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REVIEW ARTICLE

Comparative meta-analysis of complications in implantable port catheters *versus* peripherally inserted central catheters in chemotherapy-treated cancer patients

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Abstract

Background and objectives: A meta-analysis compared complications associated with Peripherally Inserted Central Catheters (PICCs) and Implanted Port Catheters (IPCs) in cancer patients undergoing chemotherapy.

Methods: A comprehensive literature search up to December 2024, involving 12,587 participants, was analyzed using pooled Odds Ratios (ORs) and Mean Differences (MDs) with 95% Confidence Intervals (CIs). Dichotomous and continuous outcome measures were evaluated *via* random-effects or fixed-effects models.

Results: Results revealed that PICC use was linked to significantly elevated risks of occlusion (OR 4.39; 95% CI 2.95-6.52, p<0.001), catheter-related infections (OR 2.42; 95% CI 1.34-4.36, p=0.003), malposition (OR 7.39; 95% CI 3.52-15.50, p<0.001), thrombosis (OR 2.88; 95% CI 2.05-4.05, p<0.001), phlebitis (OR 6.41; 95% CI 2.90-14.14, p<0.001), and accidental removal (OR 3.38; 95%

CI 1.97-5.81, p<0.001), alongside a notably shorter indwelling duration (MD -233.16 days; 95% CI -449.52 to -16.80, p=0.03) compared to IPC. However, no significant differences were found in puncture-site local infection rates (OR 1.79; 95% CI 0.88-3.64, p=0.11) or cost (MD -394.02; 95% CI -882.19 to 94.14, p=0.11) between the two devices.

Conclusion: Patients with PICCs experienced significantly more complications than those with IPCs, especially cancer patients undergoing chemotherapy. These complications included occlusions, catheter-related infections, malposition, catheter-related thrombosis, phlebitis, accidental removal, and shorter catheter lifespan. While IPC users experienced fewer of these issues, local insertion site infection duration and costs were comparable between the two groups.

However, the limited sample sizes in seven of the 31 studies included, and the small number of studies contributing to some comparisons, warrants cautious interpretation of these results.

Keywords: Cancer, Chemotherapy, Implanted port catheters, Peripherally inserted central catheters, Catheter-related difficulties, Phytomorphology bioactives, Plant antimicrobials, Medicinal antithrombotics

Introduction

Cancer is currently the second most prevalent cause of death around the world. In China, there are more than 6 million newly diagnosed cancer cases reported each year. Projections indicate that the number of individuals diagnosed with cancer will continue to grow in the future, influenced by shifts in environmental and lifestyle conditions. Chemotherapy remains a standard treatment option for cancer, capable of prolonging the life expectancy of those suffering from metastatic forms of the disease (Ang, et al. 2000). Many chemotherapy regimens are administered through intravenous routes, which may adversely affect peripheral blood vessels. Consequently, central venous access is considered more advantageous than peripheral vascular access, given that frequent venipuncture can result in discomfort for individuals (Silvestri, et al. 2004). Central venous access provides enhanced security and comfort for cancer subjects undergoing chemotherapy. The two common methodologies for administering chemotherapy through this access are Peripherally Inserted Central Catheters (PICC) and Implanted Port Catheters (IPCs) (Johansson, et al. 2013). Peripherally Inserted Central Catheters (PICCs), a type of central venous catheter inserted into arm veins, were first developed in the 1970s. The 1980s saw the creation of Implanted Port Catheters (IPCs), which are placed in the subclavian vein and offer intravenous access without external lines. These advancements in catheter technology have greatly benefited cancer patients, providing a reliable way to receive chemotherapy, long-term infusions, blood tests, and nutritional support. Consequently, nurses often inquire about comparative studies between these two access methodologies (Silvestri, et al. 2004). The issues of patient safety and the growing consciousness regarding costs are critical in the current era. Research is now predominantly aimed at comparing the safety of these two commonly utilized infusion catheters (Rotzinger, et al. 2017). Decision-makers in the medical field are looking forward to obtaining more data to conduct a thorough evaluation of the risks and financial implications of these two surgical procedures. Nevertheless, no substantial or definitive research indicates which central venous catheter is safer. The application of these two catheters varies across different countries, with healthcare professionals more often suggesting the use of peripherally implanted central venous catheters. This trend may be attributed to the belief that peripherally implanted central venous catheters have complication rates that are comparable to those of IPC, along with their lower implantation costs (Tan, et al. 2016). Other studies have specified that the long-term expenses of PICC maintenance may be even higher than those of IPC. Further research has revealed that the long-term costs related to the upkeep of PICCs could be greater than those for IPC. One study showed a higher complication rate for PICCs (32.8%) compared to IPCs. However, another study found similar rates of difficulty during catheterization procedures for both types of catheters (O'Brien, et al. 2013, Walshe, et al. 2002, Worth, et al. 2009). Common complications associated with Peripherally Inserted Central Catheters (PICCs) and implanted port catheters (IPCs) (Chan, et al. 2017).

From an interdisciplinary perspective, phytomorphological research provides insight into how plant structural features underpin the biosynthesis of bioactive compounds with antimicrobial and anti-inflammatory properties, which may conceptually relate to infection and inflammatory complications in clinical settings (Pacyga, et al. 2024).

Description of objectives

Currently, there's not enough solid evidence to help doctors and patients choose the best catheter. To enhance clinical decision-making, this meta-analysis evaluates the difficulties associated with IPC and PICCs in patients undergoing chemotherapy for cancer. Secondarily, the findings are briefly interpreted within a phytomorphological framework to provide interdisciplinary context.

