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Use of Retinal Procedures in Medicare Beneficiaries From 1997 to 2007

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Objective: To observe how the treatment of retinal conditions changed over the preceding decade.

Methods: Medicare fee-for-service data claims filed between 1997 and 2007 were analyzed.

Results: Fewer than 5000 intravitreal injections of a pharmacological agent were performed annually between 1997 and 2001. Thereafter, the annual number of intravitreal injections more than doubled every year through 2006, reaching a high of 812 413 in 2007. Photodynamic therapy procedures decreased 83% from a peak of 133 565 procedures in 2004 to 22 675 procedures in 2007, while laser treatment of choroidal lesions or neovascularization decreased 83% from a peak of 82 089 in 1999 to a minimum of 13 821 in 2007. Vitrectomies for primary retinal detachment (with or without scleral buckling) increased 72% over the study period from 11 212 in 1997 to 19 923 in 2007, while scleral buckles performed without vitrectomy decreased 69% from 8691 to 2660. Substantial volume increases were also observed for vitrectomy with retinal membrane stripping (90% increase from 29 426 in 1997 to 56 051 in 2007) or endolaser panretinal photocoagulation (86% increase from 10 319 in 1997 to 19 154 in 2007). Volumes of pneumatic retinopexy, laser prophylaxis for retinal detachment, laser treatment for retinal edema, and laser treatment for retinopathy all changed less than 25% from 1997 and 2007.

Conclusions: Marked changes in the use of several retinal procedures occurred between 1997 and 2007, particularly in the treatment of macular degeneration and retinal detachment. These changes point to greater acceptance and incorporation of vitrectomy and intravitreal injection as treatment modalities.

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RETINAL DISEASE IS HIGHLY prevalent among older individuals, and both age-related macular degeneration (AMD) and diabetic retinopathy account for more than half the irreversible blindness in older Americans.[1-5] The prevalence of both macular degeneration and diabetic retinopathy increases with age, and the number of Americans affected by these conditions is expected to increase substantially as the number of Americans older than 65 years doubles from 2010 to 2040.[6-8] Additionally, dietary and exercise habits are expected to increase the prevalence of diabetes mellitus within each age group.[7,8] Thus, many more individuals with retinal diseases are expected to require treatment in future years.

The last decade has seen substantial changes in the treatment options available for many retinal diseases, particularly in the treatment of neovascular AMD (**Figure 1**). In the 1990s, thermal laser treatment for extrafoveal and juxtafoveal choroidal neovascularization (CNV) represented the only significant treatment option with a demonstrated benefit.[9,10] In 2000, photodynamic therapy, involving laser activation of intravenously delivered verteporfin, was approved for use after having been demonstrated to be effective for subgroups of individuals with subfoveal CNV due to AMD who met specific angiographic guidelines.[11,12] In 2006, monthly intravitreal injections of ranibizumab, a monoclonal antibody that inhibits vascular endothelial growth factor (VEGF), demonstrated superior visual acuity outcomes compared with photodynamic therapy in eyes with CNV due to AMD[13] and was approved by the Food and Drug Administration. Off-label use of intravitreal bevacizumab, also

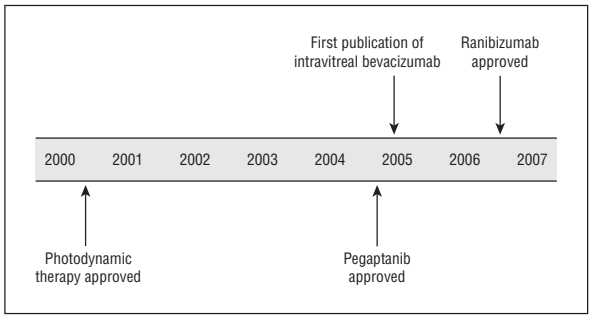

Figure 1. New retinal treatments introduced since 2000.

a monoclonal antibody against VEGF, is also commonly used for the treatment of neovascular AMD.[14,15]

Intravitreal injections of steroids and VEGF inhibitory agents have also been described in the treatment of diabetic, pseudophakic, and uveitic macular edema.[16-22] Intravitreal VEGF inhibitory agents have also been shown to quickly (though temporarily) resolve retinal or anterior segment neovascularization from diabetes or other conditions producing retinal ischemia.[23,24] Additional clinical trials are being conducted with numerous intravitreal pharmacologic agents to determine their efficacy and safety in a variety of retinal vascular diseases.

