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Top 100 cited articles related to EUS: A bibliometric analysis

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ABSTRACT

Background and Objectives: Citation analysis is a fundamental method in bibliometrics for quantifying the impact and contribution of articles on a specific biomedical field. The purpose of our study was to identify and analyze the top 100 cited articles in the field of EUS.

Methods: All published articles in the field of EUS were searched by using "endoscopic ultrasound" and its synonyms as the search terms without time limit. The Institute for Scientific Information Web of Science Core database was searched to determine the citations. The top 100 cited articles were identified and further evaluated for characteristics including publication year, authors, journals, impact factor, countries, institutions, article type, topic term, and evidence grade, among others.

Results: A total of 430 articles were cited more than 100 times. The 100 most-cited articles were published between 1988 and 2018, and the medium citation was 240.5 (104.25). The top 100 cited articles mainly focused on diagnostic performance (80%) and interventional therapy (20%). The numbers of articles studying the diagnostic accuracy of FNA (n = 29) and tumor diagnosis (n = 29) were the highest among research articles on FNA and EUS of diagnostic categories, and EUS transluminal drainage (n = 14) was the most frequently used EUS technique for therapy. The focus of the majority of the articles was on diseases of pancreas (n = 55), and among the 55 articles related to pancreatic diseases, pancreatic cancer (n = 17) and solid pancreatic masses (n = 13) were the most researched topics. In addition, we found that the proportions of diagnostic and treatment-related articles at different time periods have statistical significance (P < 0.05).

Conclusions: Our analysis provides an insight into the top 100 articles in the field of EUS, revealing EUS-guided FNA, tumor staging, and transluminal drainage as the major advances in the past 35 years. Pancreatic diseases were the most researched, especially pancreatic cancer or solid pancreatic masses. Our research has found that the number of articles on the application of EUS treatment has significantly increased.

Key words: EUS; Bibliometric analysis; FNA; Diagnostic accuracy; Pancreatic diseases

INTRODUCTION

EUS is a medical procedure that combines endoscopy and ultrasound to obtain images of the internal organs and tissues in the gastrointestinal (GI) tract and chest. Since its advent in 1980, the scope of EUS has grown to include a wide range of indications, and it is now being incorporated as an integral part of everyday practice in the field of gastroenterology.[1] The interventional capacity of EUS continues to progress considerably, with advent of new procedures such as gastrojejunostomy creation, gallbladder drainage, liver biopsy, and EUS-guided transluminal ERCP in patients with altered anatomy.[2]

A citation is the acknowledgement that one scientific article (the citing article) uses another (the cited article) as a reference. Citation analysis is a fundamental method in bibliometrics for quantifying the impact and contribution of articles on a specific biomedical field. Therefore, we can infer the contribution of a country, author, journal, and institution in a specific field based on the number of citations they receive. Though it is virtually impossible to evaluate the true value of an article, citation analysis provides a simple quantitative technique to estimate the impact of an article. The first article regarding bibliometric methods by Eugene Garfield was published in the *Journal of the American Medical Association* (JAMA) in 1987,[3] and then the application of citation analysis has continuously evolved. A number of studies have reported the most-cited articles in various clinical disciplines, such as ophthalmology,[4] general surgery,[5] orthopedic surgery,[6] neuroimaging, and cardiovascular medicine.[7] However, the top-cited articles in the field of EUS have not been reported so far.

Because the bibliometric analysis is helpful in fully evaluating the important advances in a specific field, it can be valuable in revealing the significant progresses related to EUS. The aim of this study was to identify and analyze the 100 most-cited articles in the field of EUS.

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MATERIALS AND METHODS

Data collection and strategy for data retrieval

Articles were searched on PubMed and the Institute for Scientific Information (ISI)Web of Science (WOS) Core Collection database September 30, 2023, by 2 independent investigators (T.L. and X.W.), with no time limitation. The keywords used for the search were "EUS or endoscopic ultrasound or endoscopic ultrasonography or ultrasonic fiberendoscope or ultrasonic tomography or endosonography or ultrasonic endoscopy or echo endoscopy" as the "topic" (title, abstract, author's keywords, and Keywords Plus) for WOS, and "TIAB" (title and abstract) for PubMed.

Articles searched had to satisfy the following criteria: 1) the article language was "English"; 2) the articles had to be included in science citation index (SCI); 3) the document types were "articles," "conference summary," and "review" (including meta-analysis and systematic review; 4) the categories were "gastroenterology hepatology," "surgery," "oncology," "medicine general internal," "pathology," "computer science artificial intelligence," and "geriatrics gerontology"; and 5) the content of the article should be related to gastroenterology (exclude laparoscopic ultrasound, urologic ultrasound, cardiologic ultrasound, endobronchial ultrasound, and gynecologic ultrasound).

We compared the titles of articles downloaded from PubMed every year with articles downloaded from WOS to check for any duplicate articles. The overlapping articles were removed, and we used the remaining articles to supplement the search results of WOS. The results were organized from the most-cited to the least-cited publications according to the number of times cited in the WOS Core Collection. Each search result was reviewed by 2 independent gastroenterologists (X.W. and G.R.) specialized in EUS to ensure its relation to EUS.

Data analysis of top 100 cited articles

The 100 articles with the highest number of citations that matched the search criteria were then analyzed further by 2 independent investigators (T.L. and X.K.), and the following data were compiled: publication year, authors, journal name, impact factor, country of origin, institution of origin, total number of citations for the article, article type (clinical research, review, case report, guideline, or animal study), topic term, and the location of disease. The main topics of top 100 articles were extracted by 2 investigators (X.W. and G.R.). Topics were categorized into "diagnostic performance" and "interventional therapy." Among them, diagnostic performance was further divided into EUS imaging-related diagnosis and FNA-related diagnosis. Interventional therapy was further divided into EUS transluminal drainage, EUS-guided celiac plexus neurolysis (EUS-CPN), EUS-guided intratumoral drug injection, EUS-guided ethanol lavage, and EUS-radiofrequency ablation. If we found more than one topic term in an article, we reviewed the abstract to determine whether all topic terms were included. We also classified the 100 articles according to diseases, including upper gastrointestinal tract (UGI), lower gastrointestinal tract (LGI), bile duct, gallbladder, pancreas, and mediastinum, among others. In addition, articles studying multiple-organ systems, complications, EUS-related guidelines, and reviews were categorized into other categories. The quality of evidence in these 100 articles was classified according to different levels of evidence as follows: systematic reviews and meta-analysis, randomized controlled studies, prospective cohort studies, retrospective studies, case series, expert review, and animal studies.

If there were any discrepancies in the evaluation of the articles, we would reevaluate and discuss with a third investigator (Y.P.). This method had been used in many previous articles on bibliometric analysis.[8–10]

Statistics

All of the information and data for each article were inserted into a spreadsheet and manipulated using Microsoft Excel 2021 (Microsoft Corp., Redmond, WA). The Kruskal-Wallis test and chi-square test were performed using SPSS software version 26.0 (IBM). A P value <0.05 (with Bonferroni correction) was considered statistically significant. We created the graphs and figures using SPSS software version 26.0 (IBM) and GraphPad Prism version 8.0.0 for Windows (GraphPad Software, San Diego, CA).

RESULTS

There were a total of 13,129 English papers related to EUS when searching PubMed and WOS. After removing articles with citations <10, 7163 articles were left. After removing repeated articles and articles whose topics were not EUS, 4088 articles were left, including 2955 papers cited 10–50 times, 703 cited 50–100 times, and 430 cited more than 100 times (Supplementary Figures 1 and 2, http://links.lww.com/ENUS/A361). The top 100 cited articles are listed in Table 1, and the distribution of publication years for 4088 articles is shown in Figure 1A.

The top 100 cited articles are listed in Table 1 in descending order. The median of citations was 240.5 (104.25). The highest cited article was published in 2004 by Brugge.[11] The oldest cited paper was published in 1988 by Yasuda et al., and the newest were published in 2018 by Brunschot et al. The number of articles and total number of citations were both highest in years 2001–2010 (n = 49), followed by those in years 1988–2000 (n = 35) and years 2011–2020 (n = 16) [Figure 1B, C]. The highest medium number of citations was from 1991 to 2000 (median = 270), followed by 1981 to 1990 (median = 267), 2001 to 2010 (median = 264), and 2011 to 2020 (median = 232) (P = 0.225) [Figure 1D].