Methods

Eligibility criteria

The main goal of this investigation was to assess the effects of difficulties associated with IPC and PICC in patients undergoing chemotherapy for cancer. Additionally, a comparative analysis of the two types of catheters was conducted to summarize the findings.

Data sources

The primary objectives of the present meta-analysis were to assess the difficulties associated with IPC and PICC in patients undergoing chemotherapy for cancer, as well as to investigate the implications of various outcomes. All studies included were conducted on human subjects and were published in any language. The size of the study did not influence its eligibility for inclusion. Review publications, commentaries, and other reports lacking a degree of connotation were omitted from the publication list. Fig.1 illustrates the comprehensive timeline of the study. Publications were included in the meta-analysis when they met the next specifications:

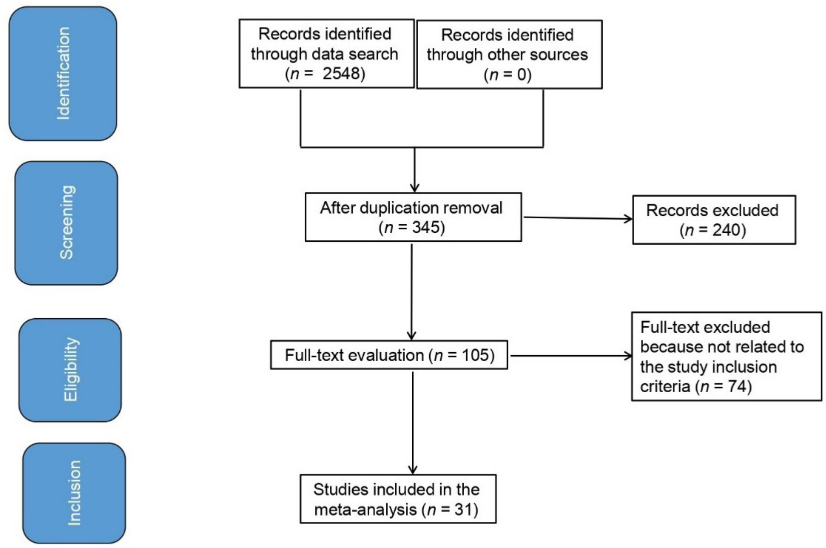

Figure 1. Flowchart of study selection following PRISMA guidelines.

1.The research design was prospective, observational, controlled, or retrospective.

2.Aimed populace comprised chemotherapy-treated cancer subjects.

3. ntervention involved IPC and PICC.

4.The study involved a comparison between IPC and PICCs.

Studies that did not focus on the difficulties arising from PICC and IPC in chemotherapy patients, those involving patients without these catheter types, or studies that did not emphasize the significance of comparative outcomes were omitted from the analysis.

Search strategy

Guided by the PICOS framework, a search strategy protocol was established, structured as follows: P (population): cancer patients undergoing chemotherapy; I (intervention/exposure): PICC and IPC; C (comparison): A comparison of PICC with IPC; O (outcome): difficulties of catheter functionality; S (study design): No restrictions applied (Liberati, et al. 2009).

To begin, we performed a detailed search of the Embase, OVID, PubMed, Google Scholar and Cochrane Library databases, with a cutoff date of March 2022. This search incorporated a range of keywords and related terms as presented in Tab.1. To exclude studies that didn't examine the relationship between PICC and IPC use after cancer chemotherapy.

Table 1. Summary of database search strategies.

Database	Research strategy
Pubmed	#1 «cancer using chemotherapy»[MeSH Terms] OR «peripherally inserted central catheters»[All Fields] OR «occlusion difficulties»[All Fields] OR «catheter-related thrombosis «[All Fields]
	#2 «implanted port catheters»[MeSH Terms] OR «cancer using chemotherapy»[All Fields] OR «catheter-related thrombosis»[All Fields] OR «occlusion difficulties»[All Fields] OR «malposition difficulties»[All Fields]
	#3 #1 AND #2
Embase	'cancer using chemotherapy'/exp OR 'peripherally inserted central catheters'/exp OR 'occlusion difficulties'/exp OR 'catheter-related thrombosis'
	#2 'implanted port catheters'/exp OR 'occlusion difficulties'/exp OR 'malposition difficulties'/exp Or 'catheter-related thrombosis'
	#3 #1 AND #2

	(cancer using chemotherapy):ti,ab,kw (peripherally inserted central catheters):ti,ab,kw OR (occlusion difficulties) :ti,ab,kw (Word variations have been searched)
Cochrane library	#2 (catheter-related thrombosis):ti,ab,kw OR (implanted port catheters):ti,ab,kw OR (occlusion difficulties) :ti,ab,kw OR (malposition difficulties) :ti,ab,kw OR (catheter-related thrombosis) :ti,ab,kw (Word variations have been searched)
	#3 #1 AND #2

Selection process

Following the epidemiological declaration, a methodology was established, which was then systematically organized and evaluated through a meta-analysis.

Data collection process

The data were compiled by established criteria, which included standardized characteristics related to the study and subjects, the last name of the lead author, the study duration, the year of publication, the country and region of the study, the type of population, clinical and treatment characteristics, categorization, methodologies of qualitative and quantitative assessment, sources of information, evaluation of outcomes, and the statistical methodologies used (Page, et al. 2021).

Data items

In cases where a single study produced varying results, we conducted independent data collection focused on evaluating the difficulties related to PICC and IPC in chemotherapy-treated cancer subjects.

