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LETTER TO THE EDITOR

Relationship between pancreatic morphological changes and diabetes in autoimmune pancreatitis: Multimodal medical imaging assessment has important potential

Qing-Biao Zhang, Dan Liu, Jun-Bang Feng, Chun-Qi Du, Chuan-Ming Li

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Abstract

Autoimmune pancreatitis (AIP) is a special type of chronic pancreatitis with clinical symptoms of obstructive jaundice and abdominal discomfort; this condition is caused by autoimmunity and marked by pancreatic fibrosis and dysfunction. Previous studies have revealed a close relationship between early pancreatic atrophy and the incidence rate of diabetes in type 1 AIP patients receiving steroid treatment. Shimada *et al* performed a long-term follow-up study and reported that the pancreatic volume (PV) of these patients initially exponentially decreased but then slowly decreased, which was considered to be an important factor related to diabetes; moreover, serum IgG4 levels were positively correlated with PV during follow-up. In this letter, regarding the original study presented by Shimada *et al*, we present our insights and discuss how multimodal medical imaging and artificial intelligence can be used to better assess the relationship between pancreatic morphological changes and diabetes in patients with AIP.

Key Words: Autoimmune pancreatitis; Diabetes; Pancreatic morphological changes; Multimodal medical imaging; Artificial intelligence

Core Tip: Early pancreatic atrophy is associated with a greater incidence of diabetes in patients with type 1 autoimmune pancreatitis who are treated with steroids. Shimada *et al* reported that the pancreatic volume of these patients initially exponentially decreased, but then slowly decreased, which considered to be an important factor related to diabetes. However, we identified several potential shortcomings of this study, such as its small sample size and complex measurement process. In future research, multimodal medical MRI images and artificial intelligence algorithms should be used, and large research samples should be included to increase the universality and reliability of the research results.

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TO THE EDITOR

We were intrigued by the recently published article entitled "Pancreatic volume change using 3 dimensions-computed tomography volumetry and its relationships with diabetes on long-term follow-up in autoimmune pancreatitis"[1]. In this study, Shimada *et al*[1] evaluated pancreatic volume (PV) changes in patients with autoimmune pancreatitis (AIP) *via* three-dimensional (3D) computed tomography (CT) using a retrospective approach and explored the relationship between these changes and diabetes. This study revealed that the change in PV, which initially exponentially decreased but then slowly decreased, is an important factor related to diabetes, and serum IgG4 Levels were positively correlated with PV during follow-up.

AIP is a rare and specific chronic pancreatic disease characterized by obstructive jaundice and a significant response to steroid therapy, (with or without pancreatic masses). AIP can be divided into two types. Type 1 AIP, which is also known as lymphoplasmacytic sclerosing pancreatitis, typically affects multiple organs. Type 2 AIP, which is also known as idiopathic duct-centric pancreatitis, mainly affects the pancreas[2]. Type 1 AIP is more common than type 2 AIP and is characterized by high serum IgG4 levels and a good response to steroid therapy[3]. In AIP patients, the pancreas is attacked by the autoimmune system, thus leading to inflammation and fibrosis of the pancreatic tissue and further resulting in pancreatic atrophy[4]. In a previous meta-analysis[5], the prevalence of diabetes in type 1 and type 2 AIP patients was 44% and 11%, respectively. Previous studies[6,7] have demonstrated a close relationship between early pancreatic atrophy and the incidence rate of diabetes in type 1 AIP patients receiving steroid treatment. However, long-term follow-up studies have not yet been conducted. Shimada *et al*[1] performed a long-term follow-up study and reported that the PV of these patients initially exponentially decreased but then slowly decreased, which was considered to be an important factor related to diabetes; additionally, serum IgG4 levels were positively correlated with PV during follow-up. Research in this field, which has deepened our understanding of the pathogenesis of AIP and has important clinical significance in preventing diabetes in AIP patients, is highly valuable.

However, we also identified several potential shortcomings in this study[1]. For example, the small sample size of this study was not sufficient to fully represent all of the AIP patients. To address this issue, the use of G*Power software to estimate the sample size is recommended. The G*Power software includes five statistical methods (F, t, χ^2, Z, and exact tests) and is often used to calculate the required sample size and conduct statistical analysis, according to previous studies[8]. In this study, we recommend the selection of an effect size of 0.5 (medium effect) based on Cohen's standard to effectively balance the sample size and to test power. The significance level (α) should be set at 0.05 to ensure statistical significance in the results, and a power of 0.8 should be used to control the type II error rate to within 20%[9,10]. To investigate the significance of the changes in the PV in AIP patients after steroid treatment, G*Power calculations revealed that a sample size of 34 cases was needed. To investigate the changes in AIP patients receiving steroid treatment compared with healthy controls, the total sample size as determined *via* G*Power calculation was 128, with 64 participants included in each group.

