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ORIGINAL PAPERS

VIRAL GASTROENTERITIS OUTBREAKS IN DEPLOYED BRITISH TROOPS DURING 2002-7

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Abstract

Objectives: The aim of this study was to see what lessons could be learnt from the suspected viral gastroenteritis outbreaks that have occurred in deployed British troops during 2002-7.

Method: Epidemiological and laboratory data from identifiable outbreaks were reviewed, including epidemic curves and the results of PCR testing for enteropathic viruses.

Results: The epidemic curves of outbreaks varied predictably in accordance with the size of the population at risk and whether this population was constant or expanding. Of 11 outbreaks identified, 10 (91%) had a proven viral cause and 10 (91%) occurred in Iraq. Of 84 enteropathic viruses identified, 61 (73%) were noroviruses and these included both unknown strains and those that were common in the UK and Europe. Of the 10 viral outbreaks, 3 (30%) occurred in medical units, 5 (50%) were associated with large-scale relief in place (RiP) deployments and 5 (50%) involved >3 different viruses, which is strongly suggestive of food or water contamination.

Conclusion: These findings can help to predict future viral gastroenteritis outbreaks and target improved prevention strategies appropriately. However, more systematic studies are now required.

Keywords: Gastroenteritis, Norovirus, Rotavirus, Adenovirus, Sapovirus, Military Personnel, Military Hygiene, Iraq, Afghanistan

Introduction

Gastroenteritis has always been a scourge on military campaigns [1], but recent experience suggests that the usual bacterial causes are being overtaken by viruses [2-4]. Norovirus is now a major cause of gastroenteritis outbreaks in military populations [5] and other semi-closed communities such as hospitals, hotels, cruise ships, nurseries and nursing homes [6]. Outbreaks in deployed military medical facilities have been a particular problem [2,3,7]. Norovirus is well-adapted to cause such outbreaks because of its high infectivity, multiple routes of transmission, pre-symptomatic and post-symptomatic viral shedding, high survivability in the environment, resistance to disinfectants, and poor long-term immunity after infection [6].

However, there are many other possible causes of gastroenteritis during military deployments and tests to confirm viral causes are usually not available in deployed microbiology laboratories. Hence the investigation of gastroenteritis outbreaks is complex and requires that samples be sent to a reference laboratory. As a result there is a tendency for outbreaks with no proven bacterial cause to be labelled as "viral" and not further investigated. This study shows what can already be learnt from routine data collected during 2002-7 and suggests that further systematic studies are now required.

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Methods

Gastroenteritis cases on overseas deployments should all be reported using the military FMed 85 notification form and J95 health data collection system. However, many cases will be missed during combat operations or large outbreaks and so these records will usually under-estimate the scale of the problem. Direct reporting of cases to Communicable Disease Control staff at the Defence Medical Services Department in the Ministry of Defence may also be undertaken by Role 3 medical facilities (field hospitals and hospital ships) during large outbreaks. We reviewed the epidemiological data from outbreaks that were directly reported during 2002-7.

Troops with gastroenteritis that present to Role 3 medical facilities on deployments are unlikely to have a trivial illness and so will usually have faecal samples sent for investigation. These samples are collected within 24 hours of admission and sent to the deployed microbiology laboratory for standard bacterial culture investigations to detect enteropathic bacteria, including Campylobacter spp., Salmonella spp., Shigella spp., Escherichia coli O157 and also Vibrio spp. where clinically indicated. If there is clinical suspicion of a viral gastroenteritis outbreak, then the remainder of the each faecal sample is stored locally at 4°C for up to 2 weeks, transported at room temperature to the UK and forwarded on to the Enteric Virus Unit of the HPA Centre for Infections. Enteropathic viruses and norovirus genotypes are identified using a standard set of PCR tests described previously [2]. Samples from ≥6 patients are usually required to identify a viral gastroenteritis outbreak [8]. We reviewed the laboratory data from outbreaks that had samples referred to the HPA laboratory during 2002-7.

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Results

Epidemiological data from direct reporting of gastroenteritis cases was available for several outbreaks during 2002-7 and significant variation was seen between these. The outbreaks at Bagram, Afghanistan in May 2002 and on RFA Argus in April 2003 occurred in small, constant populations and showed a rapid rise and fall in the number of cases (Figure 1). The outbreak at Shaibah, Iraq in April 2003 occurred in a large, expanding population and was more prolonged (Figure 2). Since then it has been observed that most outbreaks have occurred in Iraq at the time of a large-scale relief in place (RiP) deployment, where fresh troops are introduced from the UK and the density of troops in the camps doubles during the change-over period. Such outbreaks have occurred from April 2004 (Figure 3) until the present day (Figure 4). So far no outbreaks have been reported from the deployments in Helmand, Afghanistan that have been on-going since February 2006.

