Article @ Virology

Comparative Sensitivities and Specificities of Four Rapid Influenza A Antigen Detection Kits for Detection of H1N1, H3N2 and H5N1

*Shen Shu, Shi Dawei, Zhou Haiwei, Tian Yabin, Liu Donglai, Zhang Chutao**
National Institutes of Food and Drug Control, Beijing, P.R. China, 100050

ABSTRACT

Influenza viruses cause seasonal epidemics associated with high morbidity and mortality. Rapid diagnostic tests for the detection of pandemic influenza A virus are valuable for their ease using and accurate diagnosis of influenza. Many rapid influenza diagnostic kits were introduced recently. Hence, the sensitivities and specificities of them for testing influenza viruses need to monitor. In this study, the sensitivities and specificities of four diagnostic immunochromatographic assay kits for H1N1, H3N2, and H5N1 were evaluated. For the detection of the three H1N1, three H3N2 and one H5N1 virus line, rapid diagnostic tests exhibited excellent specificity (all positive). And no false-positive results were obtained. They differed in respect to the sensitivity, especially in the lower haemagglutinin titer. However, all of them achieve the requirements of National Institutes for food and drug Control (NIFDC). Commercial influenza immunochromatographic assay kits are useful tools for the rapid diagnosis of influenza. Nonetheless, confirmatory testing is always recommended.

Article history: Submitted: 10/08/2016; Revised: 30/08/2016; Accepted: 01/09/2016
DOI: 10.21092/jav.v5i3.75
Key Words: Influenza A Virus; Immunochromatographic Assay; Sensitivities; Specificities

Introduction

Influenza is transmitted easily among humans and causes seasonal epidemics associated with high morbidity and mortality. During periods of epidemic prevalence, the clinical diagnosis of influenza is difficult because other respiratory viruses are often circulating simultaneously [2]. The rapid and accurate diagnosis of influenza is essential to control influenza and provide proper treatment [1].

* Corresponding author, PhD., Major Virology
E-mail: zhangct2@126.com

A variety of different diagnostic methods can be used to detect influenza virus in the respiratory specimen. However, a rapid and simple diagnostic tests for confirming infection with influenza are urgently needed in clinical diagnosis and treatment. Rapid influenza tests which was based on immunochromatography are valuable for laboratory ease using and fast getting results. However, the sensitivities and predictive of current rapid antigen tests for influenza viruses need to monitor. In present study, we compare the analytical sensitivity and specificity of four commercially available influenza A rapid antigen detection tests for the detection of influenza A viruses of subtypes H5N1, H1N1 and H3N2.

Materials and methods

1.Virus standard reference

Seven positive virus standard reference and three negative standard virus reference were selected, which come from worldwide. (Table 1)

2. Rapid kits for influenza virus A detection

The rapid antigen detection kits evaluated were Kit1: One Step Influenza Virus A Antigen Test (GuangZhou Wondfo Biotech Co.,Ltd, China); Kit2: Diagnostic Kit for Influenza type A antigen (Hangzhou Genesis Biodetection & Biocontrol Co.,Ltd., China); Kit3: Cleaview Exact Influenza A&B, (Alere TM, China); Kit4: BinaxNOW Influenza A&B Test (Binax,Inc. ME, USA). The procedures were carried out according to manufacturer's instructions. Each kit was tested in duplicate on each virus dilution.

Table1: specificity of Influenza A virus antigen detection kit

Virus source and subtype	Virus designation	Haemagglutinin titer	Results			
			Kit1	Kit2	Kit3	Kit4
Human H1N1	A/Califonia/07/09	1:20	+	+	+	+
	A/Newcaledonia/20/99	1:320	+	+	+	+
	A/hufang/7/1999	1:80	+	+	+	+
	A/wisconsin/62/2005	1:1280	+	+	+	+
Human H3N2	A/Hiroshima/52/2005	1:96	+	+	+	+
	A/Anhuibaohe/137/2008	1:64	+	+	+	+
Human H5N1	A/Anhui/01/2005	1:64	+	+	+	+
Human B Influenza virus	B/288/04	/	-	-	-	-
Parainfluenza virus	Parainfluenza III	/	-	-	-	-
Rubella Virus	Rubella Virus	/	-	-	-	-

Results and Discussion

For testing the specificities, the four influenza virus A rapid diagnostic immunochromatographic assay kits were evaluated by three H1N1, three H3N2 and one H5N1 virus line. These rapid diagnostic tests exhibited excellent specificity. All positive virus standard references were detected the positive results. And no false-positive results were obtained in the three negative standard virus reference. (Table 1)

For testing the sensitivities, the four influenza virus A rapid diagnostic immunochromatographic assay kits were evaluated by two H1N1, and one H3N2 virus line with the different haemagglutinin titer. When the haemagglutinin titer was lower than 1:320 in H1N1, the Kit1 could work well only, others Kits all showed the negative results. Similar results were obtained in H3N2 when its haemagglutinin titer was lower than 1:5120. (Table 2)

There are no clinical symptoms or specific signs for influenza virus infec--tions. Thus, it is difficult to distinguish different influenza virus infections without confirmatory testing [3, 4]. The laboratory diagnosis of influenza can help manage influenza-infected patients in hospital or other healthcare settings.

