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Gut Colonisation with Carbapenem Resistant Organisms Containing OXA-48 in Spinal Injuries Unit; Screening of Faeces and Urine Samples

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Introduction

Spinal injuries units often house patients for long periods of time during rehabilitation, making transfer of colonising organisms between patients more likely. Carbapenemase producing organisms (CPO) limit clinical management of seriously ill patients. CPOs are considered a global threat and many hospitals now perform faecal screening to assist in the control of spread of disease. Some CPOs are difficult to detect, testing susceptible to some carbapenems. A further difficulty for detection of colonising CPOs is that they may be present in low numbers. This study compared a number of methods to detect OXA-48 containing bacteria colonising patients in a spinal injuries unit.

Methods

200 faeces and 197 urine samples from 49 patients were collected on 9 occasions over an 8 month period in 2014 (Table 1). Three screening methods were employed at different stages of the study (Fig. 1). Method 1 - 50µL of urine or a 10µL loop of faeces was cultured direct onto plates (blood agar (BA), UTI chromogenic agar (UC) and carbapenemase screening agar (CA) made with UTI chromogenic agar, 1mg/L ertapenem and 8mg/L vancomycin).
Methods 2 and 3 were preceded by an enrichment stage of overnight incubation of 10µL of faeces or 1mL of urine in 10mL Tryptone Soy Broth (TSB) containing either 4mg/L cefotaxime (CTX) (Method 2) or 1mg/L ertapenem (ERT) (Method 3). OXA-48 PCR was performed on isolates from selective media as standard and on non-selective media on known positives. A patient with an OXA-48 positive isolate at any time during the screening is identified as PP. All OXA-48 isolates were tested for susceptibilities by EUCAST disk diffusion method and typed by VNTR and PFGE. Infection control procedures were applied at a point during the study in reaction to the isolation of OXA-48 positive organisms.

Fig 1: Methods employed by study

Method 1 – ***BA, UC & CA***

Method 2 *TSB with 4mg/L CTX*	**Method 3** *TSB with 1mg/L ERT*

Overnight incubation, then culture on BA, UC & CA

Table 1: Methods used in the study varied over time. PP screened positive for OXA-48 at various times in the study.

Month (2014)	Method used	No of samples screened	No of patients screened	PP screened	PP sample screened as OXA-48 positive
Mar	1	38	19	PP 1, 2 & 6	PP 1
Apr	1	34	17	PP 1, 2 & 6	PP 1
May	1	30	13	PP 1, 2 & 6	–
Jun	1	39	19	PP 1 & 2	PP 2
Jul	1 & 2	38	25	PP 1, 2, 3, 4, 5	PP 3, 4 & 5
	2	40	20	PP 4, 5, 6	–
	2 & 3	4	2	PP 3	PP 3
	3	111	20	PP 3, 4, 5, 6, 7	PP 3, 6 & 7
Aug	3	12	7	–	–
Sep	3	4	2	–	–
Oct	3	47	24	PP 2, 3, 6, 7	–

Results

7/49 patients tested positive for OXA-48; *K. pneumoniae* (2 patients) and *E. coli* (5 patients). CPOs were recovered from urine only in 2 patients, faeces only in 1 patient and in both urine and faeces in 4 patients. CPOs were isolated on multiple occasions/samples from the same patients (Table 2). On 8/9 occasions where methods 1 and 2 or 2 and 3 were performed simultaneously, CPOs were recovered where enrichment was used.

PP	Organism	M1	Both M1&2		M2	Both M2&3		M3
			M1	M2		M2	M3	
1	*K. pneumoniae*	1/5	0/2	0/2	–	–	–	0/6
2	*K. pneumoniae*	2/10	0/2	0/2	–	–	–	–
3	*E. coli*	–	0/2	1/2	0/2	–	–	0/4
4	*E. coli*	–	0/2	2/2	0/1	–	–	0/2
5	*E. coli*	0/4	0/1	0/1	0/1	–	–	2/4
6	*E. coli*	–	0/2	0/2	–	0/2	0/2	1/5
7	*E. coli*	–	0/2	2/2	–	1/2	1/2	–

Table 2 *(left)*: Positive patients (PP): Number of positives / number of screens performed for each method (M).

Table 3 *(below)*: Susceptibility testing and typing for each OXA-48 positive.

PP	Organism	AMP	GEN	COA	CAZ	CTX	ERT	IMI	MER	CLX	TZP	AMI	CIP	Typing Result
1	*K. pneumoniae*	R	R	R	R	R	R	S	S/R	R	R	S	R	3,5,5,-,2,1,2,4,1
2	*K. pneumoniae*	R	R	R	R	R	R	I	I	R	R	S	I	5,6,1,9,2,2,2,3,1
3	*E. coli*	R	S	R	R	R	R	S	S/R	R	R	S	S	CARDP0ES-7
4	*E. coli*	R	S	R	R	R	R	S	S	R	R	S	S	CARDP0ES-7
5	*E. coli*	R	R	R	R	R	R	S	R	R	R	S	S	CARDP0ES-7
6	*E. coli*	R	S	R	R	R	R	I	I	R	R	S	S	CARDP0ES-7
7	*E. coli*	R	S	R	R	R	R	S	I	R	R	S	S	CARDP0ES-7

For all OXA-48 positive organisms imipenem (IMI) tested susceptible (S) or intermediate (I). For meropenem (MER) only 1 isolate regularly tested resistant (Table 3). All isolates were resistant (R) to 3rd generation cephalosporins and ertapenem (ERT). The two OXA-48 positive *K. pneumoniae* from PP 1 and PP 2 exhibited unique typing results. All *E. coli* isolated from PP 3-7 had the same PFGE typing profile (CARDPOES-7 is a common type in UK hospitals). No patients were clinically unwell due to a CPO infection during this period.

Stored faeces from PP 1 from Dec 2013 was tested retrospectively using methods 1 and 3. Both *E. coli* and *K. pneumoniae* harbouring OXA-48 were isolated. This *E. coli* also showed a unique typing result when compared to the other *E. coli* in the unit, but is identical to an OXA-48 negative *E. coli* also isolated from PP 1.

Conclusions

Enrichment with cefotaxime or ertapenem prior to culture enhanced detection of OXA-48 containing organisms from screening samples, however all methods were inconsistent when CPOs were present in low quantity. The study shows possible transfer of the OXA-48 gene from species to species.

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