Study risk of bias assessment

The two authors independently assessed the methodological quality of the selected research to ascertain the potential for bias within each study. The evaluation of method quality was conducted utilizing the "risk of bias instrument" as outlined in the Cochrane handbook for systematic reviews of interventions version 5.1.0 (Higgins, et al. 2011). The evaluation of each study was conducted by specific criteria, resulting in one of three classifications of bias risk: A low-risk classification was given when all quality criteria were satisfactorily met; an unclear risk classification was assigned when one or more quality criteria were only partially fulfilled or ambiguous; and a high-risk classification was applied when one or more criteria were not satisfied or were absent. The original article was reexamined to rectify any inconsistencies. Botanical sources were not subjected to this risk of bias instrument because they were not included in the statistical meta-analysis but rather served as complementary interpretive material.

Effect measures

Only those studies that described and investigated the effects of PICC on IPC were included in sensitivity analyses. These comparisons were employed for conducting sensitivity and subclass analyses.

Synthesis methodologies, reporting bias assessment, and certainty assessment

We performed a meta-analysis using either a random-effects or a fixed-effects model. Dichotomous and continuous data were analyzed to calculate the Odds Ratio (OR) and Mean Difference (MD), both with 95% Confidence Intervals (CI). The degree of heterogeneity between studies was evaluated using the I^2 statistic. An I^2 value of approximately 0% indicated no heterogeneity; 25%, low heterogeneity; 50%, moderate heterogeneity; and 75%, high heterogeneity (Sheikhbahaei, et al. 2016). For this analysis, the statistical model selection was determined by the degree of heterogeneity, as measured by I^2. If I^2 was greater than 50%, indicating substantial heterogeneity, a random-effects model was used. Conversely, a fixed-effects model was selected if I^2 was less than or equal to 50%. A subcategory analysis was conducted by stratifying the data according to pre-established outcome categories. Differences between subcategories were considered statistically significant if the p-value was less than 0.05. Publication bias was investigated using both qualitative methods, examining funnel plots of the log odds ratios, and quantitative methods, employing the Egger regression test. A p-value below 0.05 in the Egger test signified significant publication bias (Higgins, et al. 2003). The calculation of all p-values was performed using two-tailed tests. Reviewer manager version 5.3 was utilized for the statistical analyses and the creation of graphs, as provided by the Nordic Cochrane centre, affiliated with the Cochrane collaboration in Copenhagen, Denmark.

Results

The meta-analysis incorporated 28 articles that satisfied the inclusion criteria, selected from a comprehensive review of 2,548 relevant studies conducted between 2010 and 2024 (Rotzinger, et al. 2017, Revel-Vilk, et al. 2010, Kim, et al. 2010, Jain, et al. 2013, Patel, et al. 2014, Viart, et al. 2014, Bratton, et al. 2014, Tang, et al. 2014, Martella, et al. 2015, Coady, et al. 2015, Wang, et al. 2016, Lefebvre, et al. 2016, Verboom, et al. 2017, Fang, et al. 2017, Lu, et al. 2017, Liu, et al. 2017, Vashi, et al. 2017, Taxbro, et al. 2019, Clemons, et al. 2020, Yin and Li, 2020, Clatot, et al. 2020, Wang, et al. 2021, Burbridge, et al. 2021, Yun and Yang, 2021, Comas, et al. 2022, Zhang, et al. 2022, Pénichoux, et al. 2022, McKeown, et al. 2022, Shao, et al. 2022, Lu, et al. 2024, Al-meshlawey, et al. 2024). Tab 2 presents the findings from the aforementioned studies. The selected research involved a total of 11,801 cancer subjects undergoing chemotherapy at the outset; among these, 5,017 utilized PICC, while 7,177 employed IPC. Compared to patients using IPCs, those with PICCs demonstrated a statistically significant increased risk of several complications. These included occlusions (OR 4.39, 95% CI 2.95-6.52, p<0.001, low heterogeneity), catheter-related infections (OR 2.42, 95% CI 1.34-4.36, p=0.003, moderate heterogeneity), malposition difficulties (OR 7.39, 95% CI 3.52-15.50, p<0.001, no heterogeneity), catheter-related thrombosis (OR 2.88, 95% CI 2.05-4.05, p<0.001, moderate heterogeneity), phlebitis (OR 6.41, 95% CI 2.90-14.14, p<0.001, no heterogeneity), and accidental removal (OR 3.38, 95% CI 1.97-5.81, p<0.001, no heterogeneity). Furthermore, PICC lines exhibited a significantly shorter lifespan (MD -233.16, 95% CI -449.52 to -16.80, p=0.03, high heterogeneity). Figs. 2 to 10 provide further details.

Table 2. Characteristics of the selected studies for the meta-analysis.

Study	Country	Total	Peripherally inserted central catheters	Implanted port catheters
Revel - Vilk, 2010	Israel	314	188	126
Kim, 2010	Korea	96	24	72
Jain, 2013	India	123	98	25
Patel, 2014	Australia	70	36	34
Viart, 2014	France	123	98	25
Bratton, 2014	USA	144	34	110
Tang, 2014	China	2970	1509	1461
Martella, 2015	Italy	102	45	57
Coady, 2015	UK	39	9	30
Wang, 2016	China	110	60	50
Lefebvre, 2016	France	448	158	290
Rotzinger, 2017	Switzerland	2568	791	1777
Verboom, 2017	Netherlands	112	10	102
Fang, 2017	China	105	60	45
Lu, 2017	China	550	214	336
Liu, 2017	China	298	120	178
Vashi, 2017	USA	202	191	11
Taxbro, 2019	Sweden	369	201	168
Clemons, 2020	Canada	48	25	23
Yin, 2020	China	763	65	698
Clatot, 2020	France	253	126	127
Wang, 2021	China	276	138	138
Burbridge, 2021	Canada	101	50	51
Yun, 2021	Korea	467	185	282
Comas, 2022	Spain	525	292	233
Zhang, 2022	China	96	48	48

