Nurse specialists for the administration of anti-vascular endothelial growth factor intravitreal injections

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ABSTRACT

AIM: The number of individuals with chronic conditions such as age-related macular degeneration (AMD) is increasing, and consequently the treatment burden for anti-vascular endothelial growth factor (anti-VEGF) intravitreal injections is also increasing. The use of nurse specialists to administer anti-VEGF intravitreal injections has been proposed to address this treatment burden. This was a prospective safety audit to determine the safety of nurse specialists for the delivery of anti-VEGF intravitreal injections.

METHOD: A prospective safety audit was undertaken for a nurse specialist-delivered injection service in the Ophthalmology Clinic, Greenlane Clinical Centre. The department's senior medical retinal consultant supervised the nurse specialist training programme. The clinical safety of anti-VEGF intravitreal injections delivered by nurse specialists, and the impact of this programme on clinical capacity at our Institute was reviewed.

RESULTS: The nurse specialists administered a total of 2,900 injections over an 18-month period. Two patients developed endophthalmitis post injection (1 infective, 1 non-infective). Two patients had a vitreous haemorrhage, and five patients had raised intraocular pressure. The incidence of post-injection endophthalmitis, vitreous haemorrhage and raised intraocular pressure was 0.07%, 0.07% and 0.17%, respectively.

CONCLUSION: The nurse specialist-delivered injection service is a safe and effective service for treatment of wet AMD, diabetic macular oedema and vein occlusion.

The introduction of intravitreal anti-vascular endothelial growth factor (anti-VEGF) agents has revolutionised the treatment of patients with neovascular age-related macular degeneration (nAMD), diabetic macular oedema, and retinal vein occlusions. Anti-VEGF agents administered via intravitreal injection have been proven to have robust health economic benefits,[1] but optimal treatment generally requires regular 4- to 6-weekly injections.

Over the past 5 years, the demand for intravitreal services has risen rapidly, and a recent survey conducted by Macular Degeneration New Zealand (MDNZ) reveals that many eye clinics across New Zealand are already struggling to cope with this demand.[2] Furthermore, the demographic changes occurring within our society mean that the prevalence of nAMD,[3] diabetes,[4] and retinal vein occlusion,[5,6] is projected to increase sharply over the next decade.

If the publically funded ophthalmology services are to meet this challenge, there is a pressing need to develop new service models that will facilitate the delivery of these intravitreal treatments. Currently, New Zealand spends the least of all the developed