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Acurácia do Raio-X de tórax na detecção de broncopatia.

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Resumo da Dissertação

Introdução: Broncopatia é definida por uma ampla entidade de doenças que determinam espessamento patológico das paredes brônquicas. **Objetivos:** Definir a acurácia da radiografia (RX) de tórax em detectar broncopatias através de método específico manual e por meio de Inteligência artificial (IA), comparativamente à tomografia computadorizada - TCAR (Padrão-ouro) **Material e Métodos:** Trata-se de estudo retrospectivo, de casos e controles, em que foram analisados 124 pacientes submetidos a exames de imagem em centro de referência no ano de 2015-2018. As imagens de TCAR e RX de tórax foram revisadas separadamente e em ordem aleatória por três médicos com diferentes tempos de experiência em radiologia e também pelo software de IA qXR v2.0 (qure.ai) -software de aprendizado profundo- afim de determinar a acurácia do RX no estabelecimento de espessamento de paredes brônquicas, comparativamente ao padrão-ouro (TCAR). **Resultados:** O Rx de tórax apresentou uma sensibilidade variando de 72,5 a 86,67%, especificidade de 80,05 a 96,88 % e acurácia de 74,59% a 89,34 %, tomando-se como padrão ouro a TCAR. O índice de concordância Kappa entre os dois exames por cada observador foi de 0,455 a 0,756, respectivamente, pelo avaliador menos experiente e o mais experiente, sendo considerada concordância entre os métodos por cada avaliador de moderada a substancial. A acurácia na detecção de broncopatia pela IA foi mais baixa do que a dos demais radiologistas, além de uma sensibilidade mais baixa que a detectadas pelos demais médicos.

Conclusão: O RX de tórax apresenta boa acurácia diagnóstica na

detecção de broncopatia quando comparado com o exame de TCAR (padrão-ouro), no entanto quando feito a avaliação pela IA, a radiografia não apresentou a acurácia esperada.

Palavras-chave: broncopatia, Raio X de tórax, TCAR, Inteligência Artificial.

Abstract

Introduction: Bronchopathy is defined by a multiple diseases entity that cause pathological thickening of the bronchial walls. **Aim of study:** To determine the accuracy of X-ray using a specific method in detecting BWT and compare it with that of HRCT. **Materials and methods**: This is a retrospective case–control study evaluated the findings of chest X-ray and HRCT performed at Santa Casa of Porto Alegre from 2015 to 2018 in patients with and without Bronchopathy. The HRCT and chest X-ray images were reviewed separately and in random order by three physicians with different experience in radiology and also by the artificial intelligence (AI) software qXR v2.0 (qure.ai) - deep learning software - in order to determine the accuracy of RX in the establishment of bronchial wall thickening, compared to the gold standard (HRCT) **Results:** Chest X-rays showed sensitivity ranging from 72.5 to 86.67%, specificity from 80.05 to 96.88% and accuracy from 74.59% to 89.34%, using computed tomography as the gold standard. The Kappa agreement index between the two exams for each observer was 0.455 to 0.756, respectively, by the least experienced and the most experienced evaluator, with moderate to substantial agreement between methods being considered by each evaluator. The accuracy in the detection of bronchopathy by AI was lower than that of the other radiologists, in addition to a lower sensitivity than that detected by other doctors. **Conclusion:** The chest X-ray shows good diagnostic accuracy in the detection of bronchopathy when compared with the HRCT scan (gold standard), however, when performed by the AI, the radiograph did not present the expected accuracy.

Keywords: bronchopathy, chest X-ray, HRCT, Artificial Intelligence.

Lista de abreviaturas

RX: Raio X

TCAR: Tomografia computadorizada de alta resolução

IA: Inteligência artificial

Lista de Figuras

Lista de Tabelas

SUMÁRIO

REFERENCIAL TEÓRICO

1.1. Definição de broncopatia

Broncopatia é um achado de imagem caracterizado por espessamento difuso patológico das paredes dos brônquios, que pode ter origem em uma ampla entidade de doenças. Segundo Menegallo et al, estão incluídas doenças inflamatórias tais como a asma, pneumonia de organização criptogênica, fibrose cística e doenças tabaco relacionadas. Processos infecciosos virais, bacterianos e fúngicos assim como neoplásicos também estão implicados no processo etiológico de espessamento brônquico[1].

