Comparison of Re-vitrectomy Rates in TAP and INJECT versus Pars Plana Vitrectomy for Acute Endophthalmitis: A Retrospective Comparative Study

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Abstract

Background: Acute endophthalmitis is a severe complication of ocular surgery requiring prompt treatment to prevent vision loss. The optimal initial treatment—vitreous tapping with intravitreal injection (TAP) versus pars plana vitrectomy (PPV)—remains debated. Advances in vitrectomy techniques challenge conclusions from the Endophthalmitis Vitrectomy Study (EVS), prompting this study to compare re-vitrectomy rates and outcomes between TAP and PPV.

Methods: This retrospective study analyzed 34 patients diagnosed with acute endophthalmitis at a tertiary care center. Patients were divided into TAP (Group 1, n = 10) and PPV (Group 2, n = 24) groups. Demographic data, clinical presentations, microbial culture results, and outcomes—including visual acuity (VA) improvement and re-vitrectomy rates—were compared using statistical analyses. A subgroup analysis focused on patients with presenting VA ≥ hand motion.

Results: Group 1 (TAP) had a significantly higher re-vitrectomy rate (50% vs. 16.7%, p = 0.044) despite comparable VA improvement between groups (50% vs. 45.8%, p = 0.618). In the subgroup with VA ≥ hand motion, re-vitrectomy rates were higher in Group 1 (44.4% vs. 9.5%, p = 0.028), while VA improvement was similar (62.5% vs. 52.4%, p = 0.62). Positive microbial cultures were exclusive to Group 2 (29.1%).

Conclusion: TAP and PPV yield comparable VA improvement, but PPV significantly reduces the need for re-vitrectomy, highlighting the advantages of modern surgical techniques. Further research is needed to refine treatment protocols.

Keywords: Acute postoperative endophthalmitis, Management of endophthalmitis

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Background

Acute endophthalmitis, particularly in postoperative cases, remains a devastating complication in ophthalmology, requiring rapid and effective intervention to preserve vision and prevent severe sequelae such as retinal detachment or phthisis bulbi.[1,2] Despite significant advancements in surgical techniques, antimicrobial therapies, and diagnostic capabilities, the optimal initial treatment strategy continues to be a subject of debate. The two main approaches—vitreous tapping with intravitreal antimicrobial injection (TAP) and prompt pars plana vitrectomy (PPV) with intravitreal injection—have been extensively studied, but the relative efficacy of each remains controversial.[3,4]

The Endophthalmitis Vitrectomy Study (EVS), a landmark randomized controlled trial conducted in the 1990s, provided critical insights into the management of acute postoperative endophthalmitis. It demonstrated that for cases with an initial visual acuity (VA) better than light perception (LP), TAP was non-inferior to PPV combined with intravitreal antimicrobial

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injection. However, for patients with poor initial VA (LP or worse), PPV was associated with significantly better visual outcomes compared to TAP.[5] While the EVS findings remain a reference point for treatment decisions, the applicability of its conclusions to current practice is limited due to advancements in surgical and diagnostic technologies since its publication.

The vitrectomy techniques employed in the EVS era differ significantly from modern approaches. In the EVS, vitrectomy was performed using 20-gauge systems, which required larger incisions, had limited visualization capabilities, and relied on lower cutting rates. These limitations made the procedure more invasive and less precise, with a higher risk of complications such as vitreous traction or retinal tears.[6,7] Vitrectomy was primarily reserved for patients with LP or worse vision, and the emphasis was on partial vitreous removal to reduce the microbial load while minimizing surgical risk.

By contrast, modern vitrectomy systems utilize 23-, 25-, or 27-gauge sutureless platforms that allow minimally invasive surgery, improved fluidics, and high-speed cutting rates.[8-10] These advancements facilitate more comprehensive removal of vitreous opacities and infected material, better access to the retina, and safer antimicrobial delivery. Enhanced visualization tools, including wide-angle viewing systems and intraoperative optical coherence tomography (OCT), have further improved the precision of vitrectomy.[11,12] These technological improvements have led to a growing interest in PPV as an initial treatment option, even in patients with better initial VA, challenging the traditional EVS paradigm.[13]

