(RESEARCH ARTICLE)

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Stool culture versus FilmArray gastrointestinal PCR in the diagnosis of gastrointestinal infections

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Abstract

Introduction: Gastrointestinal infection is a major cause of morbidity worldwide. Culture and microscopy are time consuming and have low diagnostic yield. New rapid molecular methods such as multiplex PCR have recently been introduced for etiological diagnosis. The purpose of this study was to compare the diagnostic yield of the FilmArray gastrointestinal panel with that of standard culture for the etiological diagnosis of gastrointestinal infections.

Materials and methods: This is a retrospective study carried out within the Microbiology department of the Arrazi hospital of the CHU Mohamed VI, including all the patients treated for a gastrointestinal infection and having required hospitalization in the various departments within the Arrazi Hospital of the CHU Mohamed VI in Marrakech, over a period of 15 months.

Results: During the period studied, 124 patients were sampled. All samples were tested using stool culture and FilmArray. PCR detected significantly more positive samples, with bacterial, viral and/or parasitic infections compared to stool culture (57.3% vs 21%). Additionally, gastrointestinal PCR was able to detect all pathogens implicated in the gastrointestinal FilmArray panel except for Yersinia Enterocolitica, whereas stool culture could only detect three bacterial pathogens (*E.coli*, *Salmonella* and *Shigella*). Additionally, 52.11% of patients had co-infections that were identified only by PCR.

Conclusions: The FilmArray GI panel showed very good diagnostic performance compared to culture for the diagnosis of gastrointestinal infections and gave a more detailed picture of the spectrum of pathogens involved. Further studies are needed to determine whether multiplex PCR improves patient outcomes and reduces costs.

Keywords: Gastrointestinal infections; Molecular diagnosis; Stool culture; Samples

1. Introduction

Gastrointestinal infection is an important cause of morbidity worldwide. A wide range of bacterial, parasitic and viral pathogens can be responsible for this [1, 2, 3]. In most cases, these infections are self-limiting and disappear within a few days. However, young children, the elderly and immunocompromised patients are at greater risk of developing serious complications. Prompt diagnosis with appropriate treatment and infection control are particularly important measures in these settings.

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Stool culture is the most commonly used diagnostic method. Nevertheless, it is a time-consuming technique with a prolonged turnaround time which undermines the clinical utility of this method [4, 5, 6]. In recent years, new molecular methods such as multiplex PCR, have been introduced as rapid diagnostic techniques with reported sensitivity and specificity higher than standard methods [7, 8].

 The purpose of this study was to compare the diagnostic yield of the FilmArray GI panel with that of standard culture for the etiological diagnosis of gastrointestinal infections.

2. Material and methods

2.1. Data collection

This is a retrospective study carried out within the Microbiology department of the Arrazi hospital of the Mohamed VI university hospital center, including all the patients treated for a gastrointestinal infection and having required hospitalization in the different departments. Within the Arrazi Hospital of the Mohamed VI University Hospital Center in Marrakech. This work was carried out over a period of 15 months, from October 2018 to December 2019.

Were included in this study all the patients hospitalized in the various services within the Arrazi hospital of the Mohamed VI university hospital center, having benefited from a gastrointestinal PCR and a coproculture during the study period.

2.2. Were excluded

- Patients who have not benefited from a stool culture with a gastrointestinal PCR.
- Patients treated on an outpatient basis without medical records.

The collection of data was made from the database of the microbiology department and the hospitalization records of patients admitted to the various departments of the Arrazi hospital of the Mohamed VI university hospital center in Marrakech.

2.3. Stool culture and gastrointestinal PCR

- Coproculture or cytobacteriological examination of stools corresponds to the inoculation performed from faeces with the aim of isolating and identifying the pathogenic agents responsible for a gastrointestinal infection. Coproculture allows the search for the most frequently encountered pathogens in cases of diarrhea: *Salmonella* spp., *Shigella* spp., Campylobacter spp. or Yersinia; their demonstration can be considered as pathological and lead to the realization of an antibiogram. Stool culture test results usually take 2-3 days.
- The gastrointestinal filmarray panel: it is a simple and firm system, which involves the processing, amplification, identification and analysis of the samples, allowing the obtaining of the results in approximately one hour, with only 2 minutes of prep time. The targets of the panel include thirteen bacteria (enteroaggregative E. coli (EAEC), enterotoxigenic E. coli (ETEC), enteropathogenic E. coli (EPEC), shiga toxin-producing E. coli (STEC), E. coli O157, Enteroinvasive E. coli (EIEC) / *Shigella* spp, Campylobacter (jejuni / coli / upsaliensis), Vibrio (parahaemolyticus / vulnificus), *Salmonella* spp, Plesiomonas shigelloides, Yersinia enterocolitica, Clostridium difficile (toxin A / B), and Vibrio cholera), five viruses (Adenovirus F40/41, Astrovirus, Norovirus GI/GII, Rotavirus A, and Saprovirus (I, II, IV, V)) and four parasites (Cryptosporidium spp, Giardia lamblia, Cyclospora Cayetanensis, and Entamoeba histolytica).