The majority of the articles originated from the United States (U.S.) (n = 56), followed distantly by France (n = 13) and Germany (n = 10) (Supplementary Table 1, http://links.lww.com/ENUS/A362). Supplementary Table 2, http://links.lww.com/ENUS/A362, presents the top 10 institutions, with The University of Alabama (n = 9) and Indiana University (n = 7) leading the list, both located in the U.S. The 100 most-cited articles were published in 23 journals, with *Gastrointestinal Endoscopy* (n = 41) being the most prominent, followed by *Endoscopy* (n = 12) and *American Journal of Gastroenterology* (n = 10) [Table 2]. Sixteen individuals were first authors of 2 or more of the top-cited articles (Supplementary Table 3, http://links.lww.com/ENUS/A362), with Frank G. Gress (n = 6) and Thomas Rösch (n = 5) ranking at the top of the list.

The top cited articles focused on 2 main topics: diagnostic performance (n = 80) and interventional therapy (n = 20) [Table 3]. Over the past 35 years, there has been a notable increase in the utilization of therapeutic EUS. Among the 100 articles, the proportion of therapeutic EUS was 9% between 1988 and 2000, 20% between 2001 and 2010, and 31% between 2011 and 2020 (P < 0.05). The number of articles examining the diagnostic accuracy of FNA (n = 29) and tumor diagnosis (n = 29) was found to be the highest among the research articles focused on FNA and EUS in terms of diagnostic categories. Pancreatic/ampullary cancer (n = 12) was the most common

Table 1

Lists of top 100 cited EUS-related articles

Rank	Article	Citations
1	Brugge WR, Lewandrowski K, Lee-Lewandrowski E, Centeno BA, Szydlo T, Regan S, del Castillo CF, Warshaw AL. Diagnosis of pancreatic cystic neoplasms: a report of the cooperative pancreatic cyst study. Gastroenterology. 2004 May;126(5):1330–6	958
2	Wiersema MJ, Vilmann P, Giovannini M, Chang KJ, Wiersema LM. Endosonography-guided fine-needle aspiration biopsy: diagnostic accuracy and complication assessment. Gastroenterology. 1997 Apr;112(4):1087–95	868
3	Rösch T, Lightdale CJ, Botet JF, Boyce GA, Sivak MV Jr, Yasuda K, Heyder N, Palazzo L, Dancygier H, Schusdziarra V, et al. Localization of pancreatic endocrine tumors by endoscopic ultrasonography. N Engl J Med. 1992 Jun 25;326(26):1721–6	537
4	Williams DB, Sahai AV, Aabakken L, Penman ID, van Velse A, Webb J, Wilson M, Hoffman BJ, Hawes RH. Endoscopic ultrasound guided fine needle aspiration biopsy: a large single centre experience. Gut. 1999 May;44(5):720–6	488
5	Hewitt MJ, McPhail MJ, Possamai L, Dhar A, Vlavianos P, Monahan KJ. EUS-guided FNA for diagnosis of solid pancreatic neoplasms: a meta-analysis. Gastrointest Endosc. 2012 Feb;75(2):319–31	469
6	Chang KJ, Nguyen P, Erickson RA, Durbin TE, Katz KD. The clinical utility of endoscopic ultrasound-guided fine-needle aspiration in the diagnosis and staging of pancreatic carcinoma. Gastrointest Endosc. 1997 May;45(5):387–93	460
7	Rösch T, Braig C, Gain T, Feuerbach S, Siewert JR, Schusdziarra V, Classen M. Staging of pancreatic and ampullary carcinoma by endoscopic ultrasonography. Comparison with conventional sonography, computed tomography, and angiography. Gastroenterology. 1992 Jan;102 (1):188–99	447
8	Giovannini M, Moutardier V, Pesenti C, Bories E, Lelong B, Delpero JR. Endoscopic ultrasound-guided bilioduodenal anastomosis: a new technique for biliary drainage. Endoscopy. 2001 Oct;33(10):898–900	436
9	van der Waaij LA, van Dullemen HM, Porte RJ. Cyst fluid analysis in the differential diagnosis of pancreatic cystic lesions: a pooled analysis. Gastrointest Endosc. 2005 Sep;62(3):383–9	406
10	Vilmann P, Jacobsen GK, Henriksen FW, Hancke S. Endoscopic ultrasonography with guided fine needle aspiration biopsy in pancreatic disease. Gastrointest Endosc. 1992 Mar-Apr;38(2):172–3	404
11	Klapman JB, Logrono R, Dye CE, Waxman I. Clinical impact of on-site cytopathology interpretation on endoscopic ultrasound-guided fine needle aspiration. Am J Gastroenterol. 2003 Jun;98(6):1289–94	379
12	Hecht JR, Bedford R, Abbruzzese JL, Lahoti S, Reid TR, Soetikno RM, Kirn DH, Freeman SM. A phase I/II trial of intratumoral endoscopic ultrasound injection of ONYX-015 with intravenous gemcitabine in unresectable pancreatic carcinoma. Clin Cancer Res. 2003 Feb;9(2):555–61	370
13	Schwartz DA, Wiersema MJ, Dudiak KM, Fletcher JG, Clain JE, Tremaine WJ, Zinsmeister AR, Norton ID, Boardman LA, Devine RM, Wolff BG, Young-Fadok TM, Diehl NN, Pemberton JH, Sandborn WJ. A comparison of endoscopic ultrasound, magnetic resonance imaging, and exam under anesthesia for evaluation of Crohn's perianal fistulas. Gastroenterology. 2001 Nov;121(5):1064–72	350
14	Catalano MF, Sivak MV Jr, Rice T, Gragg LA, Van Dam J. Endosonographic features predictive of lymph node metastasis. Gastrointest Endosc. 1994 Jul-Aug;40(4):442–6	347
15	Giovannini M, Seitz JF, Monges G, Perrier H, Rabbia I. Fine-needle aspiration cytology guided by endoscopic ultrasonography: results in 141 patients. Endoscopy. 1995 Feb;27(2):171–7	346
16	DeWitt J, Devereaux B, Chriswell M, McGreevy K, Howard T, Imperiale TF, Ciaccia D, Lane KA, Maglinte D, Kopecky K, LeBlanc J, McHenry L, Madura J, Aisen A, Cramer H, Cummings O, Sherman S. Comparison of endoscopic ultrasonography and multidetector computed tomography for detecting and staging pancreatic cancer. Ann Intern Med. 2004 Nov 16;141(10):753–63	345
17	Rösch T, Lorenz R, Braig C, Feuerbach S, Siewert JR, Schusdziarra V, Classen M. Endoscopic ultrasound in pancreatic tumor diagnosis. Gastrointest Endosc. 1991 May-Jun;37(3):347–52	342
18	Catalano MF, Sahai A, Levy M, Romagnuolo J, Wiersema M, Brugge W, Freeman M, Yamao K, Canto M, Hernandez LV. EUS-based criteria for the diagnosis of chronic pancreatitis: the Rosemont classification. Gastrointest Endosc. 2009 Jun;69(7):1251–61	333
19	Palazzo L, Roseau G, Gayet B, Vilgrain V, Belghiti J, Fékéte F, Paolaggi JA. Endoscopic ultrasonography in the diagnosis and staging of pancreatic adenocarcinoma. Results of a prospective study with comparison to ultrasonography and CT scan. Endoscopy. 1993 Feb;25(2):143–50	323
20	Erickson RA, Sayage-Rabie L, Beissner RS. Factors predicting the number of EUS-guided fine-needle passes for diagnosis of pancreatic malignancies. Gastrointest Endosc. 2000 Feb;51(2):184–90	321
21	Canto MI, Goggins M, Yeo CJ, Griffin C, Axilbund JE, Brune K, Ali SZ, Jagannath S, Petersen GM, Fishman EK, Piantadosi S, Giardiello FM, Hruban RH. Screening for pancreatic neoplasia in high-risk individuals: an EUS-based approach. Clin Gastroenterol Hepatol. 2004 Jul;2(7):606–21	317
22	Khalid A, Zahid M, Finkelstein SD, LeBlanc JK, Kaushik N, Ahmad N, Brugge WR, Edmundowicz SA, Hawes RH, McGrath KM. Pancreatic cyst fluid DNA analysis in evaluating pancreatic cysts: a report of the PANDA study. Gastrointest Endosc. 2009 May;69(6):1095–102	317
23	van Brunschot S, van Grinsven J, van Santvoort HC, Bakker OJ, Besselink MG, Boermeester MA, Bollen TL, Bosscha K, Bouwense SA, Bruno MJ, Cappendijk VC, Consten EC, Dejong CH, van Eijck CH, Erkelens WG, van Goor H, van Grevenstein WMU, Haveman JW, Hofker SH, Jansen JM, Laméris JS, van Lienden KP, Meijssen MA, Mulder CJ, Nieuwenhuijs VB, Poley JW, Quispel R, de Ridder RJ, Römkens TE, Scheepers JJ, Schepers NJ, Schwartz MP, Seerden T, Spanier BWM, Straathof JWA, Strijker M, Timmer R, Venneman NG, Vleggaar FP, Voermans RP, Witteman BJ, Gooszen HG, Dijkgraaf MG, Fockens P; Dutch Pancreatitis Study Group. Endoscopic or surgical step-up approach for infected necrotising pancreatitis: a multicentre randomised trial. Lancet. 2018 Jan 6;391(10115):51–58	316
24	Tio TL, Cohen P, Coene PP, Udding J, den Hartog Jager FC, Tytgat GN. Endosonography and computed tomography of esophageal carcinoma. Preoperative classification compared to the new (1987) TNM system. Gastroenterology. 1989 Jun;96(6):1478–86	315

