INTRODUCTION

Worldwide, gastric cancer (GC) is the fourth cancer in incidence and the second most common cause of cancer death. Gastric cancer is asymptomatic in the early stages and very often diagnosed at advanced stages, determining a dismal prognosis. Expression of the HER2 gene has been identified in about 20% of gastric cancer cases, and its hyper-expression is associated with poor prognosis. Objective - To investigate HER2 immunohistochemical expression in gastric adenocarcinoma and its relationship to the histological type and anatomic location. Methods - A cross-sectional retrospective study analyzed the immunohistochemical expression of HER2 in a sample of 48 specimens of gastric cancer. Immunohistochemical analysis were performed using avidin-biotin-peroxidase method with C-erb B2 (clone EP1045Y), as a primary antibody (Biocare Medical, USA). Standardized gastric adenocarcinoma's HER2 expression criteria has been used in the analysis of samples. Results - There were seven cases with reactivity for HER2. Five were of intestinal-type while two cases were of mixed-type in which the expression occurred in the intestinal component. It was identified a significant association of HER2 expression in the intestinal subtype of gastric adenocarcinoma \((P=0.003)\). Regarding the anatomic site, HER2 was positive in only one (16.6%) of the six proximal cases and six (14.28%) of the 42 distal cases \((P=0.88)\). Conclusion - HER2 immunoexpression was identified in 14.6% of the samples, and the expression was significantly associated to Lauren's intestinal subtype.

HEADINGS - Immunohistochemistry. Stomach neoplasms. erbB-2 genes.
De Carli DM, Rocha MP, Antunes LCM, Fagundes RB. Immunohistochemical expression of HER2 in adenocarcinoma of the stomach

The sample consisted of 42 distal tumors and 6 proximal tumors. According to Lauren’s classification, 21 were of intestinal subtype, 20 diffuse subtype, and 7 of mixed subtype. The clinical stages of distal tumors were: IA (2 / 4.8%), IB (11 / 26.2%), II (7 / 16.7%), IIIA (9 / 21.4%), IV (13 / 30.9%). The 6 proximal tumors clinical stages were: IB (1 / 16.7%), II (1 / 16.7%), IIIB (1 / 16.7%) and stage IV (3 / 50%).

The grade of HER2 immunoreexpression was, as follows: 0 in 40 (83.3%) specimens, 1+ in 2 (1.1%), 2+ (equivocal) in 4 (8.3%) and 3+ in 3 (6.3%). Seven specimens presented HER2 reactivity immunoreexpression, corresponding to 14.6% of the sample. Of the 20 cases of diffuse subtype, none expressed HER2; 5 of the 21 intestinal subtype cases expressed HER2, which corresponds to 14.28% of intestinal subtype cases. Of the seven mixed subtype cases, two expressed HER2 only in the intestinal component. There was a significant association of the tumor intestinal component with HER2 expression ($P=0.003$). Of the six proximal lesions, only one (16.6%) expressed HER2. Of the 42 distal lesions, 2 were 3+ and 4 were 2+ (equivocal). There were no changes in the results of the repeated assessment for cases with grades 0, 1+ or 2+, therefore we did not see heterogeneity response in our sample. There was no statistical significance for the association of HER2 expression with anatomical location ($P=0.88$) (Table 1).

There was no association between HER2 status and tumor stage. Four cases with expression 2+ were in stages IB (01), II (01) and IIIA (02). Three cases with expression 3+ were in IB (02) and IV (01) (Figure 1).

### RESULTS

The institutional Ethics Committee approved the study protocol under CAAE number 0115.0.243.000-11.

### FIGURE 1

Lauren’s diffuse subtype of adenocarcinoma at 200X magnification, HE staining (A) and HER2 negative (B). Lauren’s intestinal subtype adenocarcinoma at 200X magnification, HE staining (C) and HER2, reactive 3+ (D).

### Table 1. Relation of HER2 immunohistochemical expression with Lauren’s histological subtypes and anatomical location of gastric adenocarcinoma

<table>
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<th>HER2 negative</th>
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<td>Intestinal</td>
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<td>2</td>
<td>17</td>
<td>14</td>
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<tr>
<td>Total</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>20</td>
<td>16</td>
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</tbody>
</table>

* $P<0.003$
DISCUSSION

In the present study, we found an overall rate of 14.6% reactivity for HER2 immunoexpression. We found a significant association between HER2 expression in the intestinal subtype, while no association was found with the diffuse type. In both cases of the mixed type, only the intestinal component of the tumor was reactive for HER2.

Our findings are very similar to those found in most American and European studies, where the prevalence rates of HER2 range from 10% to 22.8%, with the intestinal histological subtype being predominant in all the studies. Regarding anatomical location similar finding have been reported, with no difference between proximal and distal tumor, as we have found in our study.

Most studies conducted in Asia have also reported reactivity rates of 11.7% to 15.74%, similar to our findings, as well as the predominance of HER2 expression in the intestinal subtype. Only one study from Japan showed different prevalence of HER2 expression regarding to anatomical distribution. In that study, the prevalence of HER2 expression was found to be three times greater in proximal tumors.