3. Results

In this study, 124 hospitalized patients were included. These patients ranged in age from 2 months to 93 years, with a median age of 22 years. 54.03% of the patients were male and 45.97% were female, with a sex ratio M/F of 1.18. Analysis of each of the samples by both methods, stool culture and multiplex PCR, revealed that the multiplex PCR approach detected significantly more positive samples with bacterial, viral and/or parasitic infections. Specifically, 26 samples (20.96%) were positive by coproculture and 71 (57.26%) were positive by multiplex PCR (Table 1). Additionally, multiplex PCR could detect some pathogens, including E coli O157, ETEC, STEC, Campylobacter Cryptosporidium, and Giardia, which were undetectable by stool culture. The latter was able to detect only 21 cases of *E.coli*, 3 cases of *Salmonella* and 2 cases of *Shigella*.

Table 1 Proportion of pathogens detected by PCR and stool culture

Pathogens	PCR results	Stool culture results
ECEP	19.53%	
ECEA	16.4%	
ECET	2.34%	16.93%
STEC	7.02%	
ECEI	3.9%	
Shigella	3.12%	1.61%
Salmonella	4.68%	2.42%
Vibrio Cholera	0.78%	Aucun
Plesiomonas Shigelloides	0.78%	Aucun
Clostridium	7.03%	Aucun
Campylobacter	9.37%	Aucun
Cryptosporidium	7.81%	Aucun
Giardia	3.12%	Aucun
Saprovirus	2.34%	Aucun
Adénovirus	0.78%	Aucun
Rotavirus	3.12%	Aucun
Astrovirus	0.78%	Aucun
Norovirus	7.03%	Aucun

Table 2 Proportion of pathogens detected by PCR in mono and co-infection

Pathogens	Number identified in co-infection	Number identified in mono infection	% of agent in co-infection
ECEP	18	7	72%
ECEA	15	6	71.43%
ECEI	5	0	100%
ECET	3	0	100%
E.coli shiga like	3	6	33.33%
Adénovirus	1	0	100%
Rotavirus	4	0	100%
Norovirus	7	2	77.78%
Astrovirus	1	0	100%
Saprovirus	3	0	100%
Salmonella	4	2	66 .67%
Shigella	4	0	100%
Vibrio cholera	1	0	100%
Campylobacter	11	1	91.67%
Cryptosporidium	8	2	80%
Clostridium	5	4	55.55%
Giardia	4	0	100%
Plesiomonas shigelloide	0	1	0%

Within these gastrointestinal infections documented by PCR, a bacterial etiology was found in 76.8% of patients either in mono or co-infection. A viral etiology was found in 13% of patients, and a parasitic etiology was found in 10% of patients. Enteropathogenic *E.coli* was the most detected infectious agent (n=25), followed by Enteroaggregative *E.coli* (n=21), then Campylobacter (n=12) and Cryptosporidium (n=10). The most found virus was Norovirus.

In addition, 52.11% of the samples had co-infections and were detected only by multiplex-PCR. The most found association was Campylobacter and Cryptosporidium co-infection in 12.8% of cases. (Table2)

4. Discussion

In this study, we found that the multiplex PCR approach detected significantly more positive samples than stool culture, which has been reported by several studies. An Indian study by Balavinoth Ramakrishnan et al showed that 50.9% of positive samples were detected by PCR and only 17.65% were detected by stool culture [9]. A study conducted in Taiwan by Shu-Huan Huang et al showed that gastrointestinal PCR was able to detect 55.8% of positive samples, while stool culture identified 40.1% [10].

Thus, the important place of coinfections in gastrointestinal infections has been widely reported by several studies. This study reported a percentage of 52.11%. Balavinoth Ramakrishnan et al reported a 48.1% percentage of co-infections [9]. Shu-Huan Huang et al found in their study co-infections in 10.6% of cases [10]. A study conducted in California focusing on patients with HIV infection revealed co-infections in 48.4% of patients [11].

The distribution of pathogens over this period showed the predominance of bacterial etiology, which is consistent with the results of several studies. Balavinoth Ramakrishnan et al found a bacterial etiology in 62.9% of cases, with enteroaggregative *E.coli* as the most common pathogen (23.24%) [9]. Antonio Piralla et al found a bacterial etiology in 51.5% of cases [12].

5. Conclusion

The FilmArray GI panel is a powerful technique that has shown in the present study as in other similar studies a diagnostic superiority over stool culture in the etiological diagnosis of gastrointestinal infection and also allows to give a more detailed picture. of the spectrum of pathogens involved in shorter timeframes.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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