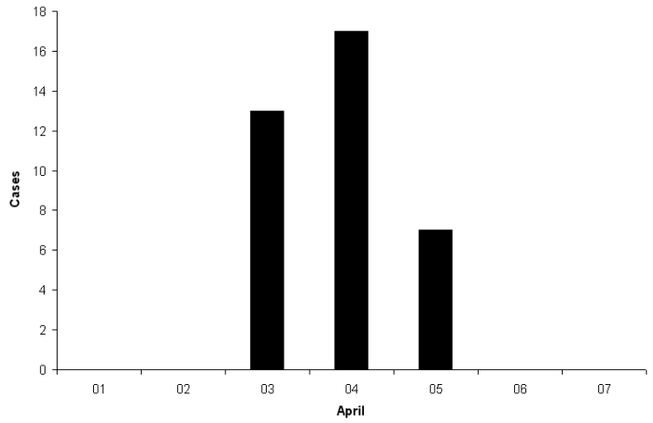

Figure 1. Epidemic curve for gastroenteritis outbreak on RFA Argus in April 2003.

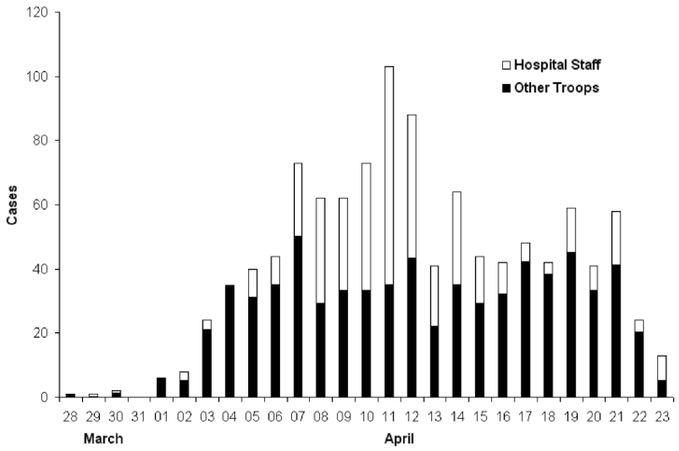

Figure 2. Epidemic curve for gastroenteritis outbreak at Shaibah, Iraq in April 2003.

Laboratory data from the deployed microbiology laboratories showed that the majority of gastroenteritis cases were not diagnosed using standard bacterial cultures (Figure 3). The minority of cases with a proven bacterial cause were due to Shigella, Salmonella and Campylobacter in order of frequency (data not shown). Results from the HPA Enteric Virus Unit showed that 132 faecal samples were received from suspected viral gastroenteritis outbreaks in deployed troops during 2002-7. Of these, 79 samples (60%) contained enteropathic viruses and 5 samples (4%) had >1 virus each. Of the 84 viruses identified, 61 (73%) were noroviruses (Table 1) and genotyping with genetic sequence analysis showed that some of these (eg. Shaibah, April 2003) were previously unknown, whereas others (eg. Basra, November 2007) were common UK or European strains [9]. Overall, there were 11 outbreaks investigated (Table 2), of which 10 (91%) had a proven viral cause and 10 (91%) occurred during Operation Telic. Of the 10 viral gastroenteritis outbreaks, 3 (30%) occurred in medical units, 5 (50%) were associated with large-scale RiP deployments and 5 (50%) involved >3 viruses (when different norovirus genotypes were considered).

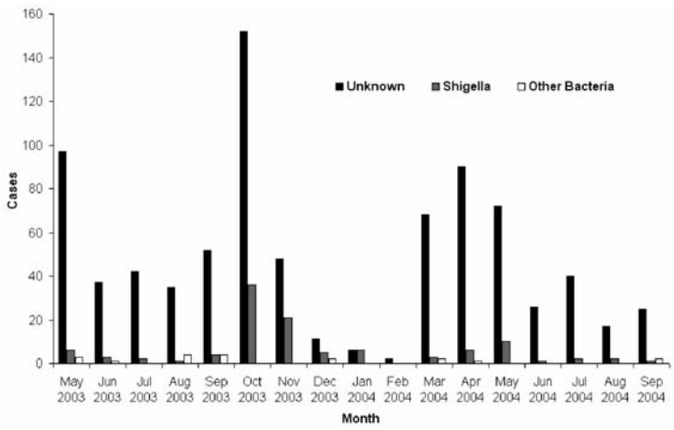

Figure 3. Epidemic curve for gastroenteritis cases at Shaibah, Iraq from May 2003 – September 2004.