In this study[1], all of the patients underwent at least three CT scans within the first year, and then at least one scan every 12 months. Too much ionizing radiation may lead to the occurrence of tumours. In addition, the soft tissue contrast of the CT images was not good. To address these issues, magnetic resonance imaging (MRI) could serve as an alternative testing measure. MRI has many advantages for evaluating pancreatic atrophy. The high soft tissue contrast of MRI can clearly display the outline and internal structure of the pancreas. Multiple sequences [including T1 weighted, T2 weighted, and diffusion weighted imaging (DWI), among other sequences] can provide information on functional and structural changes in the pancreas from different perspectives. Kobi *et al*[11] suggested that MRI is crucial for the detection, diagnosis, staging, and posttreatment monitoring of pancreatic tumours. Itani *et al*[12] indicated that magnetic resonance cholangiopancreatography can both sensitively and accurately detect pancreatic duct and bile duct abnormalities. The apparent diffusion coefficient is a quantitative indicator obtained from DWI and can be used for the early determination of the effect of steroid therapy for AIP[13]. These results indicated that MRI has many advantages over CT in revealing the morphology and internal structure of the pancreas. However, MRI also has limitations, such as increased costs, longer scanning times and the need for good patient cooperation. In addition, MRI also has some contraindications. The use of MRI is limited for patients with pacemakers, metallic foreign bodies in the body, claustrophobia, and unstable vital signs. To address these issues, it is recommended to use non-magnetic materials for metal implants in the body. For patients with claustrophobia, large aperture MRI equipment and fast scanning sequences can help complete the examination[14,15].

In this study, a semiautomatic 3D-CT volume measurement method based on CE-CT images was used for evaluating pancreatic atrophy[1]. However, during CT scanning, the thickness of the reconstructed slices in some cases was set to 2.5 mm, which may result in a deviation between the calculated volume and the actual value. To ensure the accuracy of the data, a reconstruction thickness of less than 1 mm was recommended. In addition, we recommend that at least two doctors perform contour measurements of the pancreas in a double-blind manner and the consistency tests should be performed. Furthermore, the application of artificial intelligence algorithm in pancreas segmentation has undergone rapid development and has achieved good results in recent years. Deep learning algorithms are especially well suited for handling medical images with irregular shapes and weak boundaries, thus significantly improving the efficiency of medical image segmentation[16]. Convolutional neural network (CNN), U-Net and Transform algorithms have shown significant advantages in pancreas boundary segmentation. They can accurately separate the pancreas from the surrounding tissues and perform automatic segmentation of the pancreas, with a Dice coefficient greater than 0.8[17–21]. Gao *et al*[18]proposed the use of a superpixel-based active contour model and combined it with the nnU-Net model to segment the pancreas on CT images. The final DICE index was observed to be greater than 0.85. Using the extension-contraction transformation network proposed by Zheng and Luo[21], the Dice coefficient for pancreas segmentation was shown to be 0.86. Sridevi and Jaidhan[22] proposed a new method known as the Spatial Horned Lizard Attention Approach to segment pancreatic abscesses based on MRI images, and the DICE index reached 0.95. Automatic segmentation algorithms can greatly improve work efficiency and reproducibility and reduce the bias caused by subjective factors. Deep learning technology not only plays a key role in pancreatic segmentation but also has important application value in pancreatic disease diagnosis. Zhang *et al*[23] developed an artificial intelligence model that enables fully automated diagnosis of acute pancreatitis and assessment of its severity. The deep learning model developed by Cao *et al*[24] could accurately and efficiently detect pancreatic cancer on plain CT scans and achieved an area under the curve of 0.986. In addition, deep learning has been applied in the classification and prognosis prediction of pancreatic steatosis and pancreatic tumours[25,26]. However, artificial intelligence has several limitations, such as high data requirements, significant consumption of computing resources, and relatively weak generalizability[27–29].

In summary, the study by Shimada *et al*[1] greatly deepened our understanding of the pathogenesis of diabetes in AIP patients and has important clinical significance. Artificial intelligence algorithms possess important practical value and potential advantages in this field, as they can automatically and accurately separate the pancreas and surrounding tissues and perform morphological and structural analyses. This technology can not only improve the efficiency of clinical work but also significantly enhance the accuracy of results. Multimodal imaging can display the subtle anatomical structure of the pancreas from multiple angles, providing rich pathophysiological information about AIP. The combination of multimodal imaging and artificial intelligence greatly facilitates the diagnosis, treatment, and prognostic evaluation of AIP, and can help deepen our understanding of the mechanisms underlying AIP. In future studies, we recommend incorporating multimodal medical images, including MRI, CT and positron emission tomography images, from multiple centres/devices and using artificial intelligence algorithms such as CNN, U-Net or Transform to establish models to achieve automatic segmentation of the pancreas and automatic analysis of changes in morphology and internal structure. External validation should be used, and randomized controlled trials or real-world research methods should be employed to clarify the true value of the model. In addition, professional sample estimation software (such as G*Power) was used to determine the sample size, and healthy individuals were used as the control group to improve the generalizability and reliability of the research results. Based on these recommendations, further optimization of research design, imaging methods, and artificial intelligence technology would improve the accuracy and automation greatly in the future. This had significant potential value for the clinical application and promotion of this technology.

FOOTNOTES

Author contributions: Zhang QB and Liu D contribute equally to this study as co-first authors; Du CQ and Li CM contribute equally to this study as co-first authors; Zhang QB, Liu D and Feng JB designed the research; Zhang QB performed the research; Zhang QB, Du CQ and Feng JB analysed the data; Zhang QB, Liu D, Du CQ, Feng JB and Li CM wrote the letter; and Feng JB and Li CM revised the letter.

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