Conforme Hansell, a espessura da parede dos brônquios e bronquíolos mede aproximadamente 10 a 15% do seu diâmetro[2].

De acordo com o colégio brasileiro de radiologia, espessamento da parede brônquica é reconhecido na TCAR quando a espessura da parede brônquica é duas vezes maior que a espessura da parede adjacente ou equivalente normal dos brônquios no pulmão contralateral ou quando representa menos de 80% de seu diâmetro [3].

Histologicamente, os brônquios são espessados devido a edema, aumento da quantidade de músculo liso na parede brônquica e aumento das glândulas submucosas, segundo dados apresentados por Marom et al [4].

1.2 Epidemiologia das broncopatias

Dentre todas as condições associadas a broncopatia, uma das mais prevalentes é a asma, conforme citado no Journal of asthma por DiMango et al[5].

A prevalência de espessamento brônquico na TC de alta resolução em paciente com asma varia de 44 a 92%, devendo-se esta ampla variedade a subjetividade da avaliação brônquica e às diferentes populações de pacientes[6,7].

Segundo Park et al, o espessamento da parede brônquica foi mais prevalente entre os pacientes com obstrução grave do fluxo aéreo (83% dos pacientes avaliados com volume expiratório forçado em 1 segundo [VEF1]< 60% do volume previsto) do que em pacientes com obstrução leve (35% dos pacientes com VEF1 >= 60%). Eles avaliaram o grau de broncopatia medindo o razão entre o diâmetro interno do eixo curto do brônquio e diâmetro do eixo curto da artéria pulmonar adjacente. Pacientes asmáticos com obstrução grave ao fluxo aéreo tinham uma razão bronco-artéria-diâmetro menor (média de 0,48 +- 0,11 DP) do que os pacientes com obstrução leve das vias aéreas (média de 0,6 +- 0,18) ou os indivíduos saudáveis (0,65 +_ 0,16) (p<0,01)[8].

1.3 Anatomofisiologia das vias aéreas

Segundo Hartman et al, as vias aéreas podem ser divididas fisiologicamente em pequenas vias aéreas, com diâmetros inferiores a 2 mm e grandes vias aéreas , com diâmetros superiores a 2 mm, as quais são passíveis de avaliação através dos métodos radiológicos, especialmente TC[9] .

1.4 Broncopatia na radiografia de tórax

O espessamento da parede dos brônquios é de difícil avaliação na prática diária devido a subjetividade e inespecificidade dos achados.

Um sinal radiográfico citado em vários livros didáticos e por Gluecker et al para avaliar espessamento brônquico é o "*cuffing* ", que se refere a um termo radiográfico usado para descrever o borramento ou o aumento da densidade ao redor das paredes de um brônquio ou bronquíolo visto tanto em radiografias simples quanto na TC [10]. No entanto, nota-se uma escassez na literatura de avaliação quantitativa e definição deste sinal como marcador de espessamento brônquico.

1.5 Inteligência Artificial

Conforme Savadjiev et al, ao longo do tempo, várias abordagens baseadas em IA à imagem médica produziram métodos avançados como aprendizado profundo para a leitura automática de imagens médicas incluindo desde a segmentação de órgãos até a detecção de lesões dentro de um órgão [11].

Em algumas áreas da radiologia, conforme Jha et al, a IA já está se mostrando capaz de gerar partes do laudo radiológico com descrição dos achados de modo a poupar tempo dos radiologistas, porém acreditamos que é improvável a substituição da experiência do médico radiologista pela IA[12].

