

Intraductal papillary mucinous neoplasm's 100 most significant manuscripts: A bibliometric analysis

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ABSTRACT

Aims: The aim of this bibliometric analysis was to identify the main topics and publications that have enhanced our understanding and influenced the management of intraductal papillary mucinous neoplasm (IPMN). **Methods:** The Thompson Reuters Web of Science database was searched using the terms 'Intraductal papillary mucinous neoplasm', or 'IPMN' to identify all English language manuscripts for the study. The 100 most cited articles were further analyzed by journal, topic, year, author and institution. **Results:** Total 2,833 eligible manuscripts were identified. The median (range) citation number was 129 (93–1006). The most cited paper presented consensus guidelines regarding the management of IPMN (1006 citations). The *Annals of Surgery* published the highest number of manuscripts (n = 13) and subsequently had the highest number of citations (n = 2889). The USA published most manuscripts within the top 100 (n = 46). The

most discussed topic was IPMN management (n = 29), incorporating diagnosis and surgery. The second most commonly discussed topic was histology (n = 18). **Conclusion:** This bibliometric analysis highlights how advances in the histological evaluation of IPMN have influenced current management strategies for IPMN. This manuscript highlights the most cited and influential references related to IPMN and serves as a guide to the most popular IPMN research themes.

Keywords: Bibliometric analysis, Intraductal papillary mucinous neoplasm

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INTRODUCTION

Intraductal papillary mucinous neoplasms (IPMN) are pancreatic tumors that arise from the pancreatic ductal system [1]. Histological analyses of these tumors reveal mucin secreting columnar epithelium with a variable degree of dysplastic epithelium [2]. Current evidence suggests that these cystic tumors have the potential to undergo malignant transformation as part of the dysplasia-carcinoma sequence, with 30–50% tumors undergoing such transformation [2, 3]. For this reason, research has been focussed on expanding our knowledge

regarding the molecular aspects, clinical presentation and management of these pancreatic cystic tumors. Advances in our knowledge of IPMN will influence and subsequently transform clinical practice enabling the creation of suitable treatment strategies and surveillance protocols.

A citation rank list enables identification of published research that bears most intellectual influence [4]. Once a publication is referenced by another peer-reviewed article, a citation is received. It is likely that original research with the most influence over the scientific community would be cited several times. The process of citation analysis consists of ranking articles based on the number of citations it has received. This technique can also be utilized to rank journals based on their impact on the scientific community [4].

To date several medical specialties have conducted a citation rank analysis in order to highlight the most influential papers within their own field. This includes general surgery, plastic surgery and trauma and orthopaedic surgery [4–6]. Currently, no study has assessed for the most influential IPMN manuscripts. An examination of this data would allow an understanding of how our knowledge regarding IPMN has changed and how this has impacted on clinical management. The aim of this study was to identify the studies of greatest clinical influence that has enhanced our knowledge regarding IPMN.

MATERIALS AND METHODS

The Thomson Reuters Web of Science citation indexing database was searched. The following search terminology was utilized, the term “Intraductal papillary mucinous neoplasm” or “IPMN” and “panc*” was used. The Web of Science database search was completed by two independent researchers in order to ensure that appropriate studies were included. A method described by Paladugu et al. was applied in order to review the data. The returned search from the Thomson Reuters Web of Science database was filtered to contain full manuscripts of English language only, which were subsequently sorted by number of citations [7]. Exclusion criteria consisted of non-English articles and articles that did not focus on IPMN related research. The 100 most cited manuscripts were noted. Data was extracted from each manuscript for title, author list, topic, country of origin and year of publication. The individual, and five year impact factor of each included journal was noted.

RESULTS

The Thomson Reuters Web of Science database search produced 2,833 full-length, English language papers. Table 1 highlights the 100 most cited IPMN

articles [8-106]. The total number of citations ranged from 1006 by Tanaka et al. (International consensus on the management of intraductal papillary mucinous neoplasm of the pancreas) [8] to 93 by Bernard et al. (Intraductal papillary mucinous tumors of the pancreas: predictive criteria of malignancy according to the pathological examination of 53 cases) [106]. The most recent published manuscript was produced by Kallen et al. in 2016 (Intraductal oncocytic papillary neoplasm of the pancreas) [51]. The oldest manuscript within the 100 most cited manuscripts was published in 1994 by Sessa et al. (Intraductal papillary-mucinous tumors represent a distinct group of pancreatic neoplasms: an investigation of tumor cell differentiation and K-ras, p53 and c-erbB-2 abnormalities in 26 patients) [17].