Pénichoux, 2022	France	479	213	266
McKeown, 2022	USA	50	29	21
Shao, 2022	China	404	202	202
Lu, 2024	China	322	161	161
Al-meshlawey, 2024	Egypt	60	30	30
	Total	**12587**	**5410**	**7177**

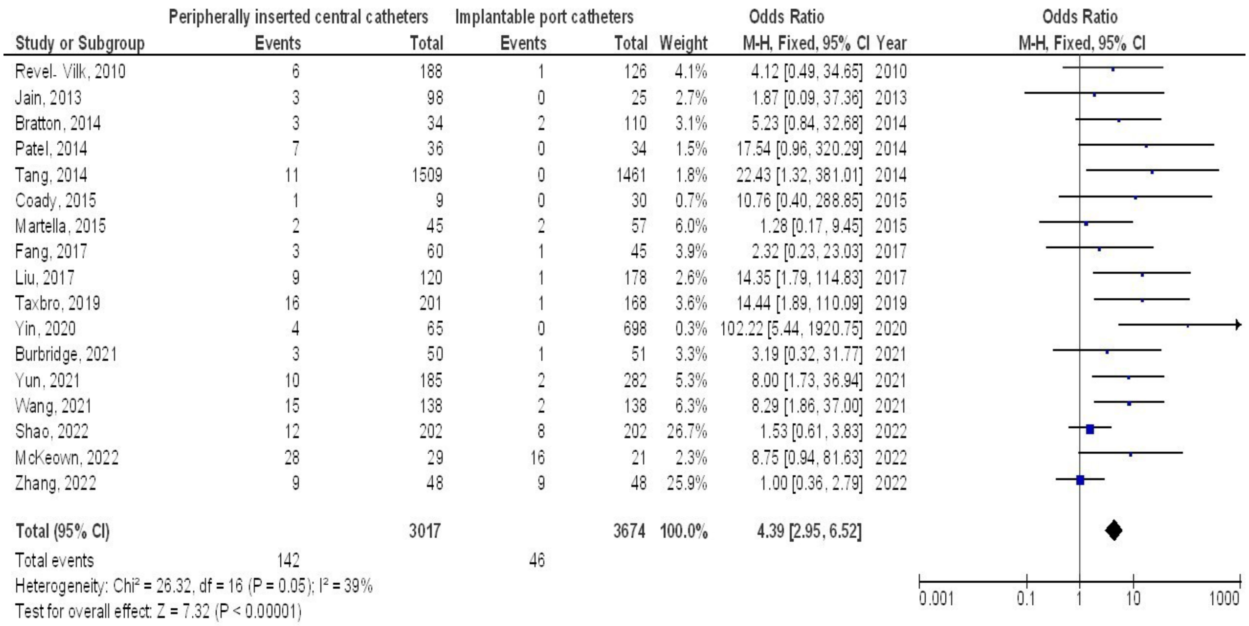

Figure 2. **The effect's forest plot of peripherally inserted central catheters compared with implanted port catheters on occlusion difficulties outcomes in cancer subjects using chemotherapy.**

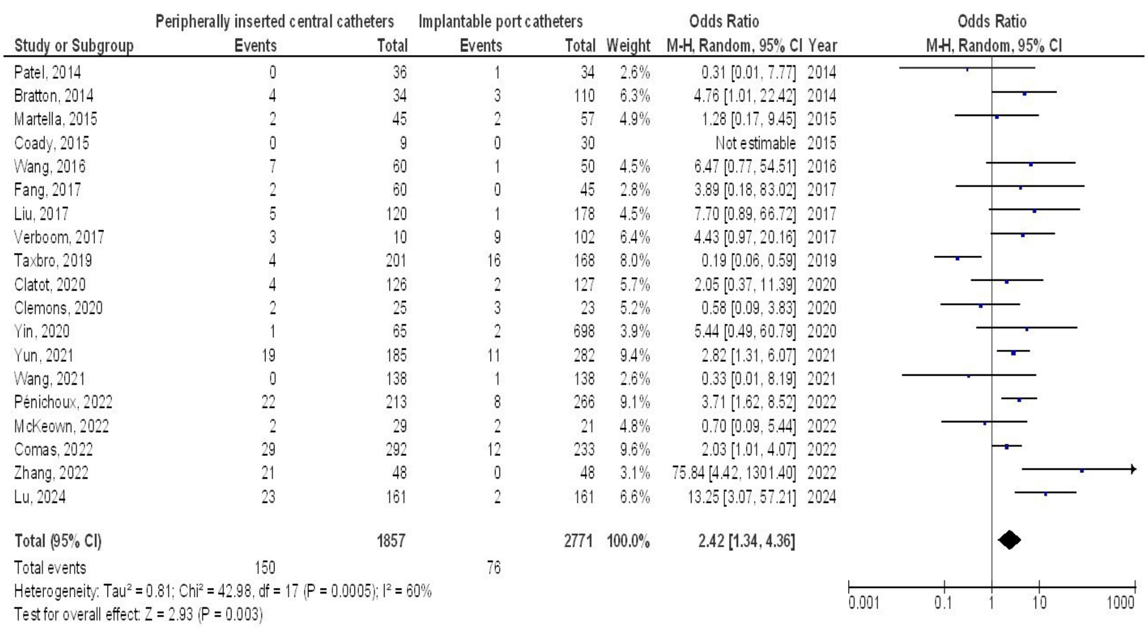

Figure 3. **Forest plot comparison of PICCs and IPCs catheter-related infection outcomes in cancer patients receiving chemotherapy.**