O software qXR v2.0 (qure.ai) é baseado em um sistema de aprendizado profundo. Foi treinado em 2,3 milhões de radiografias de tórax e seus correspondentes relatórios radiológicos para identificar várias anormalidades observadas em uma radiografia de tórax. Pode detectar e localizar vários achados em uma radiografia de tórax, incluindo classificação normal, diferentes tipos de opacidades parenquimatosas pulmonares, pneumotórax, derrame pleural, aumento cardíaco e variações anatômicas observadas no tórax [13].

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3. OBJETIVO

Segundo a OMS, 70-80% das questões clinicamente relevantes poderiam ser resolvidas apenas com radiografias simples.

Atentando ao fato de que milhares de hospitais em todo mundo e principalmente no Brasil só tem o raio x como único método diagnóstico e por este ainda compor o protocolo para manejo de pacientes com exacerbações respiratórias, entre elas a asma e a bronquite crônica, as quais têm a tomografia computadorizada de alta resolução (cortes finos de 1-2 mm) como o melhor método de imagem para avaliar doença brônquica, essa pode ser útil para confirmar achados radiográficos.

Face à oportunidade de avaliar a taxa de detecção de broncopatia pelo raio x quando comparada com o exame padrão-ouro (tomografia computadorizada), os objetivos específicos deste projeto foram:

a) Determinar a acurácia do raio x de tórax em detectar broncopatias através de sinal radiográfico conhecido (*cuffing*) e método específico, comparativamente à tomografia computadorizada (Padrão-ouro)

b) Comparar a acurácia da avaliação feita pela avaliação humana (médicos radiologistas) e a inteligência artificial.

c) Contribuir para definir com maior precisão a confiabilidade deste método para diagnóstico de broncopatias, que é sobretudo a manifestação da exacerbação de muitas doenças.

4. ARTIGO CIENTÍFICO REDIGIDO EM INGLÊS

Accuracy of chest radiography in the evaluation of bronchopathy: medical evaluation x artificial intelligence.

INTRODUCTION

Bronchopathy is defined as a radiological finding characterized by pathological thickening of the bronchial wall (1). It is determined by a wide variety of diseases, such as asthma, pneumonia, cystic fibrosis, viral, bacterial and fungal infections, which result from inflammation of the airways (2).

Among all conditions associated with bronchopathy, one of the most prevalent is asthma (3). It is estimated that half of asthma patients have bronchial thickening. The prevalence of bronchial thickening on high-resolution computed tomography of the lungs (HRCT), 1-2 mm thin sections, in a patient with asthma varies from 44 to 92%, with this wide variety due to the subjectivity of the bronchial evaluation and the different patient populations (4-5).

In the presence of a patient with respiratory exacerbation, the investigation algorithm uses imaging methods for diagnosis, including simple chest radiography and HRCT, according to clinical suspicion (6). HRCT is the best current imaging method to assess bronchial disease and can be useful to confirm radiological findings (1-3).

The evaluation of the finding of bronchopathy has been limited due to the subjectivity of the findings (1). In this context, automatic medical image analysis using artificial intelligence (AI) has been gaining importance. Over time, several approaches based on AI for medical imaging have produced advanced methods such as deep learning for automatic reading of medical images including from organ segmentation to the detection of lesions within an organ (7).

In some areas of radiology, AI is already showing able to generate parts of the radiological report with description of the findings in order to save the radiologist's time, however we believe that the replacement of the radiologist physician's experience with AI is unlikely. In this context, in addition to evaluating the accuracy of chest radiography in detecting bronchopathies when evaluated by doctors, we will compare the assessment of bronchopathy by technology with an existing AI method (8).

Due to the lack of studies evaluating the diagnostic performance of chest radiography for the assessment of bronchopathy, and the importance of this finding in the most diverse diseases, a study is needed to assess the agreement of this method with HRCT, considered the gold standard.

The aim of the present study was to assess the accuracy of chest radiography for the diagnosis of bronchopathy, and, secondarily, to assess the agreement between the methods in the assessment of the observers.

MATERIALS AND METHODS

The present study followed the guidelines for writing observational articles STROBE Statement (9).