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Table 1
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Rank	Article	Citations
25	Eloubeidi MA, Chen VK, Eltoum IA, Jhala D, Chhieng DC, Jhala N, Vickers SM, Wilcox CM. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: diagnostic accuracy and acute and 30-day complications. Am J Gastroenterol. 2003 Dec;98 (12):2663–8	315
26	Harewood GC, Wiersema MJ. Endosonography-guided fine needle aspiration biopsy in the evaluation of pancreatic masses. Am J Gastroenterol. 2002 Jun;97(6):1386–91	307
27	Gress FG, Hawes RH, Savides TJ, Ikenberry SO, Lehman GA. Endoscopic ultrasound-guided fine-needle aspiration biopsy using linear array and radial scanning endosonography. Gastrointest Endosc. 1997 Mar;45(3):243–50	300
28	Itoi T, Binmoeller KF, Shah J, Sofuni A, Itokawa F, Kurihara T, Tsuchiya T, Ishii K, Tsuji S, Ikeuchi N, Moriyasu F. Clinical evaluation of a novel lumen-apposing metal stent for endosonography-guided pancreatic pseudocyst and gallbladder drainage (with videos). Gastrointest Endosc. 2012 Apr;75 (4):870–6	295
29	Brentnall TA, Bronner MP, Byrd DR, Haggitt RC, Kimmey MB. Early diagnosis and treatment of pancreatic dysplasia in patients with a family history of pancreatic cancer. Ann Intern Med. 1999 Aug 17;131(4):247–55	291
30	Voss M, Hammel P, Molas G, Palazzo L, Dancour A, O'Toole D, Terris B, Degott C, Bernades P, Ruszniewski P. Value of endoscopic ultrasound guided fine needle aspiration biopsy in the diagnosis of solid pancreatic masses. Gut. 2000 Feb;46(2):244–9	288
31	Varadarajulu S, Bang JY, Sutton BS, Trevino JM, Christein JD, Wilcox CM. Equal efficacy of endoscopic and surgical cystogastrostomy for pancreatic pseudocyst drainage in a randomized trial. Gastroenterology. 2013 Sep;145(3):583–90.e1	287
32	Bhutani MS, Hawes RH, Hoffman BJ. A comparison of the accuracy of echo features during endoscopic ultrasound (EUS) and EUS-guided fine-needle aspiration for diagnosis of malignant lymph node invasion. Gastrointest Endosc. 1997 Jun;45(6):474–9	284
33	Frossard JL, Amouyal P, Amouyal G, Palazzo L, Amaris J, Soldan M, Giostra E, Spahr L, Hadengue A, Fabre M. Performance of endosonography-guided fine needle aspiration and biopsy in the diagnosis of pancreatic cystic lesions. Am J Gastroenterol. 2003 Jul;98(7):1516–24	281
34	Soriano A, Castells A, Ayuso C, Ayuso JR, de Caralt MT, Ginès MA, Real MI, Gilabert R, Quintó L, Trilla A, Feu F, Montanyà X, Fernández-Cruz L, Navarro S. Preoperative staging and tumor resectability assessment of pancreatic cancer: prospective study comparing endoscopic ultrasonography, helical computed tomography, magnetic resonance imaging, and angiography. Am J Gastroenterol. 2004 Mar;99(3):492–501	278
35	Micames C, Jowell PS, White R, Paulson E, Nelson R, Morse M, Hurwitz H, Pappas T, Tyler D, McGrath K. Lower frequency of peritoneal carcinomatosis in patients with pancreatic cancer diagnosed by EUS-guided FNA vs. percutaneous FNA. Gastrointest Endosc. 2003 Nov;58 (5):690–5	272
36	Anderson MA, Carpenter S, Thompson NW, Nostrant TT, Elta GH, Scheiman JM. Endoscopic ultrasound is highly accurate and directs management in patients with neuroendocrine tumors of the pancreas. Am J Gastroenterol. 2000 Sep;95(9):2271–7	272
37	Varadarajulu S, Christein JD, Tamhane A, Drelichman ER, Wilcox CM. Prospective randomized trial comparing EUS and EGD for transmural drainage of pancreatic pseudocysts (with videos). Gastrointest Endosc. 2008 Dec;68(6):1102–11	271
38	Wiersema MJ, Wiersema LM. Endosonography-guided celiac plexus neurolysis. Gastrointest Endosc. 1996 Dec;44(6):656–62	270
39	Mallery S, Matlock J, Freeman ML. EUS-guided rendezvous drainage of obstructed biliary and pancreatic ducts: Report of 6 cases. Gastrointest Endosc. 2004 Jan;59(1):100–7	266
40	Varadarajulu S, Tamhane A, Eloubeidi MA. Yield of EUS-guided FNA of pancreatic masses in the presence or the absence of chronic pancreatitis. Gastrointest Endosc. 2005 Nov;62(5):728–36; quiz 751, 753	260
41	Iglesias-Garcia J, Dominguez-Munoz JE, Abdulkader I, Larino-Noia J, Eugenyeva E, Lozano-Leon A, Forteza-Vila J. Influence of on-site cytopathology evaluation on the diagnostic accuracy of endoscopic ultrasound-guided fine needle aspiration (EUS-FNA) of solid pancreatic masses. Am J Gastroenterol. 2011 Sep;106(9):1705–10	257
42	Garcia-Aguilar J, Pollack J, Lee SH, Hernandez de Anda E, Mellgren A, Wong WD, Finne CO, Rothenberger DA, Madoff RD. Accuracy of endorectal ultrasonography in preoperative staging of rectal tumors. Dis Colon Rectum. 2002 Jan;45(1):10–5	256
43	Ando N, Goto H, Niwa Y, Hirooka Y, Ohmiya N, Nagasaka T, Hayakawa T. The diagnosis of GI stromal tumors with EUS-guided fine needle aspiration with immunohistochemical analysis. Gastrointest Endosc. 2002 Jan;55(1):37–43	255
44	Gress F, Gottlieb K, Sherman S, Lehman G. Endoscopic ultrasonography-guided fine-needle aspiration biopsy of suspected pancreatic cancer. Ann Intern Med. 2001 Mar 20;134(6):459–64	254
45	Wang KX, Ben QW, Jin ZD, Du YQ, Zou DW, Liao Z, Li ZS. Assessment of morbidity and mortality associated with EUS-guided FNA: a systematic review. Gastrointest Endosc. 2011 Feb;73(2):283–90	253
46	Wiersema MJ, Hawes RH, Lehman GA, Kochman ML, Sherman S, Kopecky KK. Prospective evaluation of endoscopic ultrasonography and endoscopic retrograde cholangiopancreatography in patients with chronic abdominal pain of suspected pancreatic origin. Endoscopy. 1993 Nov;25(9):555–64	251
47	Puli SR, Bechtold ML, Buxbaum JL, Eloubeidi MA. How good is endoscopic ultrasound-guided fine-needle aspiration in diagnosing the correct etiology for a solid pancreatic mass?: A meta-analysis and systematic review. Pancreas. 2013 Jan;42(1):20–6	244
48	O'Toole D, Palazzo L, Arotçarena R, Dancour A, Aubert A, Hammel P, Amaris J, Ruszniewski P. Assessment of complications of EUS-guided fine-needle aspiration. Gastrointest Endosc. 2001 Apr;53(4):470–4	243
49	Chang KJ, Katz KD, Durbin TE, Erickson RA, Butler JA, Lin F, Wuerker RB. Endoscopic ultrasound-guided fine-needle aspiration. Gastrointest Endosc. 1994 Nov–Dec;40(6):694–9	243
50	Iglesias-Garcia J, Poley JW, Larghi A, Giovannini M, Petrone MC, Abdulkader I, Monges G, Costamagna G, Arcidiacono P, Biermann K, Rindi G, Bories E, Dogloni C, Bruno M, Dominguez-Muñoz JE. Feasibility and yield of a new EUS histology needle: results from a multicenter, pooled, cohort study. Gastrointest Endosc. 2011 Jun;73(6):1189–96	241

