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| CORE TIP | We have presented different surveys showing the resistance of *Helicobacter pylori* (*H. pylori*) to furazolidone from Asia and South America. The resi­stance rates varied but were mostly low (< 5%). *H. pylori* mutations occurring in the *oorD* gene, including A041G, A122G, C349A(G), A78G, A112G, A335G, C156T and C165T, and in the *porD* gene, including G353A, A356G, C357T, C347T, C347G and C346A, have been indicated to be possibly related to the observed resistance. Regarding levofloxacin resistance, compound mutations of N87A, A88N and V65I at codon Asn-87 were recently observed in the *gyrA* gene for the first time. |
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 LETTERS TO THE EDITOR

Resistance of *Helicobacter pylori* to furazolidone and levofloxacin: A viewpoint

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**Abstract**

In their review, Arslan *et al*[1] did not describe the status of *Helicobacter pylori* (*H. pylori*) treatment with furazolidone and the resistance to this antibiotic. We have presented different surveys showing the resist­ance of *H. pylori* to furazolidone from Asia and South America. The resistance rates varied but were mostly low (< 5%). There are not enough data on its efficacy and resistance in the United States and Europe. *H. pylori* mutations occurring in the *oorD* gene, including A041G, A122G, C349A(G), A78G, A112G, A335G, C156T and C165T, and in the *porD* gene, including G353A, A356G, C357T, C347T, C347G and C346A, have been indicated to be possibly related to the observed resistance. Additionally, to complete Arslan *et al*’s statement regarding levofloxacin resistance, it should be noted that compound mutations of N87A, A88N and V65I at codon Asn-87 were recently observed in the *gyrA* gene for the first time. However, the results on these topics are not sufficient, and more worldwide studies are suggested.

**Key words:** Susceptibility; Furazolidone; *Helicobacter pylori*; Resistance; Levofloxacin; Treatment

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**Core tip:** We have presented different surveys showing the resistance of *Helicobacter pylori* (*H. pylori*) to furazolidone from Asia and South America. The resi­stance rates varied but were mostly low (< 5%). *H. pylori* mutations occurring in the *oorD* gene, including A041G, A122G, C349A(G), A78G, A112G, A335G, C156T and C165T, and in the *porD* gene, including G353A, A356G, C357T, C347T, C347G and C346A, have been indicated to be possibly related to the observed resistance. Regarding levofloxacin resistance, compound mutations of N87A, A88N and V65I at codon Asn-87 were recently observed in the *gyrA* gene for the first time.

**TO THE EDITOR**

We have read with great interest the valuable article by Arslan *et al*[1], titled “Importance of antimicrobial susceptibility testing for the management of eradi­cation in *Helicobacter pylori* infection”. One of the main subjects of the review was the description of the resistance rates of different antibiotics and the potential mechanisms leading to decreased in *Helicobacter pylori* (*H. pylori*) antimicrobial susceptibility. However, the authors should consider clarifying two important issues.

The authors did not allude to the status of *H. pylori* treatment with furazolidone and the resistance to this antibiotic. We have provided existing surveys reporting the resistance of *H. pylori* to furazolidone in Table 1. The resistance rates have been mostly reported to be lower than 5%; however, these rates can vary geographically. Furazolidone is not used widely in the United States and Europe; therefore, there are not enough data on its efficacy and resistance in these regions.

One of the main reasons for the emergence of resistance is related to the extensive use of furazoli­done. In addition, regarding the molecular mechanisms, some genetic mutations have been identified. Muta­tions occurring in the *2-oxoglutarate:acceptor oxidor­eductase* (*oorD*) gene, including *A041G*, *A122G*, *C349A(G)*, *A78G*, *A112G*, *A335G*, *C156T* and *C165T*, and in the *pyruvate oxidoreductase* (*porD*) gene, including *G353A*, *A356G*, *C357T*, *C347T*, *C347G* and *C346A*, are possibly related to the resistance[2,3]. *The oor and por* genes are involved in the generation of acetyl coenzyme A (acetyl-CoA) and succinyl-CoA[4]. Despite these findings, additional molecular methods are proposed to reach a better understanding of the mechanisms that were mentioned.

Arslan *et al*[1] accurately documented the mech­anism of levofloxacin resistance; *i.e.*, point mutations in the *gyrA* (DNA *gyrase*) gene were stated to be potentially linked to the resistance. However, to complete their statement, it should be noted that compound mutations of N87A, A88N and V65I at codon Asn-87 were recently observed in the *gyrA* gene for the first time. L45F, A55S, A97V, D91N, R130K and G60S are other possible mutations that need to be assessed in studies with broader sample bases[5].

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**Table 1 Studies evaluating the *Helicobacter pylori* resistance to furazolidone**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Continent | Country | Study year | Strains (*n*) | Method | Resistance (%) | Author |
| Asia | China (Shanghai) | 2000-2009 |  293 | Agar dilution |  0 | Sun *et al*[6] |
| China (Zhejiang) | 2010-2012 |  21 | Agar dilution |  0.1 | Su *et al*[7] |
| China (Zhejiang) | 2009-2014 | 9687 | Agar dilution | < 0.01 | Ji *et al*[8] |
| India (Ghaziabad and New Delhi) | NA |  68 | Agar dilution |  22.1 | Gehlot *et al*[9] |
| India (Gujarat) | 2008-2011 |  80 | Disk diffusion |  13.8 | Pandya *et al*[10] |
| Iran (Rasht) | 2012-2014 |  169 | Disk diffusion |  61.9 | Maleknejad *et al*[11] |
| Iran (Shiraz) | 2004-2005 |  106 | Agar dilution |  9.4 | Kohanteb *et al*[12] |
| Iran (Sari) | 2009 |  197 | Disk diffusion |  61.4 | Abadi *et al*[13] |
| Iran (Tehran) | 2001-2004 |  135 | Disk diffusion |  0 | Siavoshi *et al*[14] |
| Iran (Tehran) | 2002-2003 |  24 | Disk diffusion |  0 | Fallahi *et al*[15] |
| Iran (Tehran) | 2005-2008 |  110 | Disk diffusion |  4.5 | Siavoshi *et al*[16] |
| Iran (Tehran) | 2007-2008 |  104 | Disk diffusion |  0 | Sirous *et al*[17] |
| Iran | 2003-2005 |  100 | Disk diffusion |  9 | Rafeey *et al*[18] |
| South Korea | 1994-1999 |  220 | Agar dilution |  1.4 | Kim *et al*[19] |
| Malaysia (Malacca) | 2009 |  90 | Epsilometer test |  0 | Goh *et al*[20] |
| Pakistan (Karachi) | 2008-2013 |  93 | disk diffusion |  4.3 | Siddiqui *et al*[21] |
| South America | Brazil (Bragança Paulista) | NA |  90 | Agar dilution |  4 | Mendonça *et al*[22] |
| Brazil (Bragança Paulista) | NA |  138 | Agar dilution | 13 | Godoy *et al*[23] |
| Brazil (Sao Paulo) | NA |  39 | Agar dilution |  0 | Eisig *et al*[24] |
| Brazil (Sao Paulo) | 2008-2009 |  77 | Agar dilution and disk diffusion |  0 | Ogata *et al*[25] |
| Brazil (Sao Paulo) | 2008-2009 |  77 | Agar dilution |  0 | Ogata *et al*[26] |