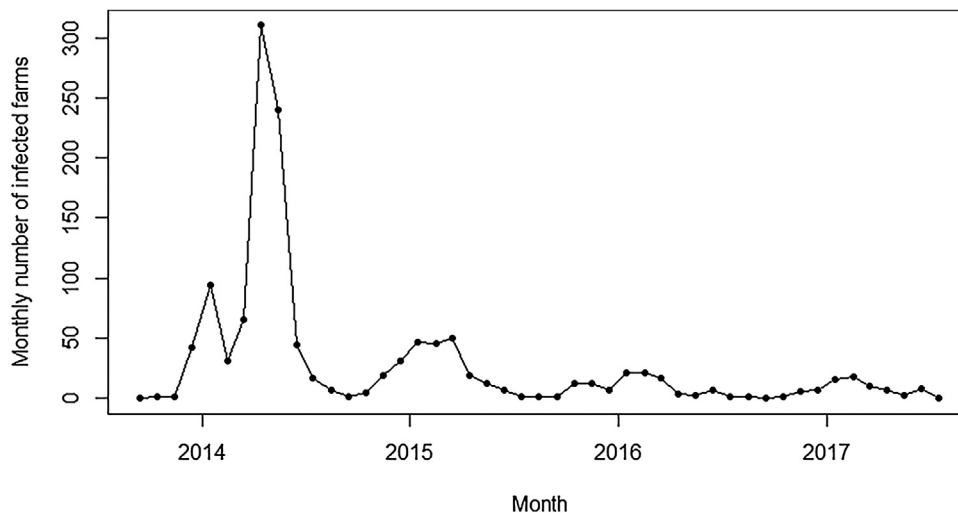


Fig. 1. Monthly number of PEDv infected farms in Japan between October 2013 and July 2017.

Molecular studies have indicated that the global pandemic was caused by the transmission of several different strains. The initial USA PEDv strain, under subgroup IIa, was the same strain detected in China in 2012 (Huang et al., 2013; Stevenson et al., 2013; Chen et al., 2014; Pasick et al., 2014). In Japan, PEDv strains isolated from recent outbreaks were genetically distinct from viruses which caused sporadic outbreaks until 2006 (Horie et al., 2016). The 38 PEDv strains collected between 2013 and 2014 in Japan were classified into two types: 34 North American type strains with high virulence and 4 insertion/deletion (INDEL) type strains; all strains were closely related to PEDv strains that were widespread in the USA and Korea in 2013 and 2014 (Suzuki et al., 2015). Another molecular analysis suggested that multiple transmissions of PEDv strains occurred between Japan, the USA, Canada, Mexico, Germany, and Korea (Yamamoto et al., 2016). As to the source of invasion, the PEDv genome detected in feed supplements at the first-case swine herd in Ontario, Canada, in January 2014 (Pasick et al., 2014) potentially suggested feed-borne invasion. However, the exact routes of the global PEDv pandemic have not been determined.

Regarding the factors causing rapid spread within countries, feeding spray-dried porcine plasma infected with PEDv was a suspected source (Gerber et al., 2014; Pasick et al., 2014), and transmission by trucks at harvest facilities was a biologically proven factor that caused rapid spread of PEDv in the USA (Lowe et al., 2014). In Canada, feed containing spray-dried porcine plasma was a source of rapid spread during the early phase of the epidemic (O'Sullivan et al., 2015). In Japan, a recently published study reported several risk factors of PEDv spread: large-scale farms, closer proximity to an infected farm, lack of veterinary visits to the farm, a greater number of feed truck visits to the farm, and shorter disinfectant contact time (less than 20 min) in trucks that transported pigs, although the study was limited by the representation of pig farms investigated [the study was conducted with management veterinarians belonging to the Japan Association of Swine Practitioners (JASP)] (Sasaki et al., 2016).

The present study was conducted to identify factors associated with inter-farm and slaughterhouse-mediated spread of PEDv in the early phase of the epidemic in southwestern Japan in 2013 and 2014, when the epidemic grew rapidly, by survival analyses using publicly available data and a case-control study using a questionnaire survey.

2. Materials & methods

2.1. Study area

Kagoshima and Miyazaki Prefectures are located in the southwestern part of Japan (Fig. 2). These prefectures have the largest and

second-largest numbers of pig producers in Japan, respectively (see exact numbers in the below section) (MAFF, 2013).

2.2. Collection of farm and epidemic information

The anonymized dataset from all pig farms was provided by the two prefectures (709 farms in Kagoshima Prefecture and 506 farms in Miyazaki Prefecture). The dataset included the administrative unit at the farm location, type of operation (farrow-to-finish, fattening, or reproduction), farm size as of June 2014 in Kagoshima and February 2014 in Miyazaki, PEDv infection status as of July 24, 2014, and the date of onset. In both prefectures, prefectural Livestock Hygiene Service Centers (LHSCs) receive notice of the occurrence of a suspected case from either the farmer or a veterinarian, and veterinarians at the LHSC sample the diseased animals or feces. A diagnosis was made based on the combination of clinical symptoms, reverse transcription polymerase chain reaction (RT-PCR) analysis, and immunohistochemistry (IHC) testing. For cases in which only feces were sampled, a diagnosis was made based on clinical symptoms and RT-PCR analysis. Infected farms reported were those diagnosed with PEDv infection based on the above tests, and therefore some infected farms might have been misclassified as “non-infected” farms if not notified to the prefectures, particularly among farms with only low-susceptible grower pigs (Lee, 2015).

Size category classification was derived from animal health services in Japan according to the type of operation. For reproduction farms, small-scale referred to farms with fewer than 100 sows; middle-scale: 101–300 sows; and large-scale: over 300 sows. For farrow-to-finish and fattening farms, small-scale referred to farms with fewer than 1000 pigs total; middle-scale: 1001–3000 pigs; and large-scale: over 3000 pigs. This classification was used for survival analyses and to match controls with cases in the questionnaire survey.

A summary of countermeasures taken before and during the epidemic was provided by both prefectures.

The areas of city/township/village administrative units were obtained from the public database of the Geospatial Information Authority of Japan (GSI, 2014). Farm density in each administrative unit was calculated by dividing the total number of any type of pig farm by the square kilometer of the unit.

Meteorological data to compare mean temperatures between February 2014 and the averaged mean February temperatures between 1981 and 2010 as well as that of March 2014, were collected from the public database (Japan Meteorological Agency, 2016) to determine whether the temperature in February 2014 was particularly high and whether slowdown of the epidemic occurred due to this effect.

Download English Version:

<https://daneshyari.com/en/article/8503564>

Download Persian Version:

<https://daneshyari.com/article/8503564>

[Daneshyari.com](https://daneshyari.com)