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Cost-Utility of Evaluation for Posterior Vitreous Detachment and Prophylaxis of Retinal Detachment

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Purpose: To evaluate the costs and cost-utility of examination for posterior vitreous detachment (PVD) and treatment of associated pathology, and of managing various other peripheral retinal disorders to prevent retinal detachment (RD).

Design: A decision analysis model of cost-utility.

Participants: There were no participants.

Methods: Published retrospective data on the natural course of PVD, retinal tears, and lattice degeneration were used to quantitate the visual benefits of examination and treatment. Center for Medicare and Medicaid Services data were used to calculate associated modeled costs in a hospital/facility–based and nonfacility/ambulatory surgical center (ASC)–based setting. Published standards of utility for a given level of visual acuity were used to derive costs and quality-adjusted life years (QALYs).

Main Outcome Measures: Cost of evaluation and treatment, utility of defined health states, QALY, and cost per QALY.

Results: The modeled cost of evaluation of a patient with PVD and treatment of associated pathology in the facility/hospital (nonfacility/ASC)–based setting was $65 to $190 ($25–$71) depending on whether a single or 2-examination protocol was used. The cost per QALY saved was $255 to $638/QALY ($100–$239/QALY). Treatment of a symptomatic horseshoe tear resulted in a net cost savings of $1749 ($1314) and improved utility, whereas treatment of an asymptomatic horseshoe tear resulted in $2981/QALY ($1436/QALY). Treatment of asymptomatic lattice degeneration in an eye in which the fellow eye had a history of RD resulted in $4414/QALY ($2187/QALY).

Conclusions: Evaluation and management of incident acute PVD (and symptomatic horseshoe tears) offer a low cost and a favorable cost-utility (low $/QALY) as a result of the minimization of the cost and morbidity associated with the development of RD, thus justifying current practice standards. *Ophthalmology 2017;■:1–8 © 2017 by the American Academy of Ophthalmology*

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Patients presenting with acute posterior vitreous detachment (PVD) are commonly encountered by both comprehensive ophthalmologists and retinal specialists.[1] Although usually a non–sight threatening, self-limited process, PVD may herald a retinal tear that, if untreated, frequently results in rhegmatogenous retinal detachment (RD), engendering substantially escalated treatment and higher risks for visual loss.[2] Thus, its occurrence represents a critical opportunity to detect a retinal tear (or earlier stage of RD) and treat in a way that minimizes morbidity. From 1997 to 2007, the annual number of prophylaxis procedures for RD using cryotherapy/diathermy and laser averaged 2631 and 17 545, respectively, as reported by Medicare beneficiaries in the United States.[3]

The evaluation and management of PVD also may lead to the detection of various common peripheral retinal abnormalities, such as retinal lattice degeneration, round retinal holes, horseshoe tears, and retinoschisis, which may or may not be RD precursors. However, by some definitions, these findings constitute symptomatic (others might parse as asymptomatic) conditions because they are detected in the setting of the PVD symptoms and prompt decisions regarding prophylactic treatment. We have previously reported favorable cost-utility of treatment and prevention of RD compared with other medical treatments using a decision analysis model of cost utility.[4] However, the cost-utility of screening strategies for PVD or of managing peripheral retinal tears or lattice has not been reported.

The purpose of the current report is 2-fold. First, we evaluate the cost-utility of screening patients with acute PVD for retinal tears. Second, we consider the cost-utility of managing various peripheral retinal disorders that may be encountered during acute PVD evaluation to prevent RD, including symptomatic and asymptomatic horseshoe retinal tears and lattice degeneration in fellow eyes of those with RD.

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Methods

This study was determined to be exempt from internal review board approval because no patient information was used. Medicare fee data for 2016 were acquired from the Centers for Medicare and Medicaid Services to obtain the cost associated with each procedure and office visit assuming they were done in Miami, Florida.[5–7] Costs were calculated for both facility (hospital-based) and nonfacility (office-based) practice fee schedules to measure the full range of treatment setting costs. All laser procedures were assumed to be done in the clinic and on the day of initial presentation, and all scleral buckle (SB), pars plana vitrectomy (PPV), and cataract extraction procedures were assumed to be done in the operating room with an anesthesiologist. The dollars per relative value unit conversion factor was $34 889 the established rate for 2017.[5]

A decision analysis[8] was modeled for each clinical vignette based on the published rates of reported incidence of retinal tear or subsequent RD associated with the given pathology. This model did not include costs of patients discovered to have an RD at the time of the PVD screening. The screened and treated populations were compared with the costs of not screening, but just treating subsequent expected numbers of RDs assuming no visits or laser preceding presentation with the RD. All cost data quoted presume that the individual's net cost is imputed in accordance with treatment with the specified frequency assumptions.

A sensitivity analysis was performed for a range of retinal tear incidences to give the expected cost-utility ranges, because some published incidences might be higher than the current consensus. All RDs (consequent to failed prophylactic treatment) were assumed to be initially treated with SB and, in the event of SB failure, later with PPV. This model also assumed a success rate of 80% for SB and 90% for PPV (on reoperation of failed SB cases).[4] The percentage of phakic patients was assumed to be 70%.[4] All phakic patients were assumed to require cataract surgery by phacoemulsification with intraocular lens implantation after PPV (again, in the event the retina was not reattached with the SB).

The procedural terminology codes used to calculate costs in this model were as follows: 67107 for SB, 67108 for PPV with or without SB, 67145 for laser demarcation of retinal tears or treatment of lattice degeneration, 66984 for phacoemulsification with insertion of intraocular lens, 92004 for a comprehensive eye code on initial visit, and 92012 for an intermediate eye code on all follow-up visits.

Anesthesia fees were calculated by multiplying the base units, time units, and conversion factor for the specific procedure when applicable. The conversion factor for Miami, Florida, in 2017 is 24.24.[5] The Current Procedural Terminology code for anesthesia for vitreoretinal surgery, 00145, is weighed as 6 base units, and the Current Procedural Terminology code for anesthesia for cataract surgery, 00142, is weighed as 4 base units. One time unit is 15 minutes, and in line with our prior analysis,[4] we assumed a case length (for anesthesia services) of 1 hour for vitreoretinal cases and 30 minutes for cataract surgery. This resulted in a total anesthesia professional fee cost of $255 for a vitreoretinal procedure and $153 for a cataract surgery procedure. Full cost details are listed in Table 1.

All costs were analyzed through a third-party insurer cost perspective in that they reflected the costs and deductibles typically associated with payments for healthcare services by an insurer (in this case Medicare). Other major costs, such as society costs, employment costs, caregiver costs, and activities of daily living costs, were not considered in this analysis.

This model assumes that any retinal tear treatment failures (i.e., progression to RD) occurred within the 90-day global period (this also assumed that any new tears were treated during that same global period and therefore did not add to the cost model) and that no other tears or RD occurred throughout the hypothetical patient's lifetime. Thus, any eye with a successfully treated retinal tear (preventing RD) is followed with visits within the 90-day global period, such that beyond that time point they are treated as "cures" and ongoing expenses are the same as if they never had the PVD occurrence, so do not add anything further to the cost model. Any eye with a retinal tear that progresses to RD receives SB with an additional follow-up visit to diagnose the RD and also 1 follow-up visit more than the inconsequential PVD patient beyond the 90-day global period (i.e., a 3- to 6-month follow-up visit before returning to routine annual schedule). Any eye with an RD that fails SB receives a PPV and requires no additional visits (only those already accounted for with the SB procedure) beyond the 90-day global period. The model assumes all initial visits are billed with a comprehensive new patient eye code (92004), and all follow-up visits are billed using an intermediate established patient eye code (92012). An average age at initial visit of 55 years was assumed, based on published studies that show the average age of onset for PVD is between 45 and 65 years.[9] Life expectancy was estimated on the basis of the Social Security Administration actuarial tables.[10]

Similar to our previous analysis,[4] we assumed that an untreated RD results in 20/400, but that a successful repair preserves 20/25 for a macular-sparing RD and 20/80 for a macula-off RD. We also assumed that 30% of RDs are macular sparing and 70% are macular involving. Any patients presenting for evaluation of PVD, retinal tear, or lattice degeneration are assumed to have 20/20 vision at baseline and maintain 20/20 if RD is prevented. Those RDs that fail repair with SB and require PPV are assumed to have final vision of 20/400 (same as untreated natural history), and the rate of failure of initial RD treatment is 20%.

All reported costs are imputed costs. That is to say they include the cost of evaluation and the proportion expected to need treatment or prophylaxis of the given retinal lesion and the potential cost implications of management of the eye should it progress to RD. Utility values were assigned to different levels of visual acuity as previously described,[11] with 20/20 equal to 0.97 units, 20/25 equal to 0.87, 20/80 equal to 0.71, and 20/400 equal to 0.54. The utility state for an untreated RD (assumed to yield 20/400) is 0.54.[11] The calculated, weighted utility state for a treated RD using these assumptions was 0.71, and thus the utility saved by preventing an RD in a 20/20 eye was 0.26 (0.97−0.71 or U_{RD}) (Table 2). A utility-based analysis is presented in the current article, but an alternative Snellen line-based approach using a conversion factor of 0.03 quality-adjusted life year (QALY) per line year saved is available in Tables S1 to S4 (available at www.aaojournal.org). Both analyses only consider 1 eye and are thus second-eye models, meaning that the eyes treated are assumed to have better vision. All calculations were performed using Microsoft Excel (Microsoft Corporation, Seattle, WA).

Posterior Vitreous Detachment

The model assumes that the rate of acute retinal tear in symptomatic PVD is 8.2% at the initial visit and that 1.5% of eyes without tears on initial examination are found to have retinal tears on a follow-up examination.[12] Two potential examination protocols were modeled: 1 with a single visit and 1 with a scheduled follow-up visit (e.g., 1 week) after the initial encounter (Fig 1). Given these assumptions, the number of patients needed to examine to detect a retinal tear in the single and 2 examination schedules was 13 and 11, respectively. The number of patients needed to examine to prevent a RD in the single and 2 examination schedules was 28 and 23, respectively.

For the single examination schedule, the net cost of evaluation for PVD was calculated as follows: $Cost_{PVD\ Screening} - Cost_{Not\ Screening}$,