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Table 1
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Rank	Article	Citations
51	Kelly S, Harris KM, Berry E, Hutton J, Roderick P, Cullingworth J, Gathercole L, Smith MA. A systematic review of the staging performance of endoscopic ultrasound in gastro-oesophageal carcinoma. Gut. 2001 Oct;49(4):534–9	240
52	Sahai AV, Zimmerman M, Aabakken L, Tarnasky PR, Cunningham JT, van Velse A, Hawes RH, Hoffman BJ. Prospective assessment of the ability of endoscopic ultrasound to diagnose, exclude, or establish the severity of chronic pancreatitis found by endoscopic retrograde cholangiopancreatography. Gastrointest Endosc. 1998 Jul;48(1):18–25	240
53	Kahaleh M, Shami VM, Conaway MR, Tokar J, Rockoff T, De La Rue SA, de Lange E, Bassignani M, Gay S, Adams RB, Yeaton P. Endoscopic ultrasound drainage of pancreatic pseudocyst: a prospective comparison with conventional endoscopic drainage. Endoscopy. 2006 Apr;38(4):355–9	238
54	Eloubeidi MA, Jhala D, Chhieng DC, Chen VK, Eltoum I, Vickers S, Mel Wilcox C, Jhala N. Yield of endoscopic ultrasound-guided fine-needle aspiration biopsy in patients with suspected pancreatic carcinoma. Cancer. 2003 Oct 25;99(5):285–92.	237
55	Giovannini M, Hookey LC, Bories E, Pesenti C, Monges G, Delpero JR. Endoscopic ultrasound elastography: the first step towards virtual biopsy? Preliminary results in 49 patients. Endoscopy. 2006 Apr;38(4):344–8	237
56	Catalano MF, Lahoti S, Geenen JE, Hogan WJ. Prospective evaluation of endoscopic ultrasonography, endoscopic retrograde pancreatography, and secretin test in the diagnosis of chronic pancreatitis. Gastrointest Endosc. 1998 Jul;48(1):11–7	235
57	Puli SR, Reddy JB, Bechtold ML, Antillon D, Ibdah JA, Antillon MR. Staging accuracy of esophageal cancer by endoscopic ultrasound: a meta-analysis and systematic review. World J Gastroenterol. 2008 Mar 14;14(10):1479–90	233
58	Prat F, Amouyal G, Amouyal P, Pelletier G, Fritsch J, Choury AD, Buffet C, Etienne JP. Prospective controlled study of endoscopic ultrasonography and endoscopic retrograde cholangiography in patients with suspected common-bile duct lithiasis. Lancet. 1996 Jan 13;347(8994):75–9	232
59	Seewald S, Groth S, Omar S, Imazu H, Seitz U, de Weerth A, Soetikno R, Zhong Y, Sriram PV, Ponnudurai R, Sikka S, Thonke F, Soehendra N. Aggressive endoscopic therapy for pancreatic necrosis and pancreatic abscess: a new safe and effective treatment algorithm (videos). Gastrointest Endosc. 2005 Jul;62(1):92–100	230
60	Gress FG, Hawes RH, Savides TJ, Ikenberry SO, Cummings O, Kopecky K, Sherman S, Wiersema M, Lehman GA. Role of EUS in the preoperative staging of pancreatic cancer: a large single-center experience. Gastrointest Endosc. 1999 Dec;50(6):786–91	229
61	Swisher SG, Maish M, Erasmus JJ, Correa AM, Ajani JA, Bresalier R, Komaki R, Macapinlac H, Munden RF, Putnam JB, Rice D, Smythe WR, Vaporciyan AA, Walsh GL, Wu TT, Roth JA. Utility of PET, CT, and EUS to identify pathologic responders in esophageal cancer. Ann Thorac Surg. 2004 Oct;78(4):1152–60; discussion 1152–60	227
62	Rösch T, Hofrichter K, Frimberger E, Meining A, Born P, Weigert N, Allescher HD, Classen M, Barbur M, Schenck U, Werner M. ERCP or EUS for tissue diagnosis of biliary strictures? A prospective comparative study. Gastrointest Endosc. 2004 Sep;60(3):390–6	225
63	Mertz HR, Sechopoulos P, Delbeke D, Leach SD. EUS, PET, and CT scanning for evaluation of pancreatic adenocarcinoma. Gastrointest Endosc. 2000 Sep;52(3):367–71	225
64	Palazzo L, Landi B, Cellier C, Cuillerier E, Roseau G, Barbier JP. Endosonographic features predictive of benign and malignant gastrointestinal stromal cell tumours. Gut. 2000 Jan;46(1):88–92	224
65	Polkowski M, Larghi A, Weynand B, Boustière C, Giovannini M, Pujol B, Dumonceau JM; European Society of Gastrointestinal Endoscopy (ESGE). Learning, techniques, and complications of endoscopic ultrasound (EUS)-guided sampling in gastroenterology: European Society of Gastrointestinal Endoscopy (ESGE) Technical Guideline. Endoscopy. 2012 Feb;44(2):190–206	223
66	Kwee RM, Kwee TC. Imaging in local staging of gastric cancer: a systematic review. J Clin Oncol. 2007 May 20;25(15):2107–16	222
67	Gress FG, Savides TJ, Sandler A, Kesler K, Conces D, Cummings O, Mathur P, Ikenberry S, Bilderback S, Hawes R. Endoscopic ultrasonography, fine-needle aspiration biopsy guided by endoscopic ultrasonography, and computed tomography in the preoperative staging of non-small-cell lung cancer: a comparison study. Ann Intern Med. 1997 Oct 15;127(8 Pt 1):604–12	222
68	Sackmann M, Morgner A, Rudolph B, Neubauer A, Thiede C, Schulz H, Kraemer W, Boersch G, Rohde P, Seifert E, Stolte M, Bayerdoerffer E. Regression of gastric MALT lymphoma after eradication of *Helicobacter pylori* is predicted by endosonographic staging. MALT Lymphoma Study Group. Gastroenterology. 1997 Oct;113(4):1087–90	222
69	Burmester E, Niehaus J, Leineweber T, Huetteroth T. EUS-cholangio-drainage of the bile duct: report of 4 cases. Gastrointest Endosc. 2003 Feb;57(2):246–51	221
70	Yasuda K, Mukai H, Fujimoto S, Nakajima M, Kawai K. The diagnosis of pancreatic cancer by endoscopic ultrasonography. Gastrointest Endosc. 1988 Jan-Feb;34(1):1–8	219
71	May A, Günter E, Roth F, Gossner L, Stolte M, Vieth M, Ell C. Accuracy of staging in early oesophageal cancer using high resolution endoscopy and high resolution endosonography: a comparative, prospective, and blinded trial. Gut. 2004 May;53(5):634–40	216
72	Gress F, Schmitt C, Sherman S, Ikenberry S, Lehman G. A prospective randomized comparison of endoscopic ultrasound- and computed tomography–guided celiac plexus block for managing chronic pancreatitis pain. Am J Gastroenterol. 1999 Apr;94(4):900–5	216
73	Herzog U, von Flüe M, Tondelli P, Schuppisser JP. How accurate is endorectal ultrasound in the preoperative staging of rectal cancer? Dis Colon Rectum. 1993 Feb;36(2):127–34	213
74	Hébert-Magee S, Bae S, Varadarajulu S, Ramesh J, Frost AR, Eloubeidi MA, Eltoum IA. The presence of a cytopathologist increases the diagnostic accuracy of endoscopic ultrasound-guided fine needle aspiration cytology for pancreatic adenocarcinoma: a meta-analysis. Cytopathology. 2013 Jun;24(3):159–71	212
75	Dumonceau JM, Polkowski M, Larghi A, Vilmann P, Giovannini M, Frossard JL, Heresbach D, Pujol B, Fernández-Esparrach G, Vazquez-Sequeiros E, Ginès A; European Society of Gastrointestinal Endoscopy. Indications, results, and clinical impact of endoscopic ultrasound (EUS)-guided sampling in gastroenterology: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. Endoscopy. 2011 Oct;43(10):897–912	211