Pharmacological advances for the treatment of retinal conditions have been complemented by advances in surgical technique. In particular, several advances have been made in vitrectomy, including the development of sutureless, microincisional vitrectomy surgery; better visualization systems; and a greater variety of microincisional instruments and materials.[25] These advances may have allowed vitrectomy to obtain a greater role in the treatment of retinal disease.

One method to gauge the acceptance of newly introduced procedures, and to measure to what extent they have displaced the previous standard of care, is to track how frequently these procedures are performed. This report examines the trends in use of the most common retinal laser and surgical treatments for Medicare beneficiaries over the period from 1997 to 2007.

METHODS

As previously described,[26] files generated by the Centers for Medicare and Medicaid Services, previously known as the Health Care Financing Administration, were used to acquire data points for this retrospective analysis. The data gathered are in the public domain and are never more recent than 2 years old. In 2009, the most recent data available were for 2007. Data for individuals enrolled in managed care Medicare plans or Medicare Part C are not publicly available and are not included in this analysis. Similarly, data for non-Medicare beneficiaries are available only through providers of specific health plans and are not included as part of this analysis.

The volumes of paid claims for Part B services corresponding to specific *Current Procedural Terminology* (*CPT*) codes were tabulated into separate files for Medicare beneficiaries for each calendar year. *Current Procedural Terminology* codes ranging from 67015 to 67228 were analyzed as part of this study. These *CPT* codes correspond with procedures used for retinal and posterior chamber procedures.

Communication with the Johns Hopkins institutional review board determined that the study did not require institutional review board approval. Because human subjects were not directly involved, it was not necessary to obtain Health Insurance Portability and Accountability Act approval nor register the study as a clinical trial.

RESULTS

The volume of the posterior segment laser treatments and surgeries performed among Medicare beneficiaries between 1997 and 2007 is cataloged by *CPT* code in the **Table**. The total number of procedures increased every year except from 1997 to 1998, with a total increase of 192% over the study period. The largest year-to-year gains were observed in 2006 and 2007, where a greater than 20% increase in total volume was observed.

Procedure volumes changed most markedly for treatments directed toward neovascular AMD. Fewer than 5000 intravitreal injections of a pharmacological agent were performed annually between 1997 and 2001 but then increased 193-fold from 4215 injections in 2001 to 812 413 injections in 2007 (**Figure 2**).

Photodynamic therapy first became available for the treatment of neovascular AMD in 2001, when 85 411 procedures were performed. Volume increased 56% to a maximum of 133 565 procedures through 2004, but then decreased 83% to a total of 22 675 procedures in 2007 (eFigure 1, http://www.archophthalmol.com). Thermal laser treatment for CNV decreased 83% over the study period, from 56 966 procedures in 1997 to 13 821 procedures in 2007. Volume decreased 56% between 2004 and 2007, corresponding to the period of greatest growth for intravitreal injections of pharmacologic agents.

Little change was observed for treatments primarily used for diabetic retinopathy (eFigure 2). Laser treatments for retinal edema (*CPT* code 67210) ranged from 123 909 to 186 964 over the studied decade, while laser treatment for proliferative retinopathy (*CPT* code 67228) fluctuated between 93 200 and 115 789.

The use of vitrectomy in several settings increased over the study period. Large increases were observed for vitrectomy with membrane stripping (90% increase from 29 426 to 56 051), endolaser (126% increase from 2002 to 4527), or endolaser panretinal photocoagulation (PRP) (86% increase from 10 319 to 19 154). Vitrectomy performed with or without scleral buckling for repair of retinal detachment (*CPT* code 67108) also increased 78% over the study period from 11 212 to 19 923 procedures, while scleral buckling as a standalone procedure decreased 69% from 8691 to 2660 procedures (**Figure 3**). Other retinal detachment procedures, including cryotherapy, pneumatic retinopexy, and laser prophylaxis of retinal detachment, were relatively stable, changing less than 25% from 1997 to 2007.