Study design

This is a retrospective cross-sectional study.

Setting and Participants

One-hundred fifty radiography and high resolution CT (HRCT) scan of adult patients were selected: 75 with a bronchial thickening diagnosis and 75 without a bronchial thickening.

Patients with incomplete exams or with a time between exams longer than three months were excluded, resulting in the final 124 exams.

Data measurements

All examinations were performed within three months and performed at the Irmandade Santa Casa de Misericórdia de Porto Alegre, between 2015 and 2018.

Two radiologists (R1 - 4 and a half years of experience; R2 - 3 and a half years of experience) and a resident radiology (R3 - 3rd year of radiology, in training) independently evaluated the chest HRCT and radiography, and were blinded to the clinical information.

The evaluation of the bronchial wall thickening was performed using a radiographic signal known as “peribronchial cuffing". This finding describes the blurring or increased density around the walls of the bronchus or bronchioles seen both on simple radiographs and on HRCT (10). The evaluation was performed in four quadrants, tracing two parallel hemiclavicular lines to the corresponding diaphragmatic end and another perpendicular line defined as the line that divides the chest into two similar parts (figure 1). From this, the smear of the bronchovascular structures included in the tracings was determined: bronchopathy (with blurring) (figure 2), without bronchopathy (without vascular blurring) (figure 3).

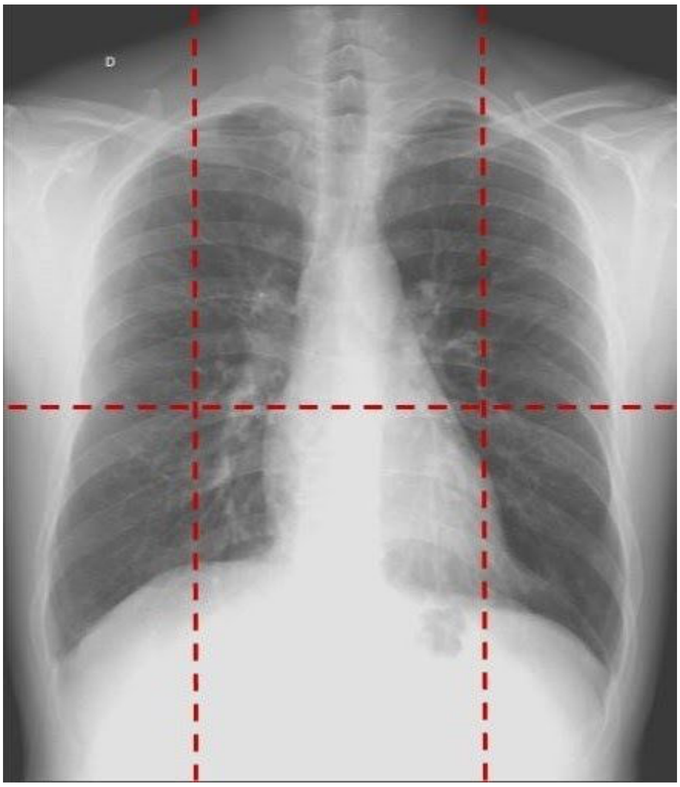

Figure 1 : Two parallel hemiclavicular lines and another perpendicular line were drawn dividing the chest into two similar parts.