Study or Subgroup	Peripherally inserted central catheters Events	Peripherally inserted central catheters Total	Implantable port catheters Events	Implantable port catheters Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
Kim, 2010	8	24	4	72	20.9%	8.50 [2.28, 31.76]	2010
Bratton, 2014	1	34	0	110	3.6%	9.90 [0.39, 248.63]	2014
Coady, 2015	5	9	0	30	1.7%	74.56 [3.50, 1589.41]	2015
Liu, 2017	4	120	1	178	12.2%	6.10 [0.67, 55.29]	2017
Clatot, 2020	2	126	2	127	30.8%	1.01 [0.14, 7.27]	2020
Wang, 2021	4	138	0	138	7.6%	9.27 [0.49, 173.80]	2021
Shao, 2022	12	202	1	202	14.8%	12.69 [1.63, 98.57]	2022
McKeown, 2022	2	29	0	21	8.3%	3.91 [0.18, 85.77]	2022
Total (95% CI)		**682**		**878**	**100.0%**	**7.39 [3.52, 15.50]**	
Total events	38		8				

Heterogeneity: $Chi^2 = 6.66$, df = 7 (P = 0.47); $I^2 = 0\%$
Test for overall effect: Z = 5.28 (P < 0.00001)

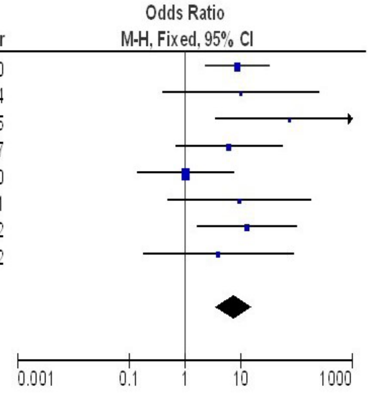

Figure 4. Forest plot comparing PICC and IPC malposition rates in cancer patients undergoing chemotherapy.

Study or Subgroup	Peripherally inserted central catheters Events	Peripherally inserted central catheters Total	Implantable port catheters Events	Implantable port catheters Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
Patel, 2014	4	36	0	34	1.1%	9.55 [0.49, 184.51]	2014
Viart, 2014	2	98	0	25	1.8%	1.32 [0.06, 28.39]	2014
Tang, 2014	6	1509	0	1461	1.2%	12.64 [0.71, 224.52]	2014
Martella, 2015	0	45	1	57	3.1%	0.41 [0.02, 10.40]	2015
Lefebvre, 2016	10	158	6	290	9.4%	3.20 [1.14, 8.97]	2016
Wang, 2016	8	60	1	50	2.2%	7.54 [0.91, 62.50]	2016
Fang, 2017	8	60	0	45	1.2%	14.73 [0.83, 262.37]	2017
Lu, 2017	12	214	0	336	0.9%	41.54 [2.45, 705.43]	2017
Verboom, 2017	2	10	11	102	3.7%	2.07 [0.39, 11.00]	2017
Clatot, 2020	9	126	7	127	15.3%	1.32 [0.48, 3.66]	2020
Clemons, 2020	6	25	2	23	3.7%	3.32 [0.60, 18.45]	2020
Yin, 2020	3	65	1	698	0.4%	33.73 [3.46, 329.08]	2020
Burbridge, 2021	7	50	9	51	18.1%	0.76 [0.26, 2.23]	2021
Wang, 2021	3	138	4	138	9.2%	0.74 [0.16, 3.39]	2021
Shao, 2022	5	202	1	202	2.3%	5.10 [0.59, 44.06]	2022
Comas, 2022	1	292	0	233	1.3%	2.40 [0.10, 59.26]	2022
Pénichoux, 2022	16	213	10	266	19.4%	2.08 [0.92, 4.68]	2022
McKeown, 2022	3	29	0	21	1.2%	5.68 [0.28, 116.06]	2022
Lu, 2024	10	161	2	161	4.4%	5.26 [1.13, 24.42]	2024
Total (95% CI)		**3491**		**4320**	**100.0%**	**2.88 [2.05, 4.05]**	
Total events	115		55				

Heterogeneity: $Chi^2 = 26.33$, df = 18 (P = 0.09); $I^2 = 32\%$
Test for overall effect: Z = 6.11 (P < 0.00001)

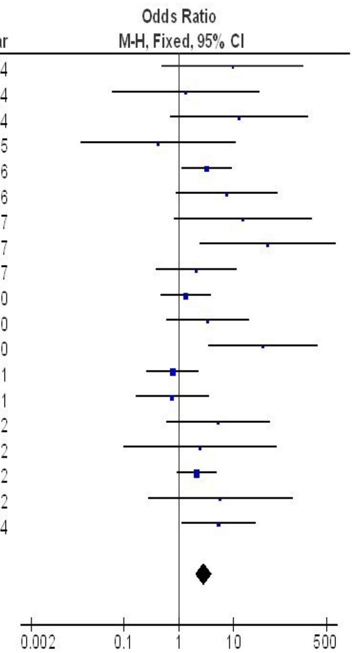

Figure 5. Forest plot comparing PICC and IPC thrombosis rates in cancer patients receiving chemotherapy.