Table2: limit of Influenza A virus antigen detection kit

Virus source and subtype	Virus designation	Haemagglutinin titer	Results			
			Kit1	Kit2	Kit3	Kit4
Human H1N1	A/Califonia/07/09	1:20	+	+	+	+
		1:40	+	+	+	+
		1:80	+	+	+	+
		1:160	+	-	+	+
		1:320	+	-	-	-
		1:640	+	-	-	-
Human H1N1	A/hufang/7/1999	1:80	+	+	+	+
		1:160	+	+	+	+
		1:320	+	+	+	+
		1:640	+	+	+	-
		1:1280	+	+	+	+
		1:2560	+	+	+	+
Human H3N2	A/wisconsin/62/2005	1:5120	+	-	-	-
		1:10240	+	-	-	-

The accuracy of rapid influenza tests is usually less than reverse transcription -polymerase chain reaction (RT-PCR) [5]. However, rapid diagnostic tests are valuable for their ease using and rapid diagnosis. This type tests can reduce unnecessary diagnostic testing, hospitalization duration, and antibiotic use while increasing antiviral use.

The clinical sensitivity and specificity of rapid influenza diagnostic tests vary considerably in previous studies. In clinical settings, rapid influenza tests are reported to have sensitivities of 45–90% and specificities of 86–100% [6-12]. Field data related to the clinical sensitivity and specificity of rapid influenza tests are of significant value to physicians, general practitioners, and other healthcare professionals when choosing which influenza rapid test to use. Meanwhile, it suggested that this type rapid test kits are very widely used.

In this study, the performance of four rapid tests for the detection of influenza A was evaluated. The overall sensitivities and specificities of the rapid influenza tests for H1N1, H3N2, and H5N1 were evaluated. For the detection of the three H1N1, three H3N2 and one H5N1 virus line, rapid diagnostic tests exhibited excellent specificity (all positive). And no false-positive results were obtained.

However, in this study, the four influenza Virus A rapid diagnostic immunechromato--graphic assay kits differed in respect to the sensitivity, especially in the lower haemagglutinin titer. There are various factors that could affect the sensitivity of rapid assays, such as the quality of specimens, standardization of sample collection technique [13, 14]. And the WHO recommends that samples should be collected within 4 days of disease onset (WHO, 2006). The others factors include periods of low prevalence, in special populations, by region, and by influenza subtype [15]. However, these four kits all can achieve the basic requirements for rapid testing the influenza A viruses of subtypes H1N1, H3N2, and H5N1. Moreover, all of them passed the validations of National Institutes for food and drug Control (NIFDC).

Conclusion

In conclusion, the rapid screening tests evaluated in this study were more useful in testing influenza A viruses. Moreover, rapid tests can be performed in a primary healthcare setting and are the key to controlling outbreaks. The four influenza virus A rapid diagnostic immune--chromatographic assay kits show the good performances, respectively.

References

[1]. Nicholson KG, Wood JM and Zambon M. Influenza [J]. Lancet. 2003, 362(9397): 1733-1745.

[2]. Jennings LC, Anderson TP, Werno AM, et al. Viral etiology of acute respiratory tract infections in children presenting to hospital: role of polymerase chain reaction and demonstration of multiple infections [J]. The Pediatric infectious disease journal. 2004, 23(11): 1003-1007.

[3]. Call SA, Vollenweider MA, Hornung CA, et al. Does this patient have influenza [J]. Jama. 2005, 293(8): 987-997.

[4]. Poehling KA and Edwards KM. Prevention, diagnosis, and treatment of influenza: current and future options [J]. Current opinion in pediatrics. 2001, 13(1): 60-64.

[5]. Uyeki TM. Influenza diagnosis and treatment in children: a review of studies on clinically useful tests and antiviral treatment for influenza [J]. The Pediatric infectious disease journal. 2003, 22(2): 164-177.

[6]. Agoritsas K, Mack K, Bonsu BK, et al. Evaluation of the Quidel QuickVue test for detection of influenza A and B viruses in the pediatric emergency medicine setting by use of three specimen collection methods [J]. Journal of clinical microbiology. 2006, 44(7): 2638-2641.

[7]. Grijalva CG, Poehling KA, Edwards KM, et al. Accuracy and interpretation of rapid influenza tests in children [J]. Pediatrics. 2007, 119(1): e6-11.

[8]. Hurt AC, Alexander R, Hibbert J, et al. Performance of six influenza rapid tests in detecting human influenza in clinical specimens [J]. Journal of clinical virology : the official publication of the Pan American Society for Clinical Virology. 2007, 39(2): 132-135.

[9]. Poehling KA, Zhu Y, Tang YW et al. Accuracy and impact of a point-of-care rapid influenza test in young children with respiratory illnesses [J]. Archives of pediatrics & adolescent medicine. 2006, 160(7): 713-718.

[10]. Rodriguez WJ, Schwartz RH and Thorne MM. Evaluation of diagnostic tests for influenza in a pediatric practice [J]. The Pediatric infectious disease journal. 2002, 21(3): 193-196.

[11]. Booth S, Baleriola C and Rawlinson WD. Comparison of two rapid influenza A/B test kits with reference methods showing high specificity and sensitivity for influenza A infection [J]. Journal of medical virology. 2006, 78(5): 619-622.

[12]. Smit M, Beynon KA, Murdoch DR et al. Comparison of the NOW Influenza A & B, NOW Flu A, NOW Flu B, and Directigen Flu A+B assays, and immunofluorescence with viral culture for the detection of influenza A and B viruses [J]. Diagnostic microbiology and infectious disease. 2007, 57(1): 67-70.

[13]. Gordon A, Videa E, Saborio S, et al. Performance of an influenza rapid test in children in a primary healthcare setting in Nicaragua [J]. PloS one. 2009, 4(11): e7907.

[14]. Uyeki TM, Prasad R, Vukotich C, et Low sensitivity of rapid diagnostic test for influenza [J]. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America. 2009, 48(9): e89-92.

[15]. Dale SE, Mayer C, Mayer MC et al. Analytical and clinical sensitivity of the 3M rapid detection influenza A+B assay [J]. Journal of clinical microbiology. 2008, 46(11): 3804-3807.