Identification of cutaneous granuloma caused by *Mycobacterium marinum* using PCR method

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**ARTICLE INFO**

*Article history:*
Received 21 February 2013
Accepted 7 April 2013
Available online 1 June 2013

*Keywords:*
*Mycobacterium marinum,*
Granuloma, PCR, HSP-65

**ABSTRACT**

Atypical *Mycobacterium* granulomatous skin infections are often caused by *Mycobacterium marinum, M. ulcerans, M. fortuitum,* and *M. avium* colonies. Skin infections probably originate from an environmental source such as contacting with aquatic animals, fish farming and swimming in the pools, and inoculate into skin through skin wounds, scratches, trauma, and surgery. The lesions appear as purple papules, nodules in hands and feet, plaque blisters wart ulcers and markers transmission (sporotrichosis) in the path of lymph nodes. They have granulomatous accumulation with giant cells, and abscess pus appears, and sometimes in the form of ulcerative. Infection is limited to the skin, while in immunosuppressed cases it would be able to infect the whole body. To determine if Mycobacteria were present in granulomatose skin lesion, a total of 58 paraffine embedded tissue blocks were obtained and their DNA was extracted. The polymerase chain reaction (PCR) was used to amplify the HSP-65 gene. PCR amplification demonstrated the presence of *Mycobacterium* spp. In 18 blocks (31%). Among these 18 blocks, 8 (44%) were positive for *M. marinum*, 3 (17%) for *M. ulcerans*, 5 (27%) for *M. fortuitum and M. chelonae,* and 2 (12%) for *M. avium*. We conclude that Mycobacteria ought to be considered in the treatment of skin granulomas in Iran.

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**1. Introduction**

Atypical *Mycobacterium* infections typically include pulmonary infections, lymphadenitis, granulomatous skin and transmitted infections (in people with immune system defects) (Wagner and Young, 2004). Skin infections are often caused by *M. marinum, M. ulcerans, M. fortuitum, M. chelonae* are atipical in from of swimming pool granuloma (Palenque., 2000). Skin infections are probably caused by a common environmental source such as being exposed to aquatic animals, fish farming ponds, and swimming pools, or through injections by causing surface wound, skin scratch, or truma (Mahaisavariya et al., 2003). Granulomatous cutaneous lesions often appear on the elbows, fingers, and hands as papules, nodules, blisters, plaques, wart ulcers, sporotrichoid transmission lesions and sometimes ulcerative.
The infection is limited to the skin and in case of immunosuppression would change to lymphatic spread infection. Transmission from person to person is rare (Tan and Chan, 1999). PCR is a specific, sensitive and accurate method for diagnosis of bacterial infections. This method can recognize a few atypical Mycobacterial genomes in paraffin-embedded tissue samples and its differentiation from granulomatous cutaneous lesions similar to parasitic and fungal infection. (Cook et al., 1994; Ghossein et al., 1992). With this diagnostic method, cutaneous lesion caused by atypical Mycobacterial can be diagnosed from other granulomatous infections such as leishmaniasis and Sporotrichosis. The detection will help in choosing the appropriate treatment of such cutaneous disease by either antibiotics or, if necessary, using surgery. (Sanchez et al., 2000; Wolinsky et al., 1972; Frevel et al., 1999).

2. Material and Methods

In this study atypical *Mycobacterium granulomatosus* skin infections diagnosed by PCR, using specific primers designed for *Mycobacterium* genes (hsp65). Fifty eight (58) formalin-fixed, paraffin-embedded tissue samples of granulomatous lesion from the period of time effective from 2006 until 2010 were obtained from the Pathology archives of Razi Hospital, Iran, Tehran. All paraffine-embedded skin tissues had clinical signs of granuloma. *Mycobacterium smegmatis* (PTCC 1307) was used as a positive control. In Lewenstein-Jensen (LJ) agar medium. They were checked for *Mycobacterium* colony appearing on the agar media after 14 days. *M. smegmatis* is a positive control for diagnosis of *M. marinum* and *Mycobacterium* except Tuberculosis (NTM).

2.1. PCR method

DNA was extracted from paraffine-embedded tissue by the method explained by Goldmann et al., (1998). In this study, a pair of primers (forward and reverse) were used to amplify a 292bp fragment of HSP-65 gene belonging to the *Mycobacterium* genus. Another pair of primers were also used to amplify a 154bp fragment of HSP-65 gene specific to *M. marinum*. The primers used are given in table 1.

DNA amplifications were carried out in a total volume of 25 μL containing 17.5 μL DNA, 0.1 μL of each primers, 0.5 μL dNTP mix (10mM) (Cinnagen Inc., Tehran, Iran) .4 μL MgCl2 (25 mM), 2.5 μL PCR buffer (10x) (Cinnagen Inc., Tehran, Iran), and 0.25 μL Taq DNA polymerase (5 u/μL) (Cinnagen Inc., Tehran, Iran). Reaction mixture were thermocycled 30 times beginning with an initial denaturation step of 20 min at 94°C. The temperature and time profile of each cycle was as following: 60°C for 1 min (Annealing) and 72°C for 1 min (extension). Reactions were finished with a final extension step at 72°C for 5 min (Fölgeira et al., 1993). 1 μL of PCR products were mixed with 2 μL of loading buffer (6x) and were electrophoresed along with 100bp DNA ladder on 1% agarose gel (100 V for 1 hr). The bands were visualized by staining with 0.5 μL/ml ethidium bromide.