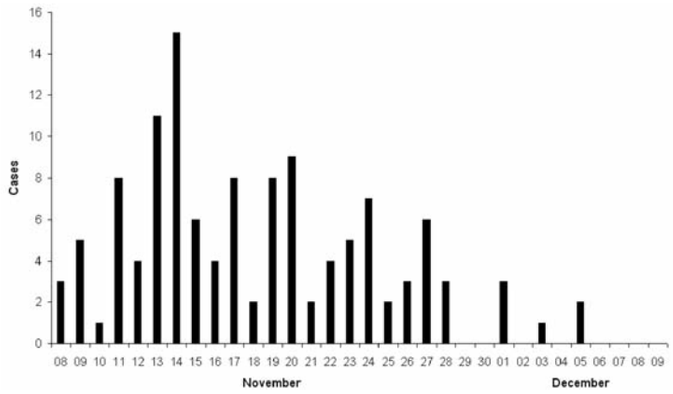

Figure 4. Epidemic curve for gastroenteritis outbreak at Basra, Iraq in November 2007.

Virus	Cases (%)
Norovirus	61 (73%)
Rotavirus	8 (10%)
Enteric Adenovirus	8 (10%)
Sapovirus	7 (9%)
Astrovirus	0 (0%)

Table 1. Enteropathic viruses in samples during military deployments from 2002-7 (N = 132)

Discussion

Although it was not possible to assess the full impact of gastroenteritis in deployed British troops during 2002-7, it was generally thought to be the greatest single cause of morbidity and a significant drain on operational effectiveness during this period. However, this study does identify certain features of viral gastroenteritis outbreaks that can be used to predict similar occurrences in the future and make recommendations on their prevention and control.

The epidemic curves of viral gastroenteritis outbreaks in deployed troops varied predictably in accordance with the population at risk. Outbreaks are likely to be prolonged when there are large or expanding populations, multiple viruses, environmental contamination or person-to-person spread involved. If more detailed epidemiological data was available,

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Date	Location	Operation	Medical Unit	During RiP	Samples (n)	NoV Strains	Other Viruses	>3 Viruses
May 2002	Bagram, Afghanistan	Veritas	Y	N	5	1	-	N
Apr 2003	RFA Argus, Persian Gulf	Telic	Y	N	13	3	SaV, RV	Y
Apr 2003	Shaibah, Iraq	Telic	Y	N	9	4	-	Y
Aug 2003	Shaibah, Iraq	Telic	N	N	7	0	-	N
Apr 2004	Shaibah, Iraq	Telic	N	Y	16	2	SaV, EAdV	Y
Oct 2004	Shaibah, Iraq	Telic	N	Y	13	4	RV	Y
Nov 2005	Shaibah, Iraq	Telic	N	Y	5	2	-	N
Feb 2006	Shaibah, Iraq	Telic	N	N	8	0	RV	N
Nov 2006	Shaibah, Iraq	Telic	N	Y	10	3	SaV	Y
Apr 2007	Basra, Iraq	Telic	N	N	3	2	-	N
Nov 2007	Basra, Iraq	Telic	N	Y	26	1	EAdV	N

Table 2. Gastroenteritis outbreaks during military deployments from 2002-7 (N = 115)
RiP, Relief in Place; NoV, norovirus; SaV, sapovirus; RV, rotavirus; EAdV, enteric adenovirus.

then these factors could be used to model and predict the extent of future outbreaks.

The approach used to confirm viral gastroenteritis outbreaks appears to have been effective and efficient since 60% of faecal samples submitted were found to contain enteropathic viruses and 91% of outbreaks investigated were proven to have a viral cause. We commend clinical and laboratory staff for sending these samples and recommend that results be returned to them as quickly as possible.

As expected, norovirus was the commonest cause of viral gastroenteritis, but it accounted for only 73% of enteropathic viruses found and did not feature at all in some outbreaks. The range of pathogens identified suggests that it would be difficult to introduce all the necessary diagnostic tests to the deployed microbiology laboratories and PCR techniques remain the preferred choice [10]. The diversity of pathogens also indicates that prophylaxis against a single virus would be of limited value and prevention measures will always need to be targeted at all causes of gastroenteritis.