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Table 1
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Rank	Article	Citations
76	Kahaleh M, Hernandez AJ, Tokar J, Adams RB, Shami VM, Yeaton P. Interventional EUS-guided cholangiography: evaluation of a technique in evolution. Gastrointest Endosc. 2006 Jul;64(1):52–9	208
77	Gress F, Schmitt C, Sherman S, Ciaccia D, Ikenberry S, Lehman G. Endoscopic ultrasound-guided celiac plexus block for managing abdominal pain associated with chronic pancreatitis: a prospective single center experience. Am J Gastroenterol. 2001 Feb;96(2):409–16	208
78	Silvestri GA, Hoffman BJ, Bhutani MS, Hawes RH, Coppage L, Sanders-Cliette A, Reed CE. Endoscopic ultrasound with fine-needle aspiration in the diagnosis and staging of lung cancer. Ann Thorac Surg. 1996 May;61(5):1441–5; discussion 1445–6	207
79	Vilmann P, Krasnik M, Larsen SS, Jacobsen GK, Clementsen P. Transesophageal endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) and endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) biopsy: a combined approach in the evaluation of mediastinal lesions. Endoscopy. 2005 Sep;37(9):833–9	206
80	Park DH, Lee SS, Moon SH, Choi SY, Jung SW, Seo DW, Lee SK, Kim MH. Endoscopic ultrasound-guided versus conventional transmural drainage for pancreatic pseudocysts: a prospective randomized trial. Endoscopy. 2009 Oct;41(10):842–8. doi: 10.1055/s-0029-1215133. Epub 2009 Oct 1. PMID: 19798610.	204
81	Giovannini M, Thomas B, Erwan B, Christian P, Fabrice C, Benjamin E, Geneviève M, Paolo A, Pierre D, Robert Y, Walter S, Hanz S, Carl S, Christoph D, Pierre E, Jean-Luc VL, Jacques D, Peter V, Andrian S. Endoscopic ultrasound elastography for evaluation of lymph nodes and pancreatic masses: a multicenter study. World J Gastroenterol. 2009 Apr 7;15(13):1587–93	204
82	Sharaiha RZ, Khan MA, Kamal F, Tyberg A, Tombazzi CR, Ali B, Tombazzi C, Kahaleh M. Efficacy and safety of EUS-guided biliary drainage in comparison with percutaneous biliary drainage when ERCP fails: a systematic review and meta-analysis. Gastrointest Endosc. 2017 May;85 (5):904–914	203
83	Bang JY, Hebert-Magee S, Trevino J, Ramesh J, Varadarajulu S. Randomized trial comparing the 22-gauge aspiration and 22-gauge biopsy needles for EUS-guided sampling of solid pancreatic mass lesions. Gastrointest Endosc. 2012 Aug;76(2):321–7	202
84	Raut CP, Grau AM, Staerkel GA, Kaw M, Tamm EP, Wolff RA, Vauthey JN, Lee JE, Pisters PWT, Evans DB. Diagnostic accuracy of endoscopic ultrasound-guided fine-needle aspiration in patients with presumed pancreatic cancer. J Gastrointest Surg. 2003 Jan;7(1):118–128	202
85	Fritscher-Ravens A, Brand L, Knöfel WT, Bobrowski C, Topalidis T, Thonke F, de Werth A, Soehendra N. Comparison of endoscopic ultrasound-guided fine needle aspiration for focal pancreatic lesions in patients with normal parenchyma and chronic pancreatitis. Am J Gastroenterol. 2002 Nov;97 (11):2768–75	201
86	Ahmad NA, Kochman ML, Brensinger C, Brugge WR, Faigel DO, Gress FG, Kimmey MB, Nickl NJ, Savides TJ, Wallace MB, Wiersema MJ, Ginsberg GG. Interobserver agreement among endosonographers for the diagnosis of neoplastic versus non-neoplastic pancreatic cystic lesions. Gastrointest Endosc. 2003 Jul;58(1):59–64	200
87	Jhala NC, Jhala DN, Chhieng DC, Eloubeidi MA, Eltoum IA. Endoscopic ultrasound-guided fine-needle aspiration. A cytopathologist's perspective. Am J Clin Pathol. 2003 Sep;120(3):351–67	199
88	Cizginer S, Turner BG, Bilge AR, Karaca C, Pitman MB, Brugge WR. Cyst fluid carcinoembryonic antigen is an accurate diagnostic marker of pancreatic mucinous cysts. Pancreas. 2011 Oct;40(7):1024–8	198
89	Levy MJ, Jondal ML, Clain J, Wiersema MJ. Preliminary experience with an EUS-guided trucut biopsy needle compared with EUS-guided FNA. Gastrointest Endosc. 2003 Jan;57(1):101–6	198
90	Gan SI, Thompson CC, Lauwers GY, Bounds BC, Brugge WR. Ethanol lavage of pancreatic cystic lesions: initial pilot study. Gastrointest Endosc. 2005 May;61(6):746–52	196
91	Lerut T, Flamen P, Ectors N, Van Cutsem E, Peeters M, Hiele M, De Wever W, Coosemans W, Decker G, De Leyn P, Deneffe G, Van Raemdonck D, Mortelmans L. Histopathologic validation of lymph node staging with FDG-PET scan in cancer of the esophagus and gastroesophageal junction: a prospective study based on primary surgery with extensive lymphadenectomy. Ann Surg. 2000 Dec;232(6):743–52	195
92	Buskens CJ, Westerterp M, Lagarde SM, Bergman JJ, ten Kate FJ, van Lanschot JJ. Prediction of appropriateness of local endoscopic treatment for high-grade dysplasia and early adenocarcinoma by EUS and histopathologic features. Gastrointest Endosc. 2004 Nov;60(5):703–10	195
93	Rösch T, Meining A, Frühmorgen S, Zillinger C, Schusdziarra V, Hellerhoff K, Classen M, Helmberger H. A prospective comparison of the diagnostic accuracy of ERCP, MRCP, CT, and EUS in biliary strictures. Gastrointest Endosc. 2002 Jun;55(7):870–6	194
94	Park DH, Jang JW, Lee SS, Seo DW, Lee SK, Kim MH. EUS-guided biliary drainage with transluminal stenting after failed ERCP: predictors of adverse events and long-term results. Gastrointest Endosc. 2011 Dec;74(6):1276–84	193
95	Kwee RM, Kwee TC. Imaging in assessing lymph node status in gastric cancer. Gastric Cancer. 2009;12(1):6–22	191
96	Wiersema MJ, Sandusky D, Carr R, Wiersema LM, Erdel WC, Frederick PK. Endosonography-guided cholangiopancreatography. Gastrointest Endosc. 1996 Feb;43(2 Pt 1):102–6	191
97	Iglesias-Garcia J, Larino-Noia J, Abdulkader I, Forteza J, Dominguez-Munoz JE. Quantitative endoscopic ultrasound elastography: an accurate method for the differentiation of solid pancreatic masses. Gastroenterology. 2010 Oct;139(4):1172–80	190
98	Goldberg SN, Mallery S, Gazelle GS, Brugge WR. EUS-guided radiofrequency ablation in the pancreas: results in a porcine model. Gastrointest Endosc. 1999 Sep;50(3):392–401	190
99	Polkowski M, Jenssen C, Kaye P, Carrara S, Deprez P, Gines A, Fernández-Esparrach G, Eisendrath P, Aithal GP, Arcidiacono P, Barthet M, Bastos P, Fornelli A, Napoleon B, Iglesias-Garcia J, Seicean A, Larghi A, Hassan C, van Hooft JE, Dumonceau JM. Technical aspects of endoscopic ultrasound (EUS)–guided sampling in gastroenterology: European Society of Gastrointestinal Endoscopy (ESGE) Technical Guideline—March 2017. Endoscopy. 2017 Oct;49(10):989–1006	189
100	Varadarajulu S, Fraig M, Schmulewitz N, Roberts S, Wildi S, Hawes RH, Hoffman BJ, Wallace MB. Comparison of EUS-guided 19-gauge Trucut needle biopsy with EUS-guided fine-needle aspiration. Endoscopy. 2004 May;36(5):397–401	186