Study or Subgroup	Peripherally inserted central catheters Events	Peripherally inserted central catheters Total	Implantable port catheters Events	Implantable port catheters Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
Bratton, 2014	1	34	0	110	3.5%	9.90 [0.39, 248.63]	2014
Tang, 2014	10	1509	0	1461	7.7%	20.47 [1.20, 349.61]	2014
Martella, 2015	1	45	0	57	6.5%	3.88 [0.15, 97.45]	2015
Lefebvre, 2016	1	158	1	290	10.7%	1.84 [0.11, 29.63]	2016
Lu, 2017	10	214	0	336	5.6%	34.56 [2.01, 592.83]	2017
Fang, 2017	10	60	0	45	7.2%	18.92 [1.08, 332.10]	2017
Clemons, 2020	0	25	1	23	23.3%	0.29 [0.01, 7.59]	2020
Burbridge, 2021	3	50	2	51	28.3%	1.56 [0.25, 9.78]	2021
Al-meshlawey, 2024	1	30	0	30	7.2%	3.10 [0.12, 79.23]	2024
Total (95% CI)		**2125**		**2403**	**100.0%**	**6.41 [2.90, 14.14]**	
Total events	37		4				

Heterogeneity: $Chi^2 = 9.40$, df = 8 (P = 0.31); $I^2 = 15\%$
Test for overall effect: Z = 4.60 (P < 0.00001)

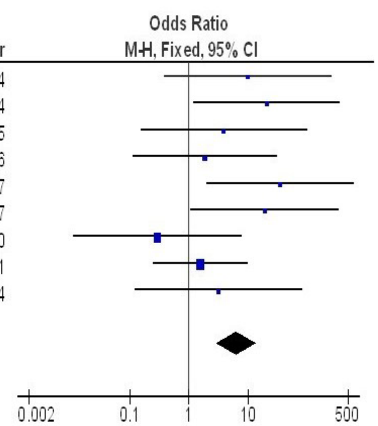

Figure 6. Forest plot of comparing PICC and IPC phlebitis outcomes in cancer patients undergoing chemotherapy.

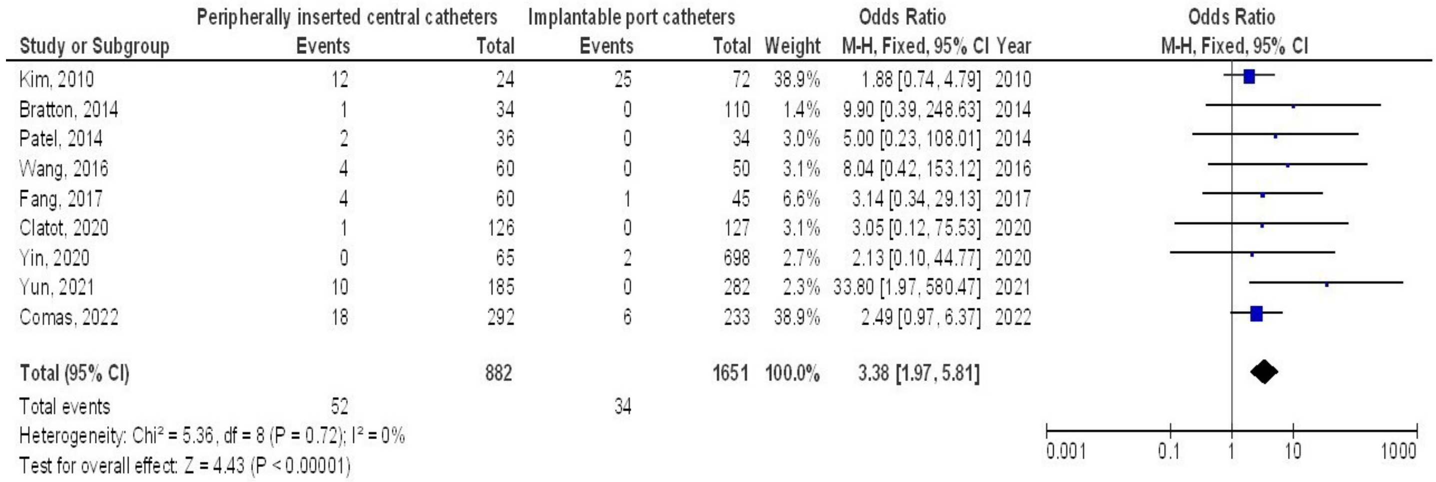

Figure 7. Forest plot comparing PICC and IPC accidental removal rates in cancer patients receiving chemotherapy.

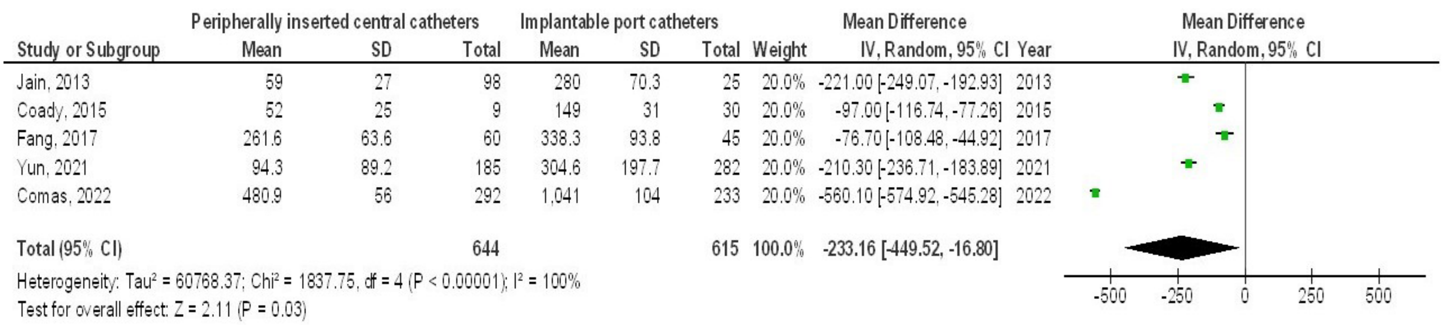

Figure 8. Forest plot comparing PICC and IPC catheter lifespan outcomes in cancer patients undergoing chemotherapy.

