Cost Evaluation of Surgical and Pharmaceutical Options in Treatment for Vitreomacular Adhesions and Macular Holes

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Objective: To evaluate cost-effectiveness and cost utilities for treatment options for vitreomacular adhesions (VMAs) and full-thickness macular holes (MHs).

Design: A Markov model of cost-effectiveness and utility.

Participants: There were no participants.

Methods: Outcomes of published clinical trials (index studies) of surgical treatment of VMAs and MHs and a prospective, multicenter clinical trial of pharmaceutical vitreolysis with intravitreal ocriplasmin with saline control were used to generate a model for costs of treatment and visual benefits. All techniques were assumed to result in a 2.5-line visual benefit if anatomy was resolved. Markov analysis, with cost data from the Centers for Medicare and Medicaid Services, was used to calculate imputed costs for each primary treatment modality in a facility setting, with surgery performed in a hospital serving as the highest end of the range and nonfacility setting with surgery performed in an ambulatory surgery center serving as the lowest end of the range.

Main Outcome Measures: Imputed costs of therapy, cost per line saved, cost per line-year saved, cost per quality-adjusted life years (QALYs).

Results: When pars plana vitrectomy (PPV) was selected as the primary procedure, the overall imputed cost ranged from $5802 to $7931. The cost per line was $2368 to $3237, the cost per line-year saved was $163 to $233 and the cost per QALY was $5444 to $7442. If intravitreal injection of ocriplasmin was the primary procedure, the overall imputed cost was $8767 to $10 977. The cost per line ranged from $3549 to $4456, the cost per line-year saved was $245 to $307, and the cost per QALY was between $8159 and $10 244. If intravitreal saline injection was used as a primary procedure, the overall imputed cost was $5828 to $8098. The cost per line was $2374 to $3299, the cost per line-year saved was $164 to $227, and the cost per QALY was $5458 to $7583.

Conclusions: As a primary procedure, PPV was the most cost-effective therapy in this model. The other treatments had similar costs per QALY saved and compare favorably with costs of therapy for other retinal diseases. *Ophthalmology 2014;■:1–7 © 2014 by the American Academy of Ophthalmology.*

The role of persistent, progressive vitreomacular adhesions (VMA) at the macula was most clearly defined clinically as a pathogenic step in macular hole (MH) formation.[1–3] More subtle forms of VMA have been widely described and even categorized as its own entity distinct from MH as optical coherence tomography (OCT) has increased its detection.[4,5]

Pars plana vitrectomy (PPV) has been the gold standard of treatment for MH over the past 20 years.[6,7] Treatment is highly effective, with overall success rates reported in the range of 80% to 90% after a single operation.[8–14] The success rate in the earliest stage, smallest, most recent cases has been reported to exceed 90%.[9–14] Although some debates in the literature remain regarding the type of gas tamponade used,[12–14] the necessity of peeling the internal limiting membrane,[9,10,15,16] and the duration of positioning postoperatively,[11,17] there is widespread agreement that the procedure is effective.

Treatment of VMA without MH has presented more of a treatment quandary. The VMA may progress to MH formation, it may resolve with spontaneous posterior vitreous detachment and improved visual acuity (VA), or it may remain dormant.[18–20] There are no reliable predictors of its course; hence, severity and progressive traction have factored as most important in clinical decision-making paradigms prompting intervention. Thus, eyes with moderately symptomatic VMA that fail to improve within a period of observation, or demonstrate progression of the traction effects, are commonly recommended for PPV, hitherto the sole therapeutic option.[21–23]

Data have recently been presented to suggest the benefit of an intravitreal injection of ocriplasmin (IVO) in patients with VMA, defined as vitreous adhesion to the macula within a 6-mm central retinal field surrounded by elevation of the posterior vitreous cortex on OCT, with or without an MH of <400 μm in diameter.[24] The Microplasmin for Intravitreous Injection – Traction Release Without Surgical Treatment (MIVI-TRUST) study demonstrated that in these patients, adhesion was relieved at a rate of 26.5% to 40.6%, thereby avoiding surgery in these patients.[24] This treatment option, albeit carrying a lower success rate than vitrectomy, may provide an alternative for patients who have overriding travel needs that preclude a gas injection; difficulties with surgery and postoperative management, such as positioning; or would

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have a significant benefit from avoiding cataract surgery. Furthermore, its relatively lower invasiveness (compared with PPV) might prompt expanded treatment indications for patients with lesser degrees of symptoms or VMA.

Implicit in these considerations, of course, is that although an in-office injection might be very attractive compared with PPV, its lower success rate and relatively high cost per dose might diminish its overall cost effectiveness.

The purpose of this report was to compare parameters of cost effectiveness and cost utility using a Markov decision tree analysis for PPV, pharmacologic intervention with IVO, and pharmacologic intervention with intravitreal saline (IVS), the control group used in the MIVI-TRUST study.