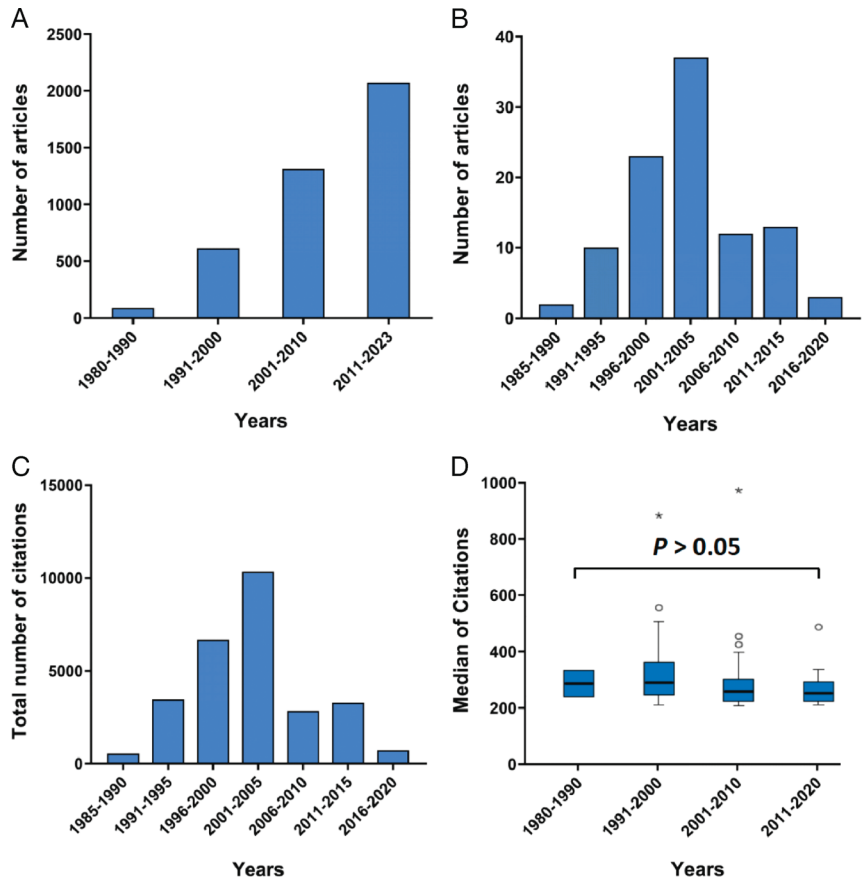

Figure 1. Number of articles or citations by publication year. A. Number of EUS-related articles for every 10 years. B. Number of top 100 cited articles by publication year. C. Number of citations of top 100 articles by publication year. D. Median of citations of top 100 articles in 3 time periods. Median of citations of top 100 articles in 4 time periods. (∘ represents outliers; * indicates extreme outliers).

tumor disease diagnosed using EUS, followed by gastroesophageal cancer (n = 10), colorectal cancer (n = 2), and lung cancer (n = 2). The most frequently used EUS technique for therapy was EUS transluminal drainage (n = 14), followed by EUS-guided celiac plexus neurolysis (EUS-CPN) (n = 3). Out of the 14 articles about EUS transluminal drainage, 7 were related to endoscopic ultrasound-guided biliary/pancreatic duct drainage (EUS-BD/PD). The majority of the articles focused on diseases of the pancreas (n = 56), followed by upper gastrointestinal tract (n = 13), bile duct or gallbladder (n = 9), lower gastrointestinal tract (n = 4), and mediastinum (n = 3) [Figure 2]. Among the 56 articles related to pancreatic diseases, the most researched topics were pancreatic cancer (n = 24) and cystic lesions (n = 8). This was followed by pancreatic pseudocyst/walled-off necrosis (WON) (n = 8), chronic pancreatitis (n = 6), undetermined mass (n = 6), and pancreatic neuroendocrine tumors (n = 2).

We classified the 100 articles according to the levels of evidence pyramid (Supplementary Figure 3, http://links.lww.com/ENUS/A362). Prospective cohort studies (n = 62) were the most frequently utilized research method, followed by retrospective studies (n = 11), systematic reviews and meta-analyses (n = 10), randomized controlled studies (n = 6), case series (n = 5), expert reviews (n = 5), and animal studies (n = 1). Additionally, among the top 100 articles, there were 5 different types of articles, namely, clinical studies (n = 80), reviews (n = 11), case reports (n = 4), guidelines (n = 4), and animal study (n = 1) (Supplementary Table 4, http://links.lww.com/ENUS/A362).

DISCUSSION

The number of citations for an article is a measure of the impact that it has on that particular field, and citation analysis has thus become a valuable tool for assessing both authors' works and journals.[12,13] Our analysis has identified the articles with the greatest impact on the citation of results in the field of EUS research over the past decades and explored current trends in this field.

Table 2

Top 10 journals in which the top-cited 100 articles were published

Rank	Journal	No. of Articles	Median of Citations (IQR)	Total Citations
1	*Gastrointestinal Endoscopy*	41	243.0 (92.0)	10,846
2	*Endoscopy*	12	230.0 (100.5)	3050
3	*American Journal of Gastroenterology*	10	275.0 (95.0)	2714
4	*Gastroenterology*	8	332.5 (524.5)	3637
5	*Gut*	5	240.0 (168.0)	1456
6	*Annals of Internal Medicine*	4	272.5 (101.5)	1112
7	*Lancet*	2	274.0	548
8	*Diseases of the Colon & Rectum*	2	234.5	469
9	*Pancreas*	2	221.0	442
10	*World Journal of Gastroenterology*	2	218.5	437

Table 3

Main topics covered in the 100 most-cited articles

Topic	No. of Articles
Diagnostic performance	80
EUS imaging-related diagnosis	39
Diagnosis of tumor	29
Pancreatic/Ampullary cancer	12
Gastroesophageal cancer	10
Colorectal cancer	2
Lung cancer	2
Others	3
Diagnosis of nontumor	10
FNA-related diagnosis	44
FNA diagnostic accuracy	29
FNA complication	3
Cyst fluid analysis	5
ROSE	3
Others	5
Interventional therapy	20
EUS transluminal drainage	14
EUS-BD/EUS-PD	7
Others	7
EUS-CPN	3
EUS-guided intratumoral drug injection	1
EUS-guided ethanol lavage	1
EUS-radiofrequency ablation	1

As a citation analysis, this type of study usually favors older published articles.[14] However, both number of published articles and total number of citations were greatest for articles published from 1995 to 2005 in our study. We speculated that the advent of EUS-FNA might contribute to this development in this period. Chang et al. published the first article on the analysis of diagnostic accuracy of EUS-FNA in 1994[15] in 100 articles. After that, the number of articles related to FNA applications, as well as the use of ROSE, has significantly increased. After 2000, the number of articles on the application of therapeutic EUS has increased significantly [as shown in Figure 3], which may explain why the numbers of studies and citations in the period from 2001 to 2005 were the largest.