The 100 most influential IPMN articles were published across 36 journals. The total number of articles per journal ranged from 1 to 13 (Table 2). The Annals of Surgery published the most articles and subsequently had most citations (n = 13 and 2889 citations). The journal with the highest impact factor (18.187) and highest five year impact factor (15.417) was Gastroenterology.

The United States of America was the country with most articles in the top 100 (n = 46), followed by Japan (n = 27) (Figure 1). The Johns Hopkins Medical Institute had the most articles in the top 100 (n = 11) and highest number of citations (n = 2383) (Table 3). Within the 100 most cited IPMN articles, 1 author had 5 and 2 authors had 3 first author publications.

One possible limitation of this study is that historical manuscripts may accumulate a higher number of citations despite lacking the impact of newer publications. In order to overcome the potential bias, the citation rate (number of citations divided by number of years since publication) was calculated for each article (Table 4). The citation rate for the top 10 articles ranged from 147 for Tanaka et al. (International consensus guidelines 2012 for the management of IPMN and MCN of the pancreas) [9] to 25 for Rodriguez et al. (Branch-Duct Intraductal Papillary Mucinous Neoplasms: Observations in 145 Patients Who Underwent Resection) [24]. USA had the most articles in the top 10 citation rate, closely followed by Japan.

Within the 100 most cited IPMN papers, management was the most frequently discussed topic (29 articles) (Table 5). Of which 14 articles were related to surgery and 9 articles focused on IPMN diagnosis. The second most common discussed topic was histology (18 of the top 100 papers). Seventeen articles reviewed IPMN prognosis. Fourteen papers reviewed the pathology of IPMN. Articles published prior to 2000, frequently published on the following topics: histology, etiology/pathophysiology and pathology of IPMN. However, this did differ when compared to papers published after 2006, where the most frequently published topics was management and prognosis of IPMN.

Table 1: The top 100 cited paper in IPMN

Rank	Citations	First author	Rank	Citations	First author
1	1006	Tanaka, M ^[8]	51	127	Lee, C ^[57]
2	737	Tanaka, M ^[9]	52	127	Brandwein, S ^[58]
3	546	Hruban, R ^[10]	53	126	Uehara, H ^[59]
4	526	Sohn, T ^[11]	54	126	Fernández-Cruz, L ^[60]
5	430	Salvia, R ^[12]	55	125	Tanno, S ^[61]
6	342	Furukawa, T ^[13]	56	125	Suzuki, Y ^[62]
7	324	Zamboni, G ^[14]	57	125	Traverso, L ^[63]
8	324	Spinelli, K ^[15]	58	125	Warshaw, A ^[64]
9	298	Loftus, E ^[16]	59	124	Matsubayashi, H ^[65]
10	292	Sessa, F ^[17]	60	124	Kubo, H ^[66]
11	291	Chari, S ^[18]	61	122	Nakamura, A ^[67]
12	286	Sugiyama, M ^[19]	62	122	Moore, P ^[68]
13	279	Fernández-del Castillo, C ^[20]	63	120	Yamaguchi, K ^[69]
14	267	Terris, B ^[21]	64	117	Crippa, S ^[70]
15	247	Canto, M ^[22]	65	116	Falconi, M ^[71]
16	246	Adsay, N ^[23]	66	114	Shibahara, H ^[72]
17	246	Rodriguez, J ^[24]	67	114	Lüttges, J ^[73]
18	226	Kobari, M ^[25]	68	113	Poley, J ^[74]
19	223	Sohn, T ^[26]	69	113	Schnelldorfer, T ^[75]
20	222	Schmidt, C ^[27]	70	113	Sahani, D ^[76]
21	219	D'Angelica, M ^[28]	71	112	Yantiss, R ^[77]
22	217	Kimura, W ^[29]	72	112	Kitagawa, Y ^[78]
23	201	Sugiyama, M ^[30]	73	112	Doi, R ^[79]
24	183	Thompson, L ^[31]	74	111	Crippa, S ^[80]
25	180	Lüttges, J ^[32]	75	110	Biankin, AV ^[81]
26	177	Terada, T ^[33]	76	108	Fukushima, N ^[82]
27	179	Zen, Y ^[34]	77	108	Rivera, J ^[83]
28	179	Adsay, N ^[3]	78	106	Linder, J ^[84]
29	176	Satoh, K ^[35]	79	105	Tanaka, M ^[85]
30	167	Maire, F ^[36]	80	104	Mino-Kenudson, M ^[86]
31	167	Adsay, N ^[37]	81	104	Shyr, Y ^[87]
32	166	Cellier, C ^[38]	82	102	Sauvanet, A ^[88]
33	163	Habbe, N ^[39]	83	101	Taouli, B ^[89]
34	162	Salvia, R ^[40]	84	101	Sugiyama, M ^[90]
35	160	Crippa, S ^[41]	85	101	Fujii, H ^[91]
36	159	Terris, B ^[42]	86	101	Sugiyama, M ^[92]
37	157	Pelaez-Luna, M ^[43]	87	100	Fritz, S ^[93]
38	155	Furukawa, T ^[44]	88	100	Correa-Gallego, C ^[94]
39	155	Z'graggen, K ^[45]	89	100	House, M ^[95]
40	153	Adsay, N ^[46]	90	100	Adsay, N ^[96]
41	148	Azar, C ^[47]	91	99	Jang, J ^[97]
42	148	Nagai, E ^[48]	92	99	Wada, K ^[98]
43	147	Sato, N ^[49]	93	98	Abe, N ^[99]
44	144	Brune, K ^[50]	94	97	Horvath, K ^[100]
45	141	Kallen, M ^[51]	95	96	Klöppel, G ^[101]
46	137	Koopmann, J ^[52]	96	95	Del Chiaro, M ^[102]
47	136	Sedlack, R ^[53]	97	94	Li, A ^[103]
48	135	Hara, T ^[54]	98	94	Furukawa, T ^[104]
49	132	Iacobuzio-Donahue, C ^[55]	99	94	Terada, T ^[105]
50	130	Sato, N ^[56]	100	93	Bernard, P ^[106]