Genotyping and genetic sequence analysis showed that some of the norovirus strains were previously unknown and so were probably acquired locally in Afghanistan or Iraq, whereas others were common UK or European strains and so were probably taken into theatre by British troops. This type of analysis was also useful in showing that there was no virological connection between the outbreaks that affected 34 Field Hospital RAMC at Bagram, Afghanistan in May 2002 [7] and at Shaibah, Iraq in April 2003 [3].

The occurrence of so many outbreaks during RiP periods merits particular attention. These could have been initiated by the exposure of newly-arrived troops to viruses overseas or by the introduction of UK and European viruses from newly-arrived troops themselves. In fact the norovirus genotype and genetic sequence data shows that both possibilities occurred. However, in both scenarios the problem was likely to have been exacerbated by the increased density of troops being accommodated during RiP periods. We recommend that troops with gastroenteritis should not deploy until at least 48 hours after all symptoms have resolved and that environmental health and infection control measures [11] should be strengthened during RiP periods.

Likewise the occurrence of so many outbreaks involving >3 different viruses is important because it strongly suggests these outbreaks were initiated by gross contamination of food or water. (Other routes of entry to initiate the outbreaks would not have resulted in so many different viruses being involved.) This was unquestionable in the RFA Argus outbreak [2] and is highly likely in all other outbreaks where >3 different viruses were identified. The possibility that this contamination occurred deliberately at some point along the supply chain or during food preparation should be considered. We recommend that fresh rations should not be introduced on deployments until adequate environmental health and infection control facilities have been established and inspected [3].

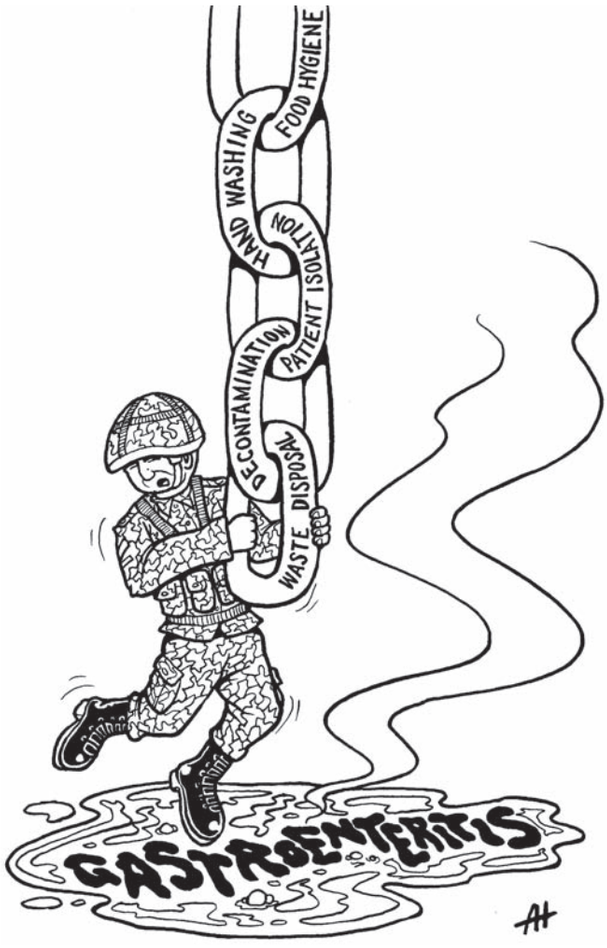

Figure 5. Chain of prevention against gastroenteritis outbreaks.

It should not be assumed that all cases or outbreaks of gastroenteritis on military deployments are due to enteropathic viruses. The testing of faecal samples using standard bacterial cultures in deployed microbiology laboratories remains essential even if the yield of positive results is low. It is also important to remember other bacterial causes of gastroenteritis that are more difficult to detect, such as enterotoxigenic Escherichia coli

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(ETEC) infection. In fact ETEC was first identified as the major cause of travellers' diarrhoea in a study on deployed British troops [12], it was a problem during the Gulf War [13] and remains so amongst US troops in the current Iraq and Afghanistan conflicts [14]. We recommend that future studies include techniques for identifying these types of bacterial infections as well.

Further work is required to determine the full impact of gastroenteritis on deployed British troops and to identify better prevention and control strategies. For example, at present certain interventions (eg. hand washing) are emphasised, but this is only one link in a chain of environmental health and infection control measures that needs to be maintained to avoid gastroenteritis outbreaks (Figure 5). Future studies will need to be more systematic, properly-resourced and able to identify cases that do not present to Role 3 medical facilities. If better epidemiological data was available, then it would be possible to create mathematical models of gastroenteritis outbreaks and determine the cost-effectiveness of various interventions, including vaccines that may become available in the next 10 years [15].

Acknowledgements

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