We found that the U.S. was the most frequent country of origin as in other medical fields; 56% of articles in the top 100 list originated from the U.S., probably as a consequence of the greater size of the American EUS community and its wealth and scientific output compared to other countries. Our findings support the application of Bradford's law, a bibliometric concept suggested by Brookes.[16] The idea behind Bradford's law is that most researchers tend to publish their articles and obtain their citations in the core journals in their respective expertise field. The top 100 cited articles in EUS research were published in 21 journals, and more than half of the articles (59%) were published in 3 famous American journals, including *Gastrointestinal* Endoscopy,[17,18] *AJG*,[19,20] and *Gastroenterology*.[11,21] In recent years, with the development of EUS technology, new authoritative journals have emerged, such as *Endoscopic Ultrasound*. As the official journal of Euro-EUS scientific committee, *Endoscopic Ultrasound* is not only filling a long-standing gap in the field of medical science, but also helping to create a stimulating new frontier on applications of EUS in the EUS-related promising minimally invasive medicine and precision medicine. Many important advances has been reported in the EUS journal in the past few years, including diagnosis of gastrointestinal tract duplication cysts,[22] EUS-guided gastroenterostomy for the management of gastric outlet obstruction,[23] EUS-guided management of gastric varices,[24] imaging features of autoimmune pancreatitis,[25] and the relationship between the morphological features of walled off pancreatic necrosis on EUS and the outcome of endoscopic transmural drainage,[26] among others.

Among the top 10 institutions, 6 are located in the U.S., and the remaining 4 are located in Germany, France, Switzerland, and Spain. We identified 16 authors who had 2 or more articles in the list of top 100 articles. Frank G. Gress, as professor of medicine in the division of gastroenterology, was the most productive author according to the number of publications.

There is a tendency that the number of publications focusing on new treatment methods and new technologies in EUS research is constantly increasing, which indicates that researchers are gradually shifting their focus from diagnostic performance to the development of new diagnostic and treatment technologies (e.g. EUS transluminal drainage and EUS-CPN). We compared the proportions of diagnostic and treatment-related articles at different time periods and conducted statistical analysis (chi-square test) [Figure 3]. We found that the proportions of these 2 types of articles at different time periods have statistical significance ($P < 0.05$). In addition, we noticed that among the top 100 articles, 5 were published in the past decade,[27–31] and among them, 3 focused on the treatment using EUS.[27,28,31] The article written by van Brunschot et al.[27] which was about EUS therapy for infected necrotizing pancreatitis, has been cited 316 times, published in 2018. Additionally, the 2017 article by Sharaiha et al.[31] on EUS-BD has garnered 203 citations. The high citation count of these 2 articles also indicates that the field of EUS therapy is gaining increasing attention. Moreover, articles related to tumor staging account for 17% of the most-cited articles. This indicates that the application of EUS in

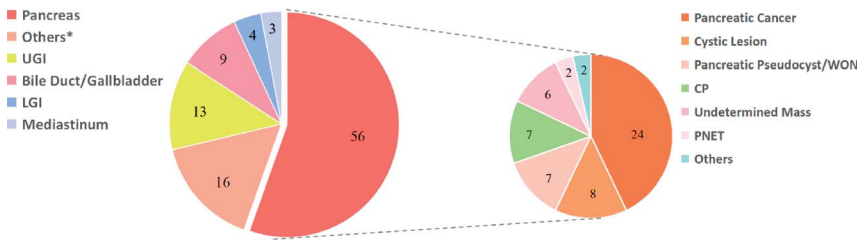

Figure 2. Proportion of EUS-related diseases in top 100 articles. *Articles studying multiple-organ systems, complications, EUS-related guidelines, and reviews were categorized into other categories.

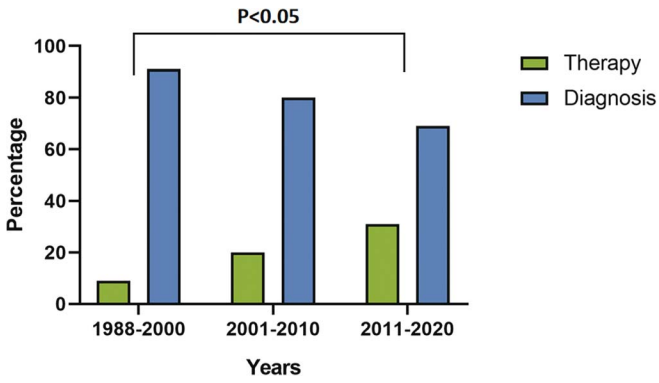

Figure 3. Proportions of articles focusing on diagnostic and therapeutic EUS in different time periods.

tumor staging has received a lot of attention from researchers and has been widely recognized.

Researchers have shown a greater interest in the application of EUS in pancreatic diseases. More than half of the top 100 articles focused on pancreatic disease [Figure 2], especially on pancreatic cancer or solid pancreatic masses. From this, we can conclude that research on the application of EUS in these 2 diseases has become more mature. However, there is still room for further research on other conditions such as PCN and chronic pancreatitis. About 60% of the top 100 articles were prospective cohort studies, which indicates that articles with higher levels of evidence are more likely to be cited. We noticed that only 6 articles employed research methods with randomized controlled studies. We speculate that the reason for this might be the relatively high cost and organization difficulties associated with conducting randomized controlled studies. Another possible factor could be that before the year 2000, research on EUS was primarily focused on diagnosis. Less randomized controlled studies have been conducted in the area of diagnosis, as the diagnostic studies related to other imaging modalities or laboratory tests.

Our study has certain limitations. First, the bibliometric data from scientific databases such as WOS are not produced exclusively for bibliometric analysis and therefore can contain errors, wherein the presence of errors is bound to affect any analysis that is performed using such data.[32] To mitigate errors, the bibliometric data in this study had been carefully checked, which included removing duplicates and erroneous entries. Second, being cited in articles is not necessarily equated to importance. Additionally, literature with fewer citations cannot be deemed as unimportant. It is subject to various limitations, such as the time of publication and language used. Third, the newly published papers often do not receive a large number of citations. For example, in the past 10 years, there have been some new advances in EUS treatment technology, such as EUS-guided gastrojejunostomy (EUS-GJ),[33] EUS-guided coil injection therapy,[34] and EUS-guided gallbladder drainage (EUS-GBD),[35] among others. Due to the late publication time, these articles have limited citations, but the importance of these technologies deserves attention. Fourth, some researchers believe that the Matthew effect also exists in literature citation.[36] People often use "classics" and "authoritative works" as criteria for selecting citations. A journal that publishes articles by famous authors may be widely cited by others, leading to a chain reaction and resulting in a high citation rate. This psychological effect of the Matthew effect masks and affects the authenticity of literature citation.

Taken together, our analysis provides an insight on the 100 most-cited articles in the field of EUS, identified seminal contributions and its origination, and revealed qualities, characteristics, and clinical implications required for a classic research article. Our research found that EUS-guided FNA, tumor staging, and transluminal drainage were the major advances in the past 35 years. Researchers have shown a greater interest in the application of EUS in pancreatic diseases, especially on pancreatic cancer or solid pancreatic masses. In addition, the number of articles on the application of EUS treatment has significantly increased. Studies on EUS remain an active field of research and will continue increasing.

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Conflicts of Interest

The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the paper.

