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Zoonoses Department

The zoonotic potential of some human gastrointestinal viruses

Thesis Presented by

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(M.V.Sc Zoonoses 2012)

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Abstract

Viral gastroenteritis is a major cause of severe acute gastroenteritis among infants and young children throughout the world. The current study was conducted to investigate the possible role of animals in the epidemiology of human rotavirus strains and human astrovirus to give insights about the zooanthroponotic transmission cycle of such strains in rural settings. For this purpose, stool specimens were collected from 52 diarrheic children inhabiting rural settings as well as fecal samples from 38 diarrheic calves and 92 rats (88 *Rattus rattus norvigecus* and 4 *Rattus rattus rattus*). All human and animal samples were firstly screened for the presence of rotavirus using ELISA kit. Afterwards, all ELISA positive samples were then examined for the occurrence of human rotavirus using RT-PCR. Of 52 diarrheic children, 8 were positive for human rotavirus giving prevalence 15.4%, whereas the prevalence of human rotavirus among examined animals was 2.6% and 3.3% for calves and rats respectively. Seriously, the blasting and phylogenetic analysis of randomly selected one human and one rat sequences revealed 99% and 98% identity with human rotavirus genotype G3P[8] respectively. Furthermore, fecal samples from 44 diarrheic cattle (12 adult cattle and 32 calves) and 40 rats (36 (*Rattus rattus norvigecus*) and 4 (*Rattus rattus rattus*)) were examined for the detection of human astrovirus firstly by ELISA then RT-PCR confirmation. Of 44cattle, two were confirmed positive samples for human astroviruses, with prevalence 4.5%, whereas, among rat samples, two positive samples could be detected by ELISA however such samples were negative by RT-PCR. In conclusion, both human rotavirus and human astrovirus may circulate among cattle and rats and thus the reverse zoonotic transmission cycle cannot be ruled out in rural settings.

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List of Abbreviations

Abbreviation	Name
BAstV	Bovine Astrovirus
bp	Base pair
ELISA	Enzyme linked immunosorbent assay
HAstVs	Human Astroviruses
PoAstVs	Porcine Astroviruses
RNA	Ribonucleic acid
RT-PCR	Reverse transcription-polymerase chain reaction
RVA	Rotavirus type A
WHO	World Health Organization

Chapter (1): Introduction

Introduction

Viruses infection considered one of the most public health threats worldwide. The first characterization of viruses infecting humans was in 1901**(Woolhouse *et al.*, 2012)** while viruses causing diarrhea remained unknown until it was discovered in 1972, when the first virus causing gastroenteritis (norovirus) was specified in an outbreak of diarrhea in Norwalk (Ohio, United States) (**Lee B E. and Pang X L. 2013)**.

In the near future after the detection of norovirus, several viruses causing gastroenteritis were described, where rotavirus was discovered in epithelial cells of children with gastroenteritis, astrovirus in infantile diarrhea cases, enteric adenoviruses in the feces of children with acute diarrhea, and sapovirus through an outbreak of gastroenteritis in an orphanage home in Japan, within area called Sapporo **(Munnink and Hoek, 2016)**.

According to WHO record, 110 million cases requiring two million hospitalizations occur every year with approximately 500,000 deaths per year belong to rotavirus gastroenteritis mostly in developing countries, in which 453,000 deaths in children younger than 5 years old **(WHO 2012).**

All the gastrointestinal viruses spill over by the fecal-oral route transmission. Rotavirus is one of the leading cause of severe diarrhea in children and second cause of gastroenteritis in adult **(Munnink and Hoek, 2016).** The clinical symptom of rotavirus ranged from subclinical infection to severe gastroenteritis

with diarrhea, vomiting, and fatal dehydration. On the other side, the naming for rotavirus, is binomial with the outer capsid viral proteins; G protein (VP7, a glycoprotein), and P protein (VP 4, a protease-cleaved protein).These allow to define the strains, which have been shown to vary over time from location to another **(Kawai *et al*., 2012; Desselberger 2014)**.

On the other hand, human astroviruses are responsible for more than 20% of sporadic cases of viral acute gastroenteritis, with incidence rates varies from 0.5% to 15% in outbreaks of acute gastroenteritis **(De Benedicitis *et al*., 2011)**. Moreover, the average incidence of human astroviruses infection is 11% worldwide, being 7% and 23% in urban and rural areas, respectively. Although, astroviruses infection occurs in both developing and developed countries, higher incidence rates were observed in the low-income countries. Classic human astrovirus infections circulate throughout the year, however, a peak of detection has been observed in colder months of temperate regions, while in tropical areas, high incidence of classic human astrovirus infections is likely to occur in the rainy season **(Bosch *et al*., 2014)**.

There are a broad variety of animal species infected with both rotavirus and astrovirus, which have high considerable genetic variety **(Wolfaardt *et al.*, 2011).**Thus, different animal species might act as a reservoir and finally infect humans through a cross species transmission and subsequent adaptation of the viruses to the new host **(De Benedectis *et al*. , 2011)**. Beside infecting humans,

rotavirus has been detected in different animal species, including farm animals (cows, pigs, and sheep), wild animals (llamas, giraffes), nonhuman primates (macaques), domestic pets (dogs, cats), rodents, and birds **(Martella *et al.*, 2010).**Furthermore, rotaviruses detected in animals can infect humans or sharing one or several genes to reassort with human rotavirus genotypes **(Ghosh and Kobayashi 2014)**.

The identification of novel human astroviruses that are genetically related to astroviruses in rats, sheep and minks suggest that wild mammals might act as a reservoir for human astroviruses. The identification of a recombinant event that may have occurred between a human astrovirus genotype 4 and a California sea lion astrovirus genotype 2 support this hypothesis **(Rivera *et al.*, 2010).**

Similar to rotavirus, astrovirus strains have been identified in feces of several mammals like cats, cattle, deer, dogs, mice, rats, pigs, sheep, mink, bats, cheetahs, rabbits, sea lions and dolphins; in addition to avian species like turkeys, chickens, ducks, pigeons, guinea fowl and also in other wild aquatic birds **(Bosh *et al*, 2014)**.

In Egypt, diarrheal diseases have a great public health burden among children below 3 years of age. Up to date, there is a few epidemiological studies that concerning the circulation and burden of enteric viruses in Egypt **(Kamel *et al.*, 2009)**.

Therefore, the current study was conducted to investigate the occurrence of human rotavirus and human astrovirus among cattle and rats as a potential hosts existing within the community of the rural settings to explore the possible reverse zoonotic transmission of such viruses and its public health significance.

The main goals of this study are to:

-Investigate the epidemiology of rotavirus, and astrovirus as a model of gastrointestinal viruses in rural settings.

-Investigate the reverse zoonotic potential of these viruses between human and animals in contact.

- Find out the similarity between viruses detected in human and animals using the phylogenic analysis as we can.

Chapter (2): Review article