Recent studies and meta-analyses have yielded conflicting results regarding the comparative efficacy of PPV and TAP. Some analyses suggest that early and complete PPV may result in superior visual outcomes, particularly in cases with significant fundus obscuration, dense vitreous opacities, or poor initial VA.[14,15] For example, a study by Tabatabaei et al. reported that early PPV in patients with hand motion (HM) vision after cataract surgery led to better VA outcomes compared to TAP alone.[16] On the other hand, other meta-analyses have indicated that TAP with intravitreal antimicrobial injection is non-inferior to PPV in terms of VA improvement, particularly in cases with better initial VA, highlighting the need for a more tailored approach based on individual clinical characteristics.[17,18]

Despite advancements, critical gaps in the literature remain. Key unresolved questions include the optimal timing and frequency of antimicrobial reinjection in cases of partial response or treatment failure, the incidence and outcomes of re-vitrectomy in deteriorating cases, and the role of adjunctive therapies such as corticosteroids or anti-inflammatory agents.[19,20] Understanding these factors is crucial for optimizing treatment protocols and improving patient outcomes.

Given these uncertainties, this comparative retrospective study seeks to evaluate the incidence of re-vitrectomy as a surrogate marker for treatment efficacy between PPV and TAP in patients with acute endophthalmitis, particularly those presenting with VA better than LP. By analyzing re-vitrectomy rates and associated clinical outcomes, this study aims to provide evidence-based guidance for clinicians and contribute to the ongoing refinement of management strategies in this complex clinical scenario.

Methods and Participants

This retrospective cohort study was conducted at Thammasat University Hospital, a tertiary care center specializing in ophthalmology services, to evaluate the efficacy of different initial treatment strategies for acute postoperative endophthalmitis. The study period spanned from 1st January 2019 to 31st December 2023, during which all patients diagnosed with acute postoperative endophthalmitis were considered for inclusion. Ethical approval was obtained from the institutional review board prior to the initiation of the study.

Inclusion and Exclusion Criteria

Patients were eligible for inclusion if they were older than 18 years and had been diagnosed with acute postoperative endophthalmitis within six weeks of undergoing uneventful intraocular surgery. Uneventful ocular surgery was defined as cases undergoing cataract surgery or other intraocular surgeries, excluding glaucoma surgery. Patients with intraoperative complications that had minimal or no effect on

visual acuity, such as posterior capsule rupture without significant vitreous loss were also included. Additionally, cases of traumatic or endogenous endophthalmitis were considered part of the study population and followed the same inclusion parameters. Patients were excluded if they met any of the following criteria:

- Best-corrected visual acuity (VA) worse than hand movement at presentation.
- History of prior treatment for postoperative endophthalmitis.
- Presence of retinal or choroidal detachment at the time of presentation.

Patient Identification and Data Collection

Patients were identified through a comprehensive review of electronic medical records and departmental databases. The diagnosis of acute endophthalmitis was confirmed based on clinical findings during ophthalmic examinations, including characteristic symptoms, signs, and microbiological evidence where available.

Eligible patients were categorized into two distinct groups based on their initial treatment approach:

1. TAP and Injection Group: Patients in this group underwent vitreous tapping (TAP) followed by intravitreal injection of antimicrobial agents as the primary therapeutic intervention. The decision to proceed with vitrectomy was based on clinical progression, such as worsening visual acuity, persistent or worsening intraocular inflammation, or lack of improvement after at least two intravitreal antimicrobial injections. The term "delayed vitrectomy" was used instead of "re-vitrectomy" to reflect that these patients had not undergone prior vitrectomy.

2. Prompt Pars Plana Vitrectomy (PPV) Group: Patients in this group underwent immediate pars plana vitrectomy (PPV) combined with intravitreal injection of antimicrobial agents as the initial treatment strategy. The vitrectomy was performed using either a 23-gauge, 25-gauge, or 27-gauge system, with the selection of gauge size at the discretion of the surgeon based on the individual case.

Patients were assigned to either the TAP group or the PPV group based on a non-randomized, physician-driven approach. The choice of initial treatment was determined by multiple factors, including the severity of clinical presentation, baseline visual acuity, presence of significant media opacity impeding fundus visualization and surgeon preference.