Author Contributions

Conceptualization: Xiangping Wang, Hui Luo, Yanglin Pan. Data searching: Xiangping Wang, Chenxi Kang, Xiaoyu Kang, Shuhui Liang. Data analysis: Tongxin Li, Chenxi Kang. Methodology: Xiangping Wang, Hui Luo, Gui Ren. Writing – original draft: Tongxin Li. Writing – review & editing: Xiangping Wang, Yanglin Pan.

References

1. Mekky MA, Abbas WA. Endoscopic ultrasound in gastroenterology: from diagnosis to therapeutic implications. *World J Gastroenterol* 2014;20(24):7801–7807.
2. Siddiqui UD, Levy MJ. EUS-guided transluminal interventions. *Gastroenterology* 2018;154(7):1911–1924.
3. Garfield E. 100 citation classics from the Journal of the American Medical Association. *JAMA* 1987;257(1):52–59.
4. Schargus M, Kromer R, Druchkiv V, Frings A. The top 100 papers in dry eye—a bibliometric analysis. *Ocul Surf* 2018;16(1):180–190.
5. Paladugu R, Schein M, Gardezi S, Wise L. One hundred citation classics in general surgical journals. *World J Surg* 2002;26(9):1099–1105.
6. Kelly JC, Glynn RW, O'Briain DE, Felle P, McCabe JP. The 100 classic papers of orthopaedic surgery: a bibliometric analysis. *J Bone Joint Surg Br* 2010;92(10):1338–1343.
7. Shuaib W, Khan MS, Shahid H, Valdes EA, Alweis R. Bibliometric analysis of the top 100 cited cardiovascular articles. *Am J Cardiol* 2015;115(7):972–981.
8. Ahmad SS, Evangelopoulos DS, Abbasian M, Roder C, Kohl S. The hundred most-cited publications in orthopaedic knee research. *J Bone Joint Surg Am* 2014;96(22):e190.
9. Chou C-Y, Chew SS, Patel DV, Ormonde SE, McGhee CN. Publication and citation analysis of the Australian and New Zealand Journal of Ophthalmology and Clinical and Experimental Ophthalmology over a 10-year period: the evolution of an ophthalmology journal. *Clin Exp Ophthalmol* 2009;37(9):868–873.
10. Steinberger J, Skovrlj B, Caridi JM, Cho SK. The top 100 classic papers in lumbar spine surgery. *Spine (Phila Pa 1976)* 2015;40(10):740–747.
11. Brugge WR, Lewandrowski K, Lee-Lewandrowski E, et al. Diagnosis of pancreatic cystic neoplasms: a report of the cooperative pancreatic cyst study. *Gastroenterology* 2004;126(5):1330–1336.
12. Garfield E. Citation indexes for science; a new dimension in documentation through association of ideas. *Science* 1955;122(3159):108–111.
13. Garfield E. The history and meaning of the journal impact factor. *JAMA* 2006;295(1):90–93.

14. He R, Yin T, Pan S, Wang M, Zhang H, Qin R. One hundred most cited article related to pancreaticoduodenectomy surgery: a bibliometric analysis. *Int J Surg* 2022;104:106775.
15. Chang KJ, Katz KD, Durbin TE, et al. Endoscopic ultrasound-guided fine-needle aspiration. *Gastrointest Endosc* 1994;40(6):694–699.
16. Brookes BC. Bradford's law and the bibliography of science. *Nature* 1969; 224(5223):953–956.
17. Hewitt MJ, McPhail MJ, Possamai L, Dhar A, Vlavianos P, Monahan KJ. EUS-guided FNA for diagnosis of solid pancreatic neoplasms: a meta-analysis. *Gastrointest Endosc* 2012;75(2):319–331.
18. Chang KJ, Nguyen P, Erickson RA, Durbin TE, Katz KD. The clinical utility of endoscopic ultrasound-guided fine-needle aspiration in the diagnosis and staging of pancreatic carcinoma. *Gastrointest Endosc* 1997;45(5):387–393.
19. Klapman JB, Logrono R, Dye CE, Waxman I. Clinical impact of on-site cytopathology interpretation on endoscopic ultrasound-guided fine needle aspiration. *Am J Gastroenterol* 2003;98(6):1289–1294.
20. Eloubeidi MA, Chen VK, Eltoum IA, et al. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: diagnostic accuracy and acute and 30-day complications. *Am J Gastroenterol* 2003;98(12):2663–2668.
21. Wiersema MJ, Vilmann P, Giovannini M, Chang KJ, Wiersema LM. Endosonography-guided fine-needle aspiration biopsy: diagnostic accuracy and complication assessment. *Gastroenterology* 1997;112(4):1087–1095.
22. Liu R, Adler DG. Duplication cysts: diagnosis, management, and the role of endoscopic ultrasound. *Endosc Ultrasound* 2014;3(3):152–160.
23. Iqbal U, Khara HS, Hu Y, et al. EUS-guided gastroenterostomy for the management of gastric outlet obstruction: a systematic review and meta-analysis. *Endosc Ultrasound* 2020;9(1):16–23.
24. McCarty TR, Bazarbashi AN, Hathorn KE, Thompson CC, Ryou M. Combination therapy versus monotherapy for EUS-guided management of gastric varices: a systematic review and meta-analysis. *Endosc Ultrasound* 2020;9(1):6–15.
25. Dong Y, D'Onofrio M, Hocke M, et al. Autoimmune pancreatitis: imaging features. *Endosc Ultrasound* 2018;7(3):196–203.
26. Rana SS, Bhasin DK, Sharma RK, Kathiresan J, Gupta R. Do the morphological features of walled off pancreatic necrosis on endoscopic ultrasound determine the outcome of endoscopic transmural drainage? *Endosc Ultrasound* 2014; 3(2):118–122.
27. van Brunschot S, van Grinsven J, van Santvoort HC, et al. Endoscopic or surgical step-up approach for infected necrotising pancreatitis: a multicentre randomised trial. *Lancet* 2018;391(10115):51–58.
28. Varadarajulu S, Bang JY, Sutton BS, Trevino JM, Christein JD, Wilcox CM. Equal efficacy of endoscopic and surgical cystogastrostomy for pancreatic pseudocyst drainage in a randomized trial. *Gastroenterology* 2013;145(3): 583–590.e1.
29. Puli SR, Bechtold ML, Buxbaum JL, Eloubeidi MA. How good is endoscopic ultrasound-guided fine-needle aspiration in diagnosing the correct etiology for a solid pancreatic mass?: A meta-analysis and systematic review. *Pancreas* 2013 Jan;42(1):20–26. doi:10.1097/MPA.0b013e3182546e79. PMID: 23254913.
30. Hebert-Magee S, Bae S, Varadarajulu S, et al. The presence of a cytopathologist increases the diagnostic accuracy of endoscopic ultrasound-guided fine needle aspiration cytology for pancreatic adenocarcinoma: a meta-analysis. *Cytopathology* 2013;24(3):159–171.
31. Sharaiha RZ, Khan MA, Kamal F, et al. Efficacy and safety of EUS-guided biliary drainage in comparison with percutaneous biliary drainage when ERCP fails: a systematic review and meta-analysis. *Gastrointest Endosc* 2017;85(5):904–914.
32. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: an overview and guidelines. *J Bus Res* 2021;133:285–296.
33. Dawod E, Nieto JM. Endoscopic ultrasound guided gastrojejunostomy. *Transl Gastroenterol Hepatol* 2018;3:93.
34. Bazarbashi AN, Aby ES, Mallery JS, et al. EUS-guided coil injection therapy in the management of gastric varices: the first U.S. multicenter experience (with video). *Gastrointest Endosc* 2024;99(1):31–37.
35. Teoh AYB, Kitano M, Itoi T, et al. Endosonography-guided gallbladder drainage versus percutaneous cholecystostomy in very high-risk surgical patients with acute cholecystitis: an international randomised multicentre controlled superiority trial (DRAC 1). *Gut* 2020;69(6):1085–1091.
36. Wang J. Unpacking the Matthew effect in citations. *J Informet* 2014;8(2): 329–339.