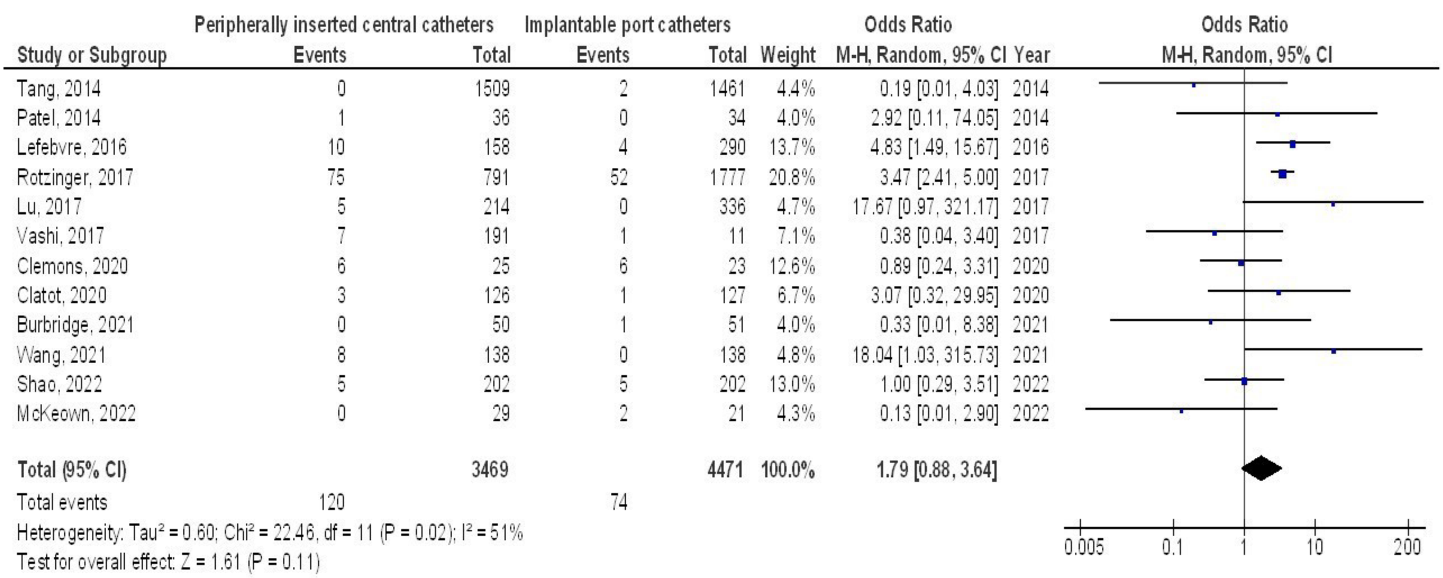

Figure 9. Forest plot comparing PICC and IPC local infection duration outcomes in cancer patients undergoing chemotherapy.

Study or Subgroup	Peripherally inserted central catheters Mean	SD	Total	Implantable port catheters Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Rotzinger, 2017	201.69	56	791	242.97	34	1777	33.4%	-41.28 [-45.49, -37.07]	2017
Wang, 2021	603.55	78.68	138	1,270.21	128.84	138	33.4%	-666.66 [-691.85, -641.47]	2021
Shao, 2022	4,091.71	345.44	202	4,566.77	453.56	202	33.2%	-475.06 [-553.68, -396.44]	2022
Total (95% CI)			**1131**			**2117**	**100.0%**	**-394.02 [-882.19, 94.14]**	

Heterogeneity: Tau² = 185516.46; Chi² = 2411.46, df = 2 (P < 0.00001); I² = 100%
Test for overall effect: Z = 1.58 (P = 0.11)

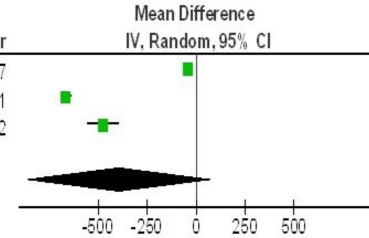

Figure 10. Forest plot comparing PICC and IPC treatment costs in chemotherapy.