ToGA trial was a phase III, randomized, controlled, multicenter study, designed to test the efficacy and safety of an anti-HER2 drug (trastuzumab) in association with chemotherapy for treatment of advanced gastric cancer. This trial showed that in patients whose lesions were HER2 positive the addition of trastuzumab to the basic chemotherapy regimen increased the survival rate to 16 months compared with 11.8 months in patients submitted to chemotherapy regimen alone. This study found a rate of 22.1% for HER2 expression. The expression of HER2 was higher in intestinal subtype lesions when compared with the diffused/mixed subtypes, similar to our findings. However, unlike our findings, this study found an increased expression of HER2 in proximal tumors. The low expression of HER2 in proximal lesions in our study could be explained by the small number of proximal tumors in our sample. The higher prevalence of HER2 in the ToGA study in relation to our findings and those of other studies may be due to ToGA’s design, where the goal of determining the effectiveness of trastuzumab in HER2 positive lesions may have led to an overestimation of the prevalence of HER2 in their results.

In Brazil, the first study conducted by Begmani et al. in 2005, analyzed the immunohistochemical expression in 462 cases and found the prevalence of HER2 expression in 12%. The HER2 expression was predominant in intestinal type, and they found no difference related to the anatomical site. Although that study showed results that are similar to ours, the frequency of HER2 expression may have been underestimated, since they used immunohistochemical grading score for breast cancer, in which the entire membrane should be stained, and not only the lateral and basolateral walls. The second study conducted in Rio Grande do Sul by Cirne-Lima et al. in 2009 identified HER2 positivity in 5.4% of 37 cases. This low rate may be due to the immunohistochemical score used, the smaller sample and the low percentage of the intestinal subtype. Our study, in addition to using HER2 gastric immunohistochemical criteria (that are specific criteria for the analysis of gastric cancer) has an equivalent percentage of intestinal and diffuse tumors, thus avoiding the predominance of a histological subtype, which would probably influence the expression of HER2. On the other side, three studies conducted recently in Brazil and using Hoffmann’s criteria found a global prevalence of 10% to 17%. This studies also found association of HER2 with intestinal subtype and only one, like ours, accessed but did not find association with the anatomical site.

Analyzing previous studies on the expression of HER2 separately in the intestinal and diffuse subtypes, we find a prevalence in intestinal type ranging from 6.1% to 28.57%, and in the diffuse type from 0.7 to 13.43%. Kataoka and colleagues, in their review of mixed subtype specimens found results similar to ours and found HER2 expressed only in the intestinal component. This finding supports the evidence that the expression of HER2 has a more consistent association with Lauren’s intestinal subtype.

Our study has limitations inherent to retrospective studies. The small number of proximal cases may have biased the data regarding the association of HER2 expression with anatomical location. Another limitation is the non-use of the FISH technique to confirm the immunohistochemical expression of HER2 in cases classified as 2+ (equivocal). Cases classified as 2+, when evaluating gene amplification by FISH, the positivity rate ranges from 36.4% to 66%. This issue is relevant because only those cases with grades 3+ and 2+ that are positive for FISH present evidence of more benefit of adding trastuzumab to the chemotherapy regimen. With the advent of trastuzumab, it has become important determine accurately HER2 expression in gastric adenocarcinoma in order to identify patients who will benefit from its use. Therefore, we need new studies that aim to identify HER2 positivity in gastric cancer. Those new studies should adopt a prospective design and appropriate score for HER2 expression as well as the use of FISH for confirmation.

CONCLUSION

Our study demonstrated HER2 immunoexpression in 14.6% of gastric adenocarcinoma. The expression was predominant in Lauren’s intestinal subtype. There was no difference in the expression related to anatomical location of the lesions or association with the clinical stage.

Authors’ contributions

Fagundes, RB, De Carli, DM and Antunes, LCM participated in the conception and design of the study. Rocha, MP and De Carli DM conducted the histological and immunohistochemical analysis. Fagundes RB performed the analysis and interpretation of the data and wrote the manuscript. All the authors approved and assumed public responsibility for the manuscript.

RESUMO - Contexto - O câncer gástrico ocupa o quarto lugar em incidência no mundo e é a segunda causa de óbito por neoplasia maligna. Por ser assintomático nas fases iniciais, na maioria das vezes, é diagnosticado em fases avançadas. A expressão do gene HER2 tem sido identificada em cerca de 20% dos casos de câncer gástrico e, sua hiper-expressão está associada a um pior prognóstico nestes pacientes. Objetivo - Investigar a expressão imunohistoquímica do HER2 em espécimes de adenocarcinoma gástrico e sua relação com a classificação histológica e localização anatômica. Métodos - Estudo transversal, retrospectivo, no qual foi analisada a expressão imunohistoquímica para o HER2, em uma amostra de 48 espécimes de câncer gástrico, através da técnica de imunohistoquímica, pelo método avidina-biotina-peroxidasílante utilizando anticorpo primário C-erb B2, clone EPI045Y (Biocare Medical, USA). Resultados - Foram encontrados sete casos reativos para o HER2; destes, cinco eram casos de adenocarcinoma do tipo intestinal e dois casos do tipo misto, porém, nestes, a expressão ocorreu no componente intestinal, o que determinou uma associação significante da expressão de HER2 com o componente intestinal do adenocarcinoma gástrico (P=0,003). Em relação ao local anatômico, HER2 foi reativo em apenas um (16,6%) de seis casos proximais e seis (14,28%) dos 42 casos distais (P=0,88). Conclusão - A expressão de HER2 ocorreu em 14,6% da amostra, associada significativamente ao subtipo intestinal de Lauren.


REFERENCES


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