Table 2: Journals with the top 100 cited IPMN papers

Journal title	Impact Factor as of 2017	5 year Impact Factor	Number of manuscripts in the top 100	Number of citations
Annals of Surgery	8.33	8.57	13	2889
American Journal of Surgical Pathology	5.15	4.59	11	2152
Gut	14.92	12.75	8	1036
American Journal of Pathology	4.21	4.56	5	669
Archives of Surgery	0.32	3.56	5	836
American Journal of Gastroenterology	10.38	9.04	4	495
Gastroenterology	18.19	15.42	4	970
Gastrointestinal endoscopy	6.22	5.31	4	535
Pancreatology	2.41	2.21	4	1963
American Journal of Surgery	2.40	2.48	3	321
Journal of Gastrointestinal Surgery	2.81	2.64	3	365
Surgery	3.31	3.25	3	315
British Journal of Surgery	5.60	5.54	2	402
Cancer	3.50	3.65	2	355
Cancer Research	8.56	8.74	2	222
Clinical Cancer Research	8.74	8.25	2	231
Clinical Gastroenterology and Hepatology	7.68	6.88	2	450
Journal of Pathology	7.38	7.21	2	216
Pancreas	2.74	2.81	2	230
Radiology	6.80	6.39	2	214
Virchows Archiv: European Journal of Pathology	2.65	2.54	2	634
American Journal of Surgical Pathology	4.95	4.78	1	267
Annals of Surgical Oncology	3.66	3.96	1	99
Archives of Pathology & Laboratory Medicine	2.63	2.74	1	141
British Journal of Cancer	5.57	5.07	1	122
Cancer Biology & Therapy	2.92	3.11	1	163
carcinogenesis	4.87	5.36	1	100
Digestive and Liver Disease	2.72	2.96	1	95
Hepatogastroenterology	0.79	0.76	1	96
Hepatology	11.71	11.52	1	179
Human Pathology	2.79	2.82	1	108
International Journal of Pancreatology	1.24	1.29	1	217
Modern Pathology	5.49	5.10	1	167
Pathology International	1.43	1.57	1	177
Scientific Reports	5.23	4.41	1	155
Seminars in Diagnostic Pathology	1.96	1.66	1	100
The Journal of Pathology	7.38	7.21	1	206

DISCUSSION

Improvements in the histological classification of IPMN, accurate diagnostic radiological imaging algorithms and a further understanding of the impact of genetics on the pathophysiology of the disease represent

71% of the articles in this bibliometric analysis. This has resulted in the development of evidence based management protocols and improved risk stratification of patients with IPMN. This process improves the identification of patients for resection who will likely receive the greatest benefit.