Discussion

The meta-analysis comprised 11,801 cancer subjects receiving chemotherapy at the start of the studies. Of these patients, 5,017 were using PICC, and 7,177 were utilizing IPC (Rotzinger, et al. 2017, Revel-Vilk, et al. 2010, Kim, et al. 2010, Jain, et al. 2013, Patel, et al. 2014, Viart, et al. 2014, Bratton, et al. 2014, Tang, et al. 2014, Martella, et al. 2015, Coady, et al. 2015, Wang, et al. 2016, Lefebvre, et al. 2016, Verboom, et al. 2017, Fang, et al. 2017, Lu, et al. 2017, Liu, et al. 2017, Vashi, et al. 2017, Taxbro, et al. 2019, Clemons, et al. 2020, Yin and Li, 2020, Clatot, et al. 2020, Wang, et al. 2021, Burbridge, et al. 2021, Yun and Yang, 2021, Comas, et al. 2022, Zhang, et al. 2022, Pénichoux, et al. 2022, McKeown, et al. 2022, Shao, et al. 2022, Lu, et al. 2024, Al-meshlawey, et al. 2024). This study found that PICCs, compared to IPCs, led to more complications in cancer patients receiving chemotherapy. Specifically, PICC users experienced higher rates of occlusions, infections, malposition, thrombosis, phlebitis, accidental removals, and shorter catheter lifespans. However, local infection rates at the insertion site and the costs associated with each catheter type were comparable. The limited sample size of 7 out of 31 with fewer than 100 participants and the few studies available for various comparisons necessitate caution in interpreting these findings. This analysis incorporated 28 cohort studies involving over 10,000 cancer subjects receiving chemotherapy, following a comprehensive literature review. Practitioners need to select the appropriate catheter type based on the patient's physical condition, expected catheter lifespan, complication rates, and other relevant factors (Kim, et al. 2010). The diminished life expectancy of PICC relative to the IPC could be due to the elevated rates of difficulties connected with the PICC, along with a greater frequency of unintentional removals (Kabsy, et al. 2010). Current infusion therapy standards (2021) state that PICCs are appropriate for use for several months and may remain in place for as long as one year (Gorski, et al. 2021). A variety of studies have confirmed that with diligent maintenance by nurses, an implanted port catheter can be employed for an extended period, often spanning several years (Kock, et al. 1998). In addition, utilizing an implanted port catheter can help reduce the discomfort associated with frequent punctures for patients receiving treatment for more than a year. The study found that the overall occurrence of all seven difficulties assessed was higher with a peripherally implanted central venous catheter than with an IPC. The presence of cancer, along with chemotherapy treatments delivered through central venous catheters, increases the likelihood of thrombosis and obstruction of vessels or lines (Singh, et al. 2017). The meta-analysis showed that implanted port catheters (IPCs) resulted in less central venous catheter thrombosis and occlusion compared to Peripherally Inserted Central Catheters (PICCs). These results were consistent with those of another systematic review that investigated risk factors for catheter-related thrombosis in cancer patients (Saber, et al. 2011). The differences in performance between PICCs and IPCs may be attributed to several factors. The longer catheter required for peripheral insertion leads to a more extensive vessel entry, while the IPC's shorter trajectory results in reduced stimulation of the vessel walls. This mechanical interaction with vascular endothelial cells by an external object may promote the activation of thrombotic factors, which can contribute to vessel blockage. Additionally, the findings of this study revealed that the occurrence of extravasation, malposition, unintentional removal, and phlebitis was significantly lower for IPCs compared to their peripherally inserted counterparts. The anchoring of the IPC base to the chest wall provides a stable access point that is less likely to be affected by upper limb movements. Conversely, the puncture site for a PICC is often located in the arm, increasing the risk of migration during physical exertion or mobility. The subgroup analysis indicated a higher rate of infection connected with PICCs compared to IPCs. According to Bouza, et al. 2002., PICCs have an external part, they offer a potential entry point for bacteria, increasing the risk of bloodstream or subcutaneous infections. IPCs, being entirely under the skin, eliminate this risk. Additionally, the difficulties arising from PICCs appear to be more significant than those associated with IPC, resulting in increased treatment costs. This context clarifies why IPC generally have lower long-term costs compared to their peripherally inserted counterparts, a finding supported by the cost analysis led by Patel, et al. 2014. His meta-analysis revealed the effects of issues related to peripherally positioned central catheters and IPC on patients with cancer who are receiving chemotherapy. Further research is necessary to elucidate these possible relationships and to compare the impact of Peripherally Inserted Central Catheters (PICCs) *versus* Implanted Port Catheters (IPCs) on clinical outcomes. Studies with larger, more standardized cohorts would enhance the validity of findings. This aligns with prior meta-analytic evidence suggesting that PICCs may offer advantages, such as reduced puncture-site infection rates and improved occlusion management (Pu, et al. 2020, Capozzi, et al. 2021, Jiang, et al. 2020, Schears, et al. 2021, Wang, et al. 2022, He, et al. 2021, Balsorano, et al. 2020, Liu, et al. 2021). Our meta-analysis found no connection between age or ethnicity and the outcomes. Further research, particularly well-designed randomized controlled trials, is needed to explore these factors, including interactions between gender, age, ethnicity, and other patient characteristics.

From an interdisciplinary standpoint, phytomorphological research describes how plant structural features underlie the production of antimicrobial, anti-inflammatory, and antithrombotic compounds. While not evaluated in this meta-analysis, such concepts may offer contextual relevance for future supportive strategies addressing catheter-related complications.

Limitations

A significant number of the studies identified in this research were not incorporated into the meta-analysis, which raises concerns regarding potential selection bias. The studies that were excluded did not fulfill the criteria necessary for addition in our study. Six of the 28 studies had sample sizes below 100, which could potentially limit the power of those studies. Furthermore, we were incapable to ascertain the extent to which age and ethnicity may have influenced the outcomes. This study intended to assess the difficulties connected with PICC and IPC in patients undergoing chemotherapy for cancer. Analysis relied on data from prior studies, which might have produce bias owing to the presence of incomplete or inaccurate information. Factors such as the nutritional status of respondents, along with their gender, age, and sex characteristics, could also represent potential sources of bias. Unfortunately, the existence of unpublished articles and missing data may further distort the findings of this research.

Additionally, the phytomorphological perspective was conceptual and not subjected to quantitative analysis.

Conclusion

Patients with PICCs experienced significantly more complications than those with IPCs, especially cancer patients undergoing chemotherapy. These complications included occlusions, catheter-related infections, malposition, catheter-related thrombosis, phlebitis, accidental removal, and shorter catheter lifespan. While IPC users experienced fewer of these issues, local insertion site infection duration and costs were comparable between the two groups. However, the limited sample sizes in seven of the 31 studies included, and the small number of studies contributing to some comparisons, warrants cautious interpretation of these results. Brief consideration of phytomorphological principles provides interdisciplinary context but does not alter the clinical conclusions of this analysis.

Author Contributions

Conceptualization: Mohamed S. Imam; Data curation: All authors; Writing-original draft preparation: All authors; Writing-review and editing: All authors.

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Conflicts of Interest

The authors declare no conflict of interest.

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