Methods

Success rates for the treatment of VMA and MH were derived from index studies that evaluated pharmacologic[24] and surgical treatment.[6–17] For anatomic success, previous reports suggest that the closure rates for small MH are ≥90% with single surgery.[8–14] Outcomes for IVO were derived from the MIVI-TRUST study—VMA was relieved with a success rate of 26.5% and the MH closure rate was 40.6%.[24] An assumption of 2.5 lines saved (i.e., regained and prevented loss) was made for both PPV and IVO successes. These estimates might be lower than actual considering that many treated patients would likely have lost additional VA if left untreated, but a principle of the methodology of the current study model was to err on the side of underestimating utility. The MIVI-TRUST study did not directly report VA improvement as an outcome measure.[24] The post hoc subgroup analysis showed that patients with a VA of <20/50 gained 3 lines of vision and those with better vision gained fewer lines; therefore, the 2.5-line estimate is consistent with these data.[24] Studies of MH repair typically include larger holes but do not describe VA outcomes for subgroups with smaller MHs; however, those patients would probably have lost additional VA if not treated (hence the input of "lines saved").

Medicare fee data were acquired from the Centers for Medicare and Medicaid Services (CMS) for the number of relative value units and cost in United States (US) dollars associated with each surgical procedure, injection, imaging study, or office visit.[25–29] Calculations were made for a facility practice in which surgery was done in a hospital operating room and a nonfacility practice in which surgery was done in an ambulatory surgical center (ASC) in the geographic area of Miami, Florida. These 2 practice care settings constituted a high- and low-end estimate of costs. Professional fees and facility fees, where applicable, were included in the calculations. The current rate of US$34.023 per relative value units was applied to calculate CMS reimbursements. Four different clinical scenarios were then reviewed using a Markov decision analysis[30] based on these index studies (Fig 1). The Markov-style analysis was selected for its ability to represent transitions between different states.[30]

In scenario 1, the initial treatment was PPV (90% anatomic success rate), with failures treated by an additional PPV. Scenario 2 modeled treatment with IVO, with failures treated with PPV and subsequent failures treated with second PPV. Scenarios 2a and 2b were calculated using 2 different initial success rates—one to evaluate the overall study group (26.5% success rate) and the second for small (<400 μm, as considered in the MIVI-TRUST studies) MHs (40.5% success rate). A third group, scenario 3, was a model based on initial treatment with IVS (10.9% success rate), the control group for the MIVI-TRUST trial, with failures treated with PPV. The subsequent failures, as in scenarios 2 and 3, were treated with PPV and repeat PPV for persistent failures. An assumed baseline of 62.9% phakic patients, the MIVI-TRUST study population,[24] was used to model costs for treating induced cataract formation after 100% of all eyes underwent PPV. Another assumption was that 2% of patients undergoing PPV would develop a retinal detachment that would be treated with PPV. Patients who developed rhematogenous retinal detachment were assumed to have no lines saved, and this is reflected in each of the scenarios.

Current Procedural Terminology codes were used to calculate professional fee inputs (including the use of the appropriate modifiers to 70% of the allowable fee for a repeat PPV; Tables 1 and 2). Professional anesthesia fees were calculated based on a sum of base and time units, multiplied by a conversion factor of $25.52. In the case of Current Procedural Terminology code 00145, 6 base units and 4 time units (1 hour) were used to estimate the professional fee of $255. For Current Procedural Terminology code 00142, 4 base units and 2 time units (30 minutes) were used to estimate a total of $153 in anesthesia professional fees.

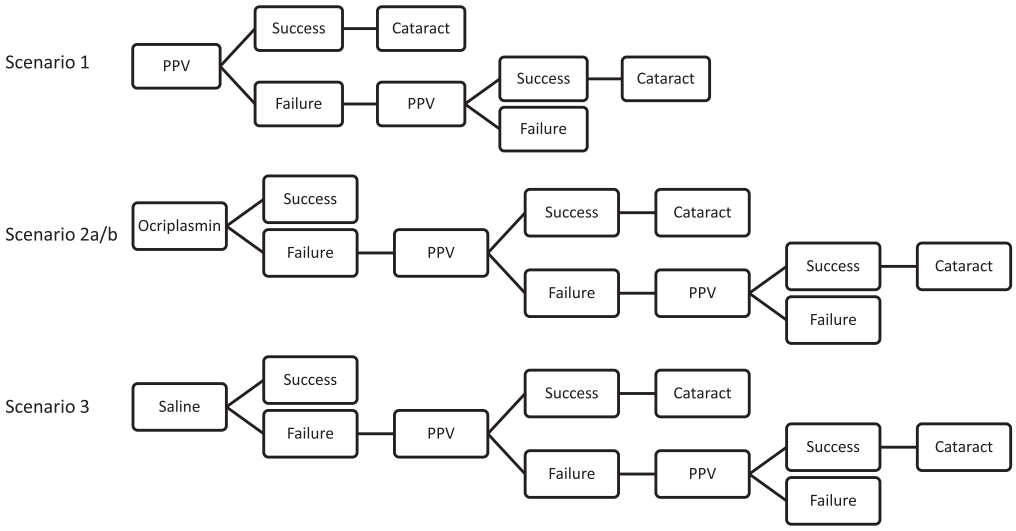

Figure 1. Decision model used for Markov analysis. Phakic patients receiving pars plana vitrectomy (PPV) (62.9%) were expected to require future cataract surgery.