COMMENT

Observing changes in procedural volume is one method to determine if, and to what extent, new technological

Table. Volume Comparison Between Years for Retina Surgery Codes

Description	CPT Code	No. of Procedures										
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Posterior sclerotomy	67015	1812	1990	1900	1891	1863	1938	1784	1781	1807	1878	1755
Vitreous placement												
Vitreous substitute	67025	1622	1761	1868	1817	1536	2127	1270	2244	2203	1986	2185
Intravitreal drug implant	67027	NA	406	359	293	163	133	126	109	119	251	193
Pharmacological agent (injection)	67028	3305	3218	2637	2745	4215	14 853	43 093	82 994	250 793	530 018	812 413
Lysis of vitreous strands												
Manual	67030	180	180	160	189	215	208	205	199	202	209	230
Laser	67031	4539	4460	3849	3651	3847	4197	2927	2996	3754	3554	3817
PPV	67036	12 410	11 907	12 811	13 024	11 884	14 595	12 986	13 208	13 698	13 285	13 010
With retinal membrane stripping	67038	29 426	31 895	41 397	41 712	40 063	51 068	48 752	52 099	54 683	55 375	56 051
With endolaser	67039	2002	2171	5655	2258	2471	2851	3029	3522	3856	4218	4527
With endolaser PRP	67040	10 319	12 081	15 087	13 852	14 742	17 044	18 595	19 946	20 145	19 470	19 154
Retinal detachment repair												
Cryotherapy/diathermy	67101	1530	1422	1388	1257	1242	592	1346	1720	1822	1550	1546
Laser	67105	4741	4299	4486	4224	4858	5484	5196	5709	5443	5429	5293
Scleral buckling	67107	8691	7636	7822	6592	5412	5181	4838	4341	3706	3162	2660
PPV	67108	11 212	11 557	15 066	15 711	14 830	17 477	18 318	19 213	19 804	19 593	19 923
Pneumatic retinopexy	67110	2829	2819	3060	2878	3285	3514	2976	3790	3701	3554	3476
Previous PPV or scleral buckle	67112	907	931	941	709	660	783	862	976	914	958	856
Removal/release of:												
Encircling element	67115	127	148	112	102	106	127	108	103	96	85	83
Posterior segment implant, extraocular	67120	823	818	838	794	535	942	892	1030	979	974	912
Posterior segment implant, intraocular	67121	445	551	809	750	652	930	979	1127	1018	1056	1043
Prophylaxis for retinal detachment												
Cryotherapy/diathermy	67141	3899	3455	2771	2486	2325	2621	1908	2671	2505	2270	2025
Laser	67145	16 476	16 031	15 714	15 161	16 124	17 531	18 819	19 364	19 437	19 433	18 906
Treatment of retinal lesion or edema												
Cryotherapy/diathermy	67208	893	1033	846	580	552	530	428	562	732	380	367
Laser	67210	139 487	143 149	123 909	171 688	177 152	186 964	182 224	176 463	163 194	147 829	139 495
Radiation	67218	445	391	412	346	506	818	715	684	732	626	599
Treatment of choroidal lesion or neovascularization												
Laser	67220	56 966	58 471	82 089	47 142	31 367	32 203	31 082	31 285	26 240	18 323	13 821
Photodynamic therapy	67221	NA	NA	NA	NA	82 628	100 012	98 169	126 603	112 183	43 823	21 337
Photodynamic therapy, second eye	67225	NA	NA	NA	NA	2783	4876	5107	6962	7495	3124	1338
Treatment of retinopathy												
Cryotherapy/diathermy	67227	1880	669	1262	1166	974	984	493	1008	NA	678	525
Laser	67228	115 789	99 922	106 208	101 011	103 875	108 464	109 846	109 601	105 480	99 051	93 200
Total		**432 755**	**423 371**	**453 456**	**454 029**	**530 865**	**599 047**	**617 073**	**692 310**	**826 741**	**1 002 142**	**1 240 740**
Change from previous year, %			–2.2	7.1	0.1	16.9	12.8	3.0	12.2	19.4	21.2	23.8

Abbreviations: *CPT, Current Procedural Terminology*; NA, not applicable; PPV, pars plana vitrectomy; PRP, panretinal photocoagulation.