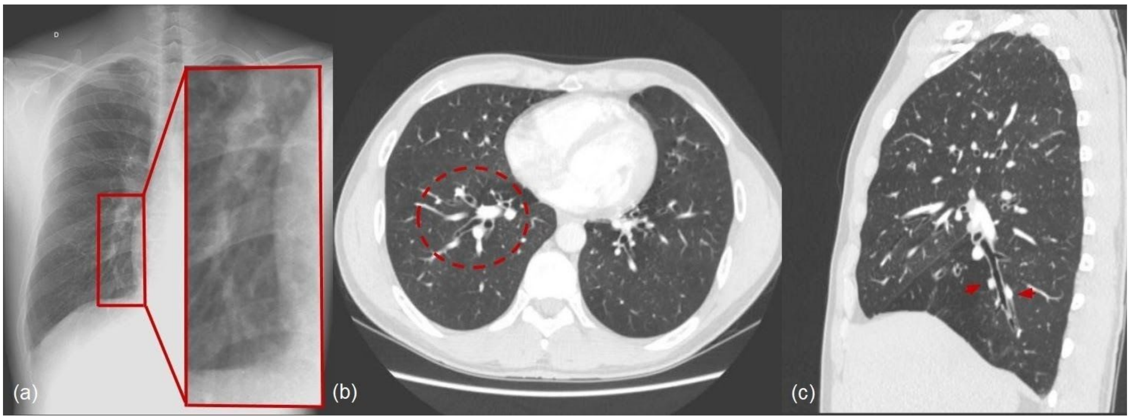

Figure 2: (a) enlargement of the lower right quadrant of radiography showing a blur of the bronchovascular structures suggesting bronchopathy. **(b)** axial tomographic section showing a slight thickening of the bronchial walls (dashed circle). **(c)** sagittal tomographic section showing slight thickening of the bronchial walls (red arrows).

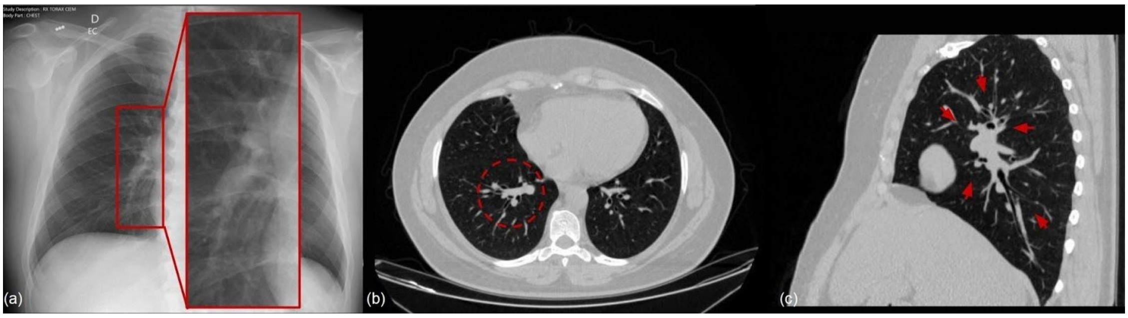

Figure 3: (a) enlargement of the lower right quadrant of an X-ray where the bronchovascular bundles are clearly defined, with no signs of bronchopathy being defined. **(b)** axial tomographic section showing absence of bronchial thickening (dashed circle). **(c)** sagittal tomographic section showing absence of bronchial thickening (red arrows).

The brochial wall thickening is recognized in HCTR when the thickness of the bronchial wall is twice as large as the wall thickness of adjacent or equivalent normal bronchi in the contralateral lung or when it represent less than 80% of its external diameter (11).

Artificial intelligence:

The software qXR v2.0 (qure.ai) was used as a fourth evaluator.

QXR is based on a deep learning system, has been trained on 2.3 million chest X-rays and its corresponding X-ray reports to identify various abnormalities seen on a chest X-ray, can detect and locate various findings on a chest X-ray, including normal classification, different types of lung parenchymal opacities, pneumothorax, pleural effusion, cardiac enlargement and anatomical variations observed in the chest.

The radiographs from our database were submitted to the software, saved in dcm format, and only one of the analyzes was excluded due to reading incompatibility, and the variation “opacities” was considered positive for bronchopathies, since the finding we evaluated manually it was the blurring of the bronchovascular structures generating opacities

In the original study of the software, the algorithm was able to detect normal radiographic reports with a sensitivity of 0.94 and a specificity of 1 in relation to the specialist reader and the accuracy of the software in detecting opacities was 0,94 (0,93 -0,96) (12).

Statistical analysis:

Statistical analysis of the data was performed with the IBM SPSS Statistics software package, version 22.0 (IBM Corporation, Chicago, IL, USA).