A standardized case record form was employed to systematically extract data from electronic health records. The collected information included patient demographics, such as age, gender, and relevant medical history, as well as clinical presentation details, including initial visual acuity, presenting symptoms, and the duration of symptoms prior to diagnosis. Microbiological findings were also documented, specifically the results of vitreous or aqueous humor cultures. Treatment-related data encompassed procedural details of TAP or PPV, the types of antimicrobial agents administered, and any adjunctive therapies used. Additionally, outcomes and complications were recorded, including visual outcomes, the incidence of treatment-related complications, the need for additional surgical interventions such as re-vitrectomy, and final visual acuity.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Baseline characteristics and clinical variables were summarized using descriptive statistics, with categorical data presented as frequencies and percentages and continuous data expressed as mean ± standard deviation or median with interquartile range, as appropriate. Comparative analyses between the TAP and Injection Group and the PPV Group were performed using the chi-square test for categorical variables and either the Student's t-test or Mann-Whitney U test for continuous variables. Statistical significance was defined as $p < 0.05$. Robust statistical methods were employed to minimize bias and enhance the reliability of findings.

By employing this methodological framework, the study aims to assess the incidence of re-vitrectomy as a surrogate marker for treatment efficacy and provide evidence-based insights into the management of acute postoperative endophthalmitis.

Results

In this study, 34 patients diagnosed with acute postoperative endophthalmitis were analyzed, with 10 patients in the TAP and injection group and 24 patients in the PPV group. The median age of patients in the TAP and injection group was 70.5 years (range 24-83), while the PPV group had a median age of 68.5 years (range 24-87). Gender distribution was comparable between the groups, with male patients comprising 40% in the TAP and injection group and 50% in the PPV group. Median presentation days were slightly shorter in the TAP and injection group (2 days; range 1-30) compared to the PPV group (3 days; range 1-21).

Table 1: Baseline characteristic

	Tap and injection (n = 10)	PPV (n = 24)	Remarks
Median age (range)	70.5 (24-83)	68.5 (24-87)	
Gender			
- Male	4 (40%)	12 (50%)	
- Female	6 (60%)	12 (50%)	
Median presentation day (range)	2 (1-30)	3 (1-21)	Group 2 (NA = 3)
VA at presentation			
- LP	1 (10%)	1 (4.2%)	
- PJ	0	2 (8.3%)	
- HM	2 (20%)	17 (70.8%)	
- FC	3 (30%)	1 (4.2%)	
- ≥ 5/200	4 (40%)	3 (12.5%)	
Number of IVT antibiotic injection			
- 1	5 (50%)	17 (70.8%)	
- 2	4 (40%)	5 (20.8%)	
- 3	1 (10%)	0	
- 4	0	1 (4.2%)	
- 5	0	1 (4.2%)	
Cause of endophthalmitis			
- APCE	7(70%)	16 (66.7%)	
- Traumatic	1(10%)	4 (16.7%)	
- Endogenous	0	1 (4.2%)	
- Others	2 (20%)	0	
- Unidentified	0	3 (12.5%)	
Cultured positive	0	7 (29.1%)	

Visual acuity (VA) at presentation showed notable differences between the groups. The majority of patients in the PPV group (70.8%) presented with hand motion (HM) VA, compared to only 20% in the TAP and injection group. Conversely, 40% of patients in the TAP and injection group had a VA of ≥5/200, compared to 12.5% in the PPV group. Regarding the number of treatments required, 50% of patients in the TAP and injection group achieved resolution with one treatment, compared to 70.8% in the PPV group. However, 40% of TAP and injection group patients required two treatments, while only 20.8% of the PPV group required the same.

Among the causes of endophthalmitis, acute postoperative cataract endophthalmitis (APCE) was the most common, accounting for 70% in the TAP and injection group and 66.7% in the PPV group. Traumatic causes were more prevalent in the PPV group (16.7%) compared to the TAP and injection group (10%). Interestingly, positive culture results were found exclusively in the PPV group, with 29.1% of patients yielding microbial growth, whereas no culture-positive cases were observed in the TAP and injection group.