advances are being accepted into clinical practice. Previous studies that examined the use of retinal procedures did not cover the period after the introduction of VEGF inhibitory agents and only focused on subsets of procedures.[27,28] In this report, we examined the volume of retinal procedures performed in Medicare recipients between 1997 to 2007. The 192% increase in the total volume of retinal procedures was much larger than the 11% increase in the population older than 65 years predicted by census data for the closest corresponding 10-year period and the 11% increase in overall Medicare enrollment from 1997 to 2007.[6,29] Overall, procedure totals were driven higher by large increases in the number of intravitreal injections performed from 2003 to 2007. Most of the observed increase in intravitreal injection of pharmacologic agents likely resulted from the use of intravitreal VEGF inhibitors for neovascular AMD.

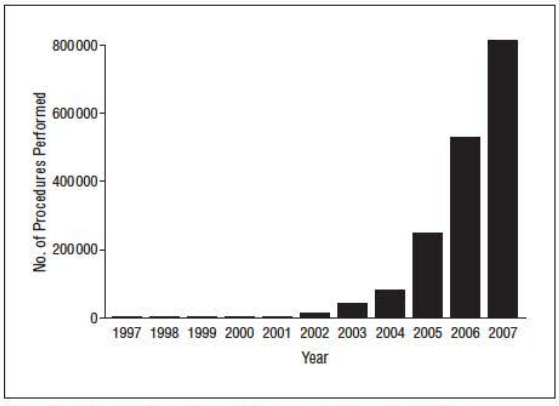

Figure 2. Intravitreal injections of pharmacologic agents, Medicare recipients, 1997 to 2007.

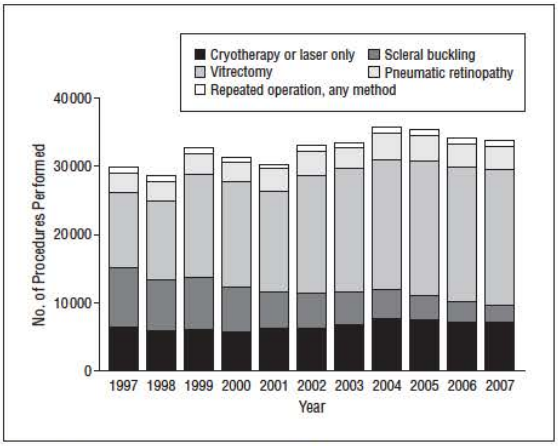

Figure 3. Retinal detachment procedures, Medicare recipients, 1997 to 2007.

These injections now represent a major component of the treatment of retinal disease.

Our data derived from *CPT* codes used in billing services for Medicare recipients do not identify which pharmacologic agent was injected. Thus, we could not assess the relative use of bevacizumab and ranibizumab. It is also possible that some of the growth of intravitreal injections is attributable to other pharmacologic agents, particularly in the period prior to 2004 when injections were less than 2.5% of retinal procedures. For instance, intravitreal steroid injections have been described for use in uveitic, pseudophakic, diabetic, and central retinal vein occlusion–associated macular edema and in combination with photodynamic therapy for treatment of neovascular AMD.[17,19,22,30,31] Additionally, pegaptanib was introduced for treatment of neovascular AMD in 2004[32] and may have contributed to the growth in intraocular injections prior to ranibizumab approval.

Less fluctuation was observed with common laser treatments of diabetic retinopathy, ie, laser for macular edema and PRP, though small decreases in use were observed between 2002 and 2007. No studies have demonstrated superiority of VEGF inhibitory agents and/or intravitreal steroids over established laser-based therapies for the treatment of diabetic macular edema or proliferative diabetic retinopathy.[16,18,24] As such, the small decrease in PRP and laser for macular edema during the latter half of the studied decade may represent variations due to demographic or health care use trends and not necessarily a shift to alternative therapies (ie, intravitreal injections).

Our data provide limited insights into the treatment of surgical complications of PDR, including vitreous hemorrhage, traction retinal detachment, rhegmatogenous retinal detachment, or combined tractional/rhegmatogenous retinal detachment. While the database does not allow us to firmly distinguish the type nor underlying etiology of the retinal detachment, one notable trend was that vitrectomies with endolaser PRP (*CPT* code 67040) doubled from 1997 to 2007. It is possible that this trend may reflect a tendency to intervene earlier in eyes with vitreous hemorrhage, though other reasons for increasing endolaser PRP with vitrectomy cannot be excluded.