A Shapiro-Wilk test verified the normal distribution for all parameters. The results were presented as cases (proportion), mean ± standard deviation (SD), or by median and interquartile range (P25-P75) for asymmetric distributions.

The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) compared with HRCT as the reference standard were calculated.

The Cohen kappa coefficient between the two specialties was calculated, and classified according to the following classification: between 0.81 and 1.0 as almost perfect concordance, values between 0.61 and 0.8 as strong concordance, between 0.41 and 0.6, as moderate, between 0.21 and 0.4, as reasonable, between 0 and 0.2, as weak, and less than zero as insignificant.

The tests were bidirectional and the differences were considered significant with $p < 0.05$.

The study protocol was approved by the Research Ethics Committee of the Irmandade Santa Casa de Misericórdia de Porto Alegre, between 2015 and 2018 - ISCMPA (CAAE no. 79759917.9.0000.5335) and all the researchers signed the data confidentiality term.

RESULTS

From 2015 to 2018, 150 chest HCTR and radiography were evaluated.

Among all patients, 60% were male. Patients of all age groups were studied, ranging from 1 to 93 years old, with the majority (43.2%) of patients between 50 and 60 years old and only 3 pediatric patients aged 1, 3 and 6 years old.

Table 1 shows the diagnostic performance of chest radiography for the diagnosis of bronchopathy. The chest radiography showed sensitivity ranging from 72.5 to 86.67%, specificity from 80.05 to 96.88%, and accuracy from 74.59% to 89.34% compared with HCTR, the gold standard.

In addition, it demonstrates the ability of artificial intelligence software to evaluate radiographs, demonstrating a very low sensitivity in detecting abnormalities, around 36.7% with a negative predictive value of 35.2%.

Table 1. Diagnostic capacity by radiography in relation to HCTR by different evaluators.

Parameters	sensitivity	specificity	PPV	NPV	accuracy
AI	36,7%	90,9%	91,4%	35,2%	**51,6%**
Radiologist 1	86.67%	96,88%	98,73%	72,09%	**89,34%**
Radiologist 2	75,9%	86,05%	90,91%	66,07%	**79,51%**
Radiologist 3	**72,53%**	**80,65%**	**91,67%**	**50,00%**	**74,59%**

Note: AI,artificial intelligence; PPV, positive predictive value; NPV, negative predictive value.

The Cohen's kappa coefficient are demonstrated in Table 2. We showed a good agreement of chest HCTR and radiography for Radiologist 1 κ 0.756 (0,632 – 0,878) p<0,001. Strong agreement for Radiologist κ 2 0,580 (0,434 – 0,721) p< 0,001 and moderate for Radiologist 3 κ 0.455 (0,311 – 0,621) p <0,001.

Table 2. Intraobserver evaluation- Cohen's kappa coefficient (κ) - of imaging findings compatible with bronchopathy between HCTR and radiography

Parameters	Radiologist 1 (κ)	Radiologist 2(κ)	Radiologist 3 (κ)
Bronchopathy			
URQ	0,622	0,611	0,490
ULQ	0,588	0,653	0,483
LRQ	0,758	0,661	0,462
LLQ	0,716	0,594	0,432
Total	0,756	0,580	0,455

Note: URQ, upper right quadrant; ULQ, upper left quadrant; LRQ, lower right quadrant; LLQ, lower left quadrant.

In Table 3, we also compare the Kappa agreement index (κ) in the radiographs between radiologists and artificial intelligence, showing (κ) 0.205 (0.074 - 0.336) p = 0.002 between AI and radiologist 1, 0.303 (0.154 - 0.451) p <0.001 between AI and radiologist 2 and 0.278 (0.138 - 0.419) p <0.001 between radiologist 3 and AI, with weak agreement between artificial intelligence and radiologist 1 and slight agreement between radiologist 2, radiologist 3 and artificial intelligence.