Table 2: Number of re-vitrectomy between two groups

	Tap and injection (n = 10)	PPV (n = 24)	Remarks
Number of re-vitrectomy	5 (50%)	4 (16.7%)	p-value = 0.04
VA improve > 2 lines	5 (50%)	11 (45.83%)	p-value = 0.61 Group 1 (NA = 1)

In this study, the primary outcome was the rate of re-vitrectomy, which was significantly higher in the TAP and injection group compared to the PPV group. Specifically, 50% of patients in the TAP and injection group (5 out of 10) required a re-vitrectomy, compared to 16.7% of patients in the PPV group (4 out of 24). This difference was statistically significant, with a p-value of 0.044, indicating that the PPV group had a significantly lower re-vitrectomy rate.

Regarding visual acuity (VA) improvement, defined as an improvement of more than two lines, the proportion of patients achieving this outcome was similar between the two groups. In the TAP and injection group, 50% (5 out of 10) experienced significant VA improvement, compared to 45.83% (11 out of 24) in the PPV group. However, this difference was not statistically significant, with a p-value of 0.618.

These findings suggest that while the PPV group demonstrated a significantly lower rate of re-vitrectomy compared to the TAP and injection group, the two treatment modalities yielded comparable results in terms of visual acuity improvement. The lower re-vitrectomy rate in the PPV group may reflect the advantages of comprehensive surgical intervention during the initial treatment.

Table 3: Patients with visual acuity ranging from hand motion to better

	Tap and injection (n = 9)	PPV (n = 21)	Remarks
Median age (range)	70 (24-83)	66 (24-87)	
Gender			
- Male	4 (44.4%)	12 (57.1%)	
- Female	5 (55.6%)	9 (42.9%)	
Median presentation day (range)	2 (1-30)	4 (1-21)	
Number of treatment			
- 1	5 (55.6%)	16 (76.2%)	
- 2	3 (33.3%)	4 (19.0%)	
- 3	1 (11.1%)	0	
- 4	0	0	
- 5	0	1 (4.8%)	
Cultured positive	0	6 (28.6%)	
VA at 6 months			
- ≥ 20/40	4 (44.4%)	7 (33.3%)	
- 20/50-5/200	3 (33.3%)	7 (33.3%)	
- < 5/200	2 (22.2%)	7 (33.3%)	
Days from CEIOL to presentation			
- < 5 days	7 (77.8%)	11 (57.9%)	Group2 (NA = 3)
- ≥ 5 days	2 (22.2%)	7 (33.3%)	
Number of re-vitrectomy	4 (44.4%)	2 (9.5%)	p-value = 0.02
VA improve > 2 lines	5 (62.5%)	11 (52.4%)	p-value = 0.62 Group 1 (NA = 1)

In a subgroup analysis of patients presenting with visual acuity (VA) ranging from hand motion to better as shown in Table 3, a total of 30 patients were included, with 9 in the TAP and injection group and 21 in the PPV group. The median age was slightly higher in the TAP and injection group at 70 years (range 24-83) compared to 66 years (range 24-87) in the PPV group. Male patients comprised 44.4% in the TAP and injection group and 57.1% in the PPV group. The median time to presentation was shorter in the TAP and injection group (2 days; range 1-30) compared to the PPV group (4 days; range 1-21).

In terms of treatment frequency, 55.6% of the TAP and injection group required only one treatment compared to 76.2% of the PPV group. However, 33.3% of the TAP and injection group needed two treatments, compared to 19.0% in the PPV group. Notably, 11.1% of patients in the TAP and injection group required three treatments, while no patients in the PPV group required this many interventions. Positive microbial cultures were only observed in the PPV group, with a positivity rate of 28.6%, while no culture-positive cases were reported in the TAP and injection group.

At six months, visual outcomes showed comparable results between the groups. In the TAP and injection group, 44.4% achieved a VA of ≥20/40, compared to 33.3% in the PPV group. Similarly, the proportion of patients with a VA of 20/50–5/200 was equal in both groups at 33.3%. However, a higher proportion of the PPV group (33.3%) had VA <5/200 compared to 22.2% in the TAP and injection group. The majority of patients presented within five days of cataract surgery in both groups (77.8% in the TAP and injection group vs. 57.9% in the PPV group), but a greater proportion of patients in the PPV group presented after five days (33.3%) compared to the TAP and injection group (22.2%).