Table 3: Institutions with the highest number of papers in the top 100

Name of Institution	Number of Publications in top 100	Total number of citations
Johns Hopkins Medical Institutions	11	2383
Massachusetts General Hospital	9	1357
University of Verona	8	1542
Kyorin University School of Medicine	6	912
Kyushu University	5	2092
Mayo Clinic	4	838
Karmanos Cancer Institute	4	666
Tohoku University School of Medicine	3	744
Virginia Mason Medical Center	3	336
University of Kiel	3	390
Kagoshima University	2	236
Memorial Sloan-Kettering Cancer Center	2	398
Tokyo Women's Medical University	2	249
Hôpital Beaujon	2	434

Table 4: Top 10 IPMN papers with the highest citation rate

Rank	Citation rate	First Author	Senior Author	Title	Institution	Country
1	147	Tanaka, M [9]	International Association of Pancreatology.	International consensus guidelines 2012 for the management of IPMN and MCN of the pancreas	Kyushu University	Japan
2	141	Kallen, M [51]	Naini, B	Intraductal Oncocytic Papillary Neoplasms of the Pancreas	David Geffen School of Medicine	USA
3	91	Tanaka, M [8]	International Association of Pancreatology.	International consensus guidelines for management of intraductal papillary mucinous neoplasms and mucinous cystic neoplasms of the pancreas.	Kyushu University	Japan
4	42	Hruban, R [10]	Yonezawa, S	An illustrated consensus on the classification of pancreatic Intraepithelial neoplasia and intraductal papillary mucinousneoplasms	Johns Hopkins Medical Institutions	USA
5	40	Sohn, T [11]	Lillemoe, K	Intraductal papillary mucinous neoplasms of the pancreas: an updated experience	Johns Hopkins Medical Institutions	USA
6	33	Salvia, R [12]	Warshaw, A	Main-duct intraductal papillary mucinous neoplasms of the pancreas: clinical predictors of malignancy and long-term survival following resection	University of Verona	Italy
7	29	Furukawa, T [13]	Yonezawa, S	Classification of types of intraductal papillary-mucinous neoplasm of the pancreas: a consensus study	Tohoku University School of Medicine	Japan
8	26	Furukawa, T [44]	Shiratori, K	Whole-exome sequencing uncovers frequent GNAS mutations in intraductal papillary mucinous neoplasms of the pancreas	Tokyo Women's Medical University	Japan
9	25	Spinelli, K [15]	Pitt, H	Cystic pancreatic neoplasms: observe or operate	Medical College of Wisconsin	USA
10	25	Rodriguez, J [24]	Fernández-del Castillo, C	Branch-Duct Intraductal Papillary Mucinous Neoplasms: Observations in 145 Patients Who Underwent Resection	Harvard Medical School	USA

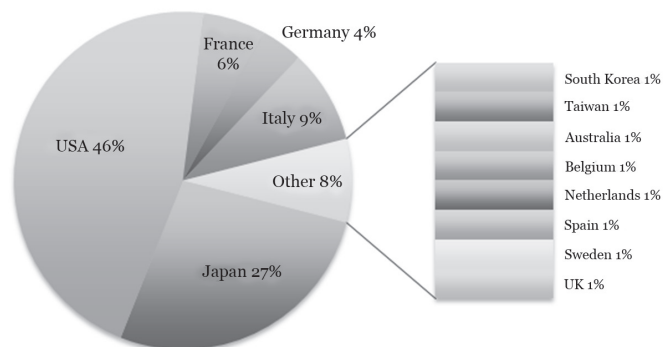


Figure 1: A comparison of citations by country.

Table 5: Most frequently referenced topics *.

Subject	Number of papers
Management	29
Surgery	14
Histology	18
Prognosis	17
Pathology	14
Genetics	14
Aetiology/Pathophysiology	13
Science	13
Diagnosis	9
Epidemiology	2

*Several manuscripts had an overlap of topics, thus cell numbers do not add up to 100.