3. Results

Of 58 paraffin-embedded tissues studied, 18 (31%) samples had granulomatous skin infections caused by atypical Mycobacterial and 40 (69%) samples of granulomatous skin infection had recourse of non-Mycobacterium (Parasitic and fungal).

PCR identification of Atypical Mycobacterial species in samples was successful in 18 strains and showed specific amplicon at 292 bp (Figure 1). It proved that 31% of suspected granuloma tissues were infected with Atypical *Mycobacterium*. The results of PCR samples are present in Table 2 and 3. Based on the results obtained by PCR test, 8 (44%) isolates were positive for *M. marinum*, 3 (17%) isolates for *M. ulcerans*, 5 (27%) isolates for *M. fortuitum-cheloneae* and 2 (12%) isolates for *M. avium*, as they showed specific amplicon at 154 bp (Figure 2). The method used in this study showed that 8 out of 58 granuloma tissues were infected with *M. marinum*. Of all samples studied, 40 (69%) were negative for PCR tests, which shows they have been infected with other parasitic and fungal microorganisms.
Table 1. Nucleotide sequences and primers used for identification of *Mycobacterium* spp. Design primers can detect all of Mycobacterium atypic species.

<table>
<thead>
<tr>
<th>Primer</th>
<th>Target genes</th>
<th>Sequence</th>
<th>Length(bp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSP-65</td>
<td>F: 5'-GCCAAGAAGACCAGCAGA-3'</td>
<td>292</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R: 5'-GTGATGACGCCCTTCGTGC-3'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F: 5'-AAGCGGGCATCGAGAAGG-3'</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R: 5'-ACCTTGCTGCCATGGCCTG-3'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Identification of Atypical *Mycobacterium* species of samples, Atypic Mycobacterial-PCR and *M. marinum*-PCR results.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Atypical <em>Mycobacterium</em>- PCR</th>
<th>Mycobacterium species- PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>31%</td>
<td>18</td>
<td>Total</td>
</tr>
<tr>
<td>17%</td>
<td><em>Mycobacterium ulcerans</em> (3)</td>
<td>+</td>
</tr>
<tr>
<td>12%</td>
<td><em>Mycobacterium avium</em> (2)</td>
<td>+</td>
</tr>
<tr>
<td>27%</td>
<td><em>M. fortuitum chelonae</em> (5)</td>
<td>+</td>
</tr>
<tr>
<td>44%</td>
<td><em>Mycobacterium marinum</em> (8)</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>58</td>
<td>Total</td>
</tr>
</tbody>
</table>

Figure 1. Specificity of the PCR detection assay using the specific primers. M: Marker 100bp; PC: positive control [*M. smegmatis* (PTCC 1307)]; NC: Negative control, 1-9 suspected samples. The formation of 292bp bands in 9 Atypical *Mycobacterium* positive samples.
4. Discussion

The results reported in this paper confirmed the detection of M. marinum as major agent of swimming pool granuloma for the first time in Iran. These results reported occurrence of M. marinum in Iran as well as with intensive of granuloma tissues (Sciacce, 2006). Microorganism with characteristics of Atypical Mycobacterial was isolated from granuloma skin tissues. The identification of the isolates was performed by PCR test. Routine identification of Atypical Mycobacterial species is usually based on Classic methods including acid-fast staining, culture, biochemical tests, BACTEC and immunofluorescence examination (Tsukamura, 1981). PCR is faster than the routine tests and it can be used as trusty and supersede test in the detection of M. marinum from skin tissues. In current study this technique showed a distinct advantage over the culture method of identification. In this study, examination of 58 granuloma skin tissue samples provided 18 Atypical Mycobacterium species. All Mycobacterium positive samples that were analyzed for M. marinum infection by PCR method were positive (44%). On the other hand, of 58 skin tissue samples, 18 (31%) were infected with Atypical Mycobacterium species, while 40 (69%) samples were infected by non Mycobacterium organisms. This study suggests that among different collecting sites, granuloma skin tissue samples are suitable for detection of M. marinum and the number of Atypical Mycobacterial in granuloma tissue may vary considerably. The results of this study confirmed that the main agent of fish tank granuloma was M. marinum and other strains may infect granuloma.

In other studies they used the PCR technique to amplify 16S rRNA and 23S rRNA genes to identify species of Mycobacterium (Abed et al., 1995). Reaserrhces proved that skin infection with M. marinum which in most cases it was associated and the majority of these skin lesions were on the hands with clinical sporotrichosis appearance (Sanchez et al., 2000). Based on the results obtained by an epidemiological study, cutaneous infection patients infected with M. marinum had been exposed to the fish due to their job as fishermen.
It can be concluded that the most dangerous places to get infected with this bacterium are swimming pools and fish farming ponds (Johnson and Tzumi., 1987). Granulomatous skin infections caused by atypical Mycobacterium generally occurs in soft tissues, skin and sometimes deep wounds, necrotic ulcers and subcutaneous on the skin and lesion has granulomatus transmission in the path of lymph glands similar cutaneous (Leishmaniasis & Sporotrichosis) ,(Sciacce-Kirby, 2006).

In conclusion, this report demonstrates that PCR can be considered as the method of choice for identification of Atypic Mycobacteria. The culture method not only can be costly and time consuming, but also may show some false negative results. The PCR method is rapid, reliable, and simple for detection of Mycobacterium contamination in granuloma tissues. This technique can successfully detect M.marinum and differentiate it from other similar parasitic and fungal microorganisms that cause granulomatous skin lesions.

References