The rate of re-vitrectomy was significantly higher in the TAP and injection group, with 44.4% of patients requiring this intervention compared to only 9.5% in the PPV group (p-value = 0.028). Conversely, improvement in VA by more than two lines was similar between the groups, observed in 62.5% of the TAP and injection group and 52.4% of the PPV group, with no statistically significant difference (p-value = 0.62).

These findings align with previous studies, such as the Endophthalmitis Vitrectomy Study (EVS), which reported no significant differences in visual outcomes between TAP and injection versus PPV in patients presenting with VA ranging from hand motion to better. However, the significantly lower re-vitrectomy rate in the PPV group highlights the potential advantages of primary surgical intervention in this subgroup.

Discussion

This retrospective study provides comparative insights into the outcomes of TAP with intravitreal injection and PPV as initial treatment strategies for acute postoperative endophthalmitis. While both approaches achieved comparable visual acuity (VA) improvements, the significantly lower re-vitrectomy rates in the PPV group highlight its potential advantages in certain clinical scenarios.

Our findings indicate a significantly higher rate of re-vitrectomy in the TAP group compared to the PPV group. This observation aligns with previous studies suggesting that the comprehensive removal of infectious material and inflammatory mediators via PPV can reduce the likelihood of persistent or recurrent infection.[13,14] The higher re-vitrectomy rates in the TAP group may reflect the limitations of this approach in cases where partial removal of vitreous opacities fails to achieve adequate microbial clearance.

Modern vitrectomy techniques, characterized by smaller gauge systems, higher cutting rates, and enhanced visualization, likely contributed to the reduced re-vitrectomy rates observed in our PPV group. These advancements have been shown to enhance the safety and efficacy of PPV, making it a more viable first-line intervention even in cases with relatively good initial VA.[8,9,11]

In terms of VA improvement, both groups demonstrated comparable results, with no statistically significant differences observed. This finding is consistent with the Endophthalmitis Vitrectomy Study (EVS), which reported similar visual outcomes for TAP and PPV in patients presenting with VA better than light perception.[5,17] However, it is worth noting that the applicability of the EVS findings to current practice is limited by the evolution of surgical and diagnostic technologies.

Recent meta-analyses have suggested that early and complete PPV may yield better visual outcomes in specific subgroups, particularly those with dense vitreous opacities or poor initial VA.[15,16] Our subgroup analysis did not

demonstrate a significant advantage of PPV in terms of VA improvement, underscoring the importance of individualized treatment decisions based on clinical presentation and available resources.

The presence of positive culture results exclusively in the PPV group raises intriguing questions about the diagnostic yield of microbiological analysis in endophthalmitis management. Previous studies have shown that PPV provides a higher yield of positive cultures compared to TAP due to the larger volume of vitreous sample obtained.[3,18] This diagnostic advantage may facilitate targeted antimicrobial therapy, potentially improving treatment outcomes.

The timing of intervention remains a critical factor in the management of acute endophthalmitis. Our data suggest that patients in the TAP group presented slightly earlier than those in the PPV group, potentially influencing the choice of initial treatment. Early intervention has been associated with better outcomes in endophthalmitis, irrespective of the treatment modality employed.[19]

Adjunctive therapies, such as corticosteroids, were not analyzed in our study but warrant further investigation. Corticosteroids have been proposed to mitigate inflammatory damage in endophthalmitis, although their role remains controversial.[20]

Our findings support the use of PPV as a primary treatment strategy for acute postoperative endophthalmitis, particularly in cases where minimizing the need for additional interventions is a priority. However, the comparable VA outcomes between the two groups highlight the feasibility of a tailored approach, with TAP serving as a less invasive alternative in selected cases. The choice of treatment should consider factors such as initial VA, extent of vitreous involvement, and resource availability.

This study is limited by its retrospective design and small sample size, which may limit the generalizability of our findings. Larger, prospective studies are needed to confirm our results and address unresolved questions, such as the optimal timing and frequency of antimicrobial reinjections and the long-term outcomes of different treatment strategies.

Additionally, the role of advanced imaging modalities, such as intraoperative optical coherence tomography (OCT), in guiding treatment decisions deserves further exploration. Integrating these technologies into clinical practice may enhance the precision of both TAP and PPV, ultimately improving patient outcomes.[11,12]

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