Publications with the highest levels of influence over the scientific community are theoretically much more likely to be cited. The subsequent citations form the foundation of the impact factor. The impact factor can be used as a proxy measure to identify journals with higher quality research and most influential manuscripts. The impact factor highlights the average citations of the article published within the journal during a predefined time period. The journals with the highest impact factor within this study are Gastroenterology, Gut and Hepatology (Impact Factor of 18.19, 14.92 and 11.711 respectively). The median impact factor of this study was 4.54 with 39% of the manuscripts published in journals with an impact factor less than 3.00. One proposed explanation for this is the impact of novelty of the findings of these articles. Novelty may be associated to science in general or only IPMN. Previously published findings established in other disease processes may then be reproduced and re-established in IPMN. It is unlikely that these original articles would be published in high impact factor journals. In the setting of this study these articles are considered likely to be influential.

Within this bibliometric analysis of the 100 most cited IPMN manuscripts, a variety of topics were covered. Histology of IPMN was the principle focus of

18 of the 100 most cited articles. Historically, diverse descriptive terminology was used to describe IPMN, thus causing diagnostic confusion. Recent advances in the histological analysis of IPMN have allowed the identification and subclassification of IPMN into 4 unique histopathological subtypes. These subtypes include oncocytic, gastric, pancreaticobiliary and intestinal types [104]. The sub-classification is dependent on the immunophenotypes and cryoarchitectural features of the tumor. As a consequence of this sub-classification, we have a greater understanding of the malignant transformation potential of these tumors. This newly acquired knowledge influences our current treatment strategies and surveillance protocols for IPMN. Another important factor to consider is that these advances in histology permits correct identification of differential diagnoses of IPMN enabling the identification of benign tumors with a more favorable prognosis.

The definitive treatment for IPMN is surgery. However, surgery as a main topic of focus was only present in 17 of the 100 most cited papers and therefore is underrepresented in this study. Of the 17 papers that focussed on surgery, over half discussed novel surgical techniques for IPMN management, ranging from the role of laparoscopic surgery to techniques that preserve pancreatic parenchyma. Despite advances in surgical technique, pancreatic surgery remains to be associated with postoperative morbidity and mortality. A global change in the approach to pancreatic cystic tumor management has been noted. Historically, early aggressive surgery had been advocated. However as our understanding of the pathophysiology and the natural history of the disease have improved, surgery is reserved for patients' with cystic tumors associated with high risk stigmata (dilated pancreatic duct, cyst >3cm, presence of high grade dysplasia) [107]. Surveillance protocols have been created by consensus of expert opinion that permit organized follow-up and monitoring of patients with IPMN who fail to meet the criteria for resection. This allows close observation for the development of concerning cystic features providing a good example of how advances in our understanding of the disease pathophysiology impacts and influences current management strategies.

There are study limitations within this manuscript. The main limitation is the potential for several types of bias, which in theory may affect the validity of the study results. English language bias, self-citation, powerful person bias and institutional bias may result in disproportionate citation. It is worth highlighting that older manuscripts are likely to collect more citations. An attempt has been made to overcome this potential bias through calculating the citation rate index. The most influential manuscripts may take several years to accumulate citations as a consequence of the publication lead-time for the citing manuscripts. Thus newly published articles with sufficient citations to be included in the top 100 contain useful and relevant information that have added importance to the

pre-existing literature regarding IPMN. Only the first and senior authors, and subsequently the institution of the first author was included in the analysis of this study. This represents another study limitation. It is likely that first authors would have collaborated and co-authored other manuscripts in the top 100 resulting in a under representation in the current study design.

CONCLUSION

This bibliometric analysis has highlighted the most cited IPMN manuscripts, which describe the pathophysiology of the disease and the current management strategies. Advances in our knowledge regarding the histology and prognosis of IPMN have influenced current practices. A paradigm shift has been observed from early aggressive surgery to the identification of patients with high risk cystic tumor features to establishing screening surveillance protocols to monitor the disease. The content of the 100 most cited manuscripts regarding IPMN demonstrated the diversity and the breadth of the newly acquired knowledge regarding IPMN over the last 23 years. This has resulted in improved treatment outcomes for patients with IPMN. The vast majority of these articles were published within journals with a recorded impact factor of less than 10, suggestive of an assumed lack of novelty to the general scientific community. This study not only identifies the most influential manuscripts in IPMN, it also creates a reference for both clinicians and scientific researchers who undertake research in the field of IPMN to what makes a citable paper. This study proposes that newer publications associated with higher citation rates, will significantly influence clinical practice and impact on the top 100 over the next 5 to 10 years.

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Authors declare no conflict of interest.

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