The Kappa agreement index (κ) was also compared between the two radiography and tomography, in the evaluation of the tomographies by radiologists 1, 2 and 3 with the data from the radiographs evaluated using the

Artificial Intelligence Software. Observing an agreement κ 0,186 (0,078 – 0,294) p=0,001 between AI and CT evaluated by radiologist 1. κ 0,225 (0,097 – 0,353) p=0,001 between AI and CT scans evaluated by radiologist 2 and κ 0.214 (0.108 – 0.320) p=0,001 between AI and CT scans assessed by radiologist 3, observing a very weak agreement between HRCT assessed by radiologists 1 and radiographs by AI, and slight agreement between radiologists 2, radiologists 3 and artificial intelligence.

Table 3. Evaluation among observers-Artificial Intelligence x Radiologists-Cohen's kappa coefficient (κ)

Line 1: compatible imaging findings on X-ray bronchopathy among Radiologists and Artificial Intelligence

Line 2: imaging findings compatible with bronchopathy on the X-ray by the assessment of artificial intelligence and CT scans evaluated by radiologists

Parameters	Radiologist 1 (κ)	Radiologist 2(κ)	Radiologist 3 (κ)
Bronchopathy			
RX	0,205 (0,074 – 0,336)	0,303 (0,154 – 0,451)	0,278 (0,138 – 0,419)
TC	0,186 (0,078 – 0,294)	0,225 (0,097 – 0,353)	0.214 (0.108 – 0.320)

DISCUSSION

The results of the present study demonstrate a moderate to good intraobserver agreement for bronchopathy through the interpretation of radiography and HRCT.

We believe that the agreement for such findings could be greater if the observers were more experienced in chest radiology, allowing greater distinction of the standards, however, we tried to reproduce the daily practice, in which general radiologists are required to interpret these findings.

Computed Tomography is the method of choice among imaging methods for the evaluation of bronchial wall thickening. In the current study, however, chest radiography demonstrated good accuracy, sensitivity and specificity, compared to the gold standard.

According to WHO recommendations, about 70 to 80% of clinical findings can be resolved with radiographs (13). In addition, most hospitals have only radiography as a diagnostic method.

In addition, when assessing the AI software's ability to assess radiographs, a lower accuracy than that observed by radiologists and a very low sensitivity for abnormality detection, around 36.7%, with a negative predictive value 35.2%. This shows that in addition to the AI detecting little, it still has a lesser capacity to say that the exam is normal, with a much lower negative predictive value in relation to the radiologists who evaluated the same radiographs and with the specificity overlapping that of the evaluators / radiologists (90,9%), that is, showing no advantage in relation to medical evaluation.

When comparing the evaluation of bronchopathy on the X-ray performed by radiologists and AI, the agreement index was considered weak between the AI and the most experienced evaluator (radiologist 1) and mild between the radiologist 2, radiologist 3 and AI.

In the assessment of radiographs considered positive for bronchopathy by AI with HRCT considered positive by radiologists 1, the agreement index was very weak between AI and radiologist 1 and slight agreement between radiologist 2, radiologist 3 and AI.

We believe that although the algorithm used by AI has an expressive and growing database with more than 2.5 million RX from several tested sources, the accuracy in detecting bronchial thickening was poor due to being a fine finding ", that had a guided approach of evaluation by human intelligence, in this case, the cognitive integration of information combining the semiological analysis of the characteristics of the images in a specific anatomical and pathophysiological context, factors not attainable by the AI algorithm.

As already demonstrated by the current literature, assessments of medical images based on AI are commonly made in comparison with the performance of radiologists or medical consensus, however, the influence of the context / clinical history and the subjective interpretation of the images can make these experimental AI algorithms unreliable (8).

Limitations:

All radiologists knew that the finding to be evaluated was thickening of the bronchial walls, which may have influenced the results.

Thus, exacerbated symptomatic respiratory patients, the X-ray could be used with good accuracy to assess bronchial walls.

The analysis of the radiographs made by the AI software was not as successful as we expected, but we have no doubt that these tools are likely to transform the radiologist's routine, however, the biggest challenge will be to determine which specific radiology points will benefit from the use of these algorithms, since although they promise a quick and correct diagnosis, it seems to be necessary to correlate with clinical hypotheses and the evaluation of images within a context, a factor that we believe still needs validation in AI methods.

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5. CONCLUSÕES

Em conclusão, os achados radiográficos de broncopatia apresentaram uma boa concordância na análise por cada observador e uma boa sensibilidade, especificidade e acurácia pelos diferentes avaliadores médicos com tempos diferentes de experiência, aspectos que sugerem ser um método bom para detecção de broncopatia, permitindo o uso do raio x de tórax como ferramenta de acompanhamento em pacientes adultos com suspeita clínica de broncopatia.

A análise das radiografias feitas pelo software de IA não teve o sucesso que esperávamos, mas não temos dúvidas de que essas ferramentas provavelmente transformarão a rotina do radiologista, no entanto, o maior desafio consistirá em determinar quais pontos específicos da radiologia se beneficiarão do uso desses algoritmos, já que embora prometam um diagnóstico rápido e correto, parece ser necessária a correlação com as hipóteses clínicas e a avaliação das imagens dentro de um contexto, fator que acreditamos ainda precisar de validação nos métodos de IA.

6. BIOGRAFIA

Sou natural de Santa Bárbara do Sul-RS, fui graduada em Medicina pela Universidade Católica de Pelotas em 2015, local onde tive a experiência de ser bolsista de iniciação científica por 4 anos pelo CNPQ e FAPERGS.

Fiz a residência médica em radiologia e diagnóstico por imagem no programa vinculado a UFSCPA na Irmandade Santa Casa de Misericórdia de Porto Alegre, local onde trabalho há cerca de 1 ano como médica radiologista no grupo do abdômen, pós-conclusão da residência médica.

7. APÊNDICE

Análise estatística

Os dados foram apresentados por frequência e porcentagem ou média ± DP. Para avaliar a concordância inter- e intra-observador utilizamos coeficientes de Kappa. Sua interpretação foi realizada com base nos seguintes parâmetros: Kappa de 0,01 indica concordância “muito fraca" Kappas de 0,01 a 0,20 indicam concordância "fraca"; Kappas de 0,21 a 0,40 indicam concordância "leve"; Kappas de 0,41 a 0,60 indicam concordância "moderada"; Kappas de 0,61 a 0,80 indicam concordância "substancial"; Kappas de 0,81 a 1,00 indicam concordância "quase perfeita" [1].

Utilizando a CT como padrão-ouro calculamos a acurácia, sensibilidade, especificidade, valor preditivo positivo (VPP) e valor preditivo negativo (VPN) em relação ao raio X. Em todos os casos, valores de P menores que 0,05 foram considerados estatisticamente significativos. As análises estatísticas foram realizadas usando o SPSS v.22 (IBM, Chicago, IL, EUA).

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8. ANEXOS

8.1. Parecer do Comitê de Ética da UFCSPA

O presente estudo faz parte de um projeto intitulado “**Acurácia do Raio-X de tórax na detecção de broncopatia”,** aprovado pelos Comitês de Ética em Pesquisa (CEP) da Irmandade da Santa Casa de Misericórdia de Porto Alegre -ISCMPA (Parecer N° 2430.338) .

COMPROVANTE DE ENVIO DO PROJETO

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Acurácia do Raio-X de tórax na detecção de broncopatia

Pesquisador: RAFAELA ABREU COCCO

Versão: 1

CAAE: 79759917.9.0000.5335

Instituição Proponente: Irmandade da Santa Casa de Misericordia de Porto Alegre - ISCMPA

DADOS DO COMPROVANTE

Número do Comprovante: 132723/2017

Patrocionador Principal: Financiamento Próprio

Informamos que o projeto Acurácia do Raio-X de tórax na detecção de broncopatia que tem como pesquisador responsável RAFAELA ABREU COCCO, foi recebido para análise ética no CEP Irmandade da Santa Casa de Misericordia de Porto Alegre - ISCMPA em 09/11/2017 às 15:35.