Our data demonstrated that, over the study decade, the use of scleral buckling alone to treat retinal detachment decreased, while the use of vitrectomy increased substantially. However, vitrectomy performed alone or in combination with scleral buckling for retinal detachment repair is coded similarly in this database. Thus, we cannot differentiate whether scleral buckling is being replaced by vitrectomy alone or by procedures combining vitrectomy with scleral buckling. Vitrectomy (with or without scleral buckling surgery) for pseudophakic retinal detachments has been suggested to produce better anatomic success and visual outcomes compared with scleral buckling alone.[33] However, no difference in outcomes has been suggested in the treatment of phakic retinal detachments.[34,35] It is possible that advances in vitrectomy technique and instrumentation, perceptions that better results were achieved with vitrectomy, and/or a rise in fellowship-trained retinal specialists resulted in greater use of vitrectomy as the preferred method of repairing retinal detachment. In addition, given the older ages associated with our Medicare study population, it is likely that a significant proportion had pseudophakia, which may have influenced the decision to choose vitrectomy over scleral buckling as the surgical procedure.

Vitrectomy use was also noted to increase in several other settings, including with non-PRP endolaser and with membrane stripping. The broader use of vitrectomy across numerous conditions suggests that alternate explanations for its increased use, ie, changing disease prevalence or demographic shifts, are unlikely. It is possible, however, that the frequency of vitrectomy for specific conditions such as epiretinal membranes, vitreomacular traction, or macular holes may have increased with improved retinal imaging, such as optical coherence tomography, which may help better visualize the pathology involved and can yield better insight into when surgical intervention would be appropriate for a specific patient.

Several limitations are inherent in our analysis. Because the database only evaluates paid Medicare claims, this analysis excludes patients younger than 65 years, as well as those older than 65 years receiving their health care outside of Medicare. The exclusion of younger patients may miss trends due to trauma, type 1 diabetes, or other common conditions rarely found in those older than 65 years. We also cannot necessarily generalize our findings to people older than 65 years receiving their health from insurers outside of Medicare and also Medicare Part C and Medicare health maintenance organizations. Retinal procedures paid for by Medicare may have changed partially as a result of Medicare enrollment or switching between Medicare Parts B and C. Trends might also be created by changes in reimbursement that altered how surgeons coded for their services. We also assume in our analysis that physicians coded procedures correctly, though it is possible that systematic errors are made in coding that would lead to biased conclusions. Finally, there is ambiguity inherent in the *CPT* coding system, because the underlying diagnosis for which the procedure is performed is not available in the Centers

for Medicare and Medicaid Services data set. For example, vitrectomy for retinal detachment performed with or without scleral buckling is assigned the same *CPT* code.

The dramatic rise in retinal procedures poses important financial issues to both the ophthalmic community and society as a whole. The increased cost associated with procedure volumes alone may not be significant, because most of the increase results from an intravitreal injection of a pharmacologic agent, a relatively low-cost procedure. However, each injection is also associated with a separate medication charge (not covered in our Medicare database), which is approximately $2000 for each vial of ranibizumab. Medication costs associated with monthly administration of ranibizumab over a 1-year period are approximately $24 000 per patient. Although the costs associated with ranibizumab are high, ranibizumab is the first therapy to significantly improve vision in more than 30% of treated patients, and it has been shown to have a positive impact on vision-related quality of life.[36,37] Further work will be necessary to investigate whether lower-cost alternatives, such as bevacizumab, are noninferior to ranibizumab. Indeed, the Comparison of AMD Treatment Trials (CATT) Study is currently conducting a randomized clinical trial comparing bevacizumab and ranibizumab in eyes with neovascular AMD.

Observing use patterns adds value, because it demonstrates how disease is treated and can be used to identify possible discrepancies between the best evidence-based treatments for a condition (as defined by clinical trials and meta-analyses from the literature) and current practice patterns. In this report, we observe that intravitreal injections of pharmacologic agents have gained widespread acceptance for the treatment of neovascular AMD and that vitrectomy is being increasingly applied to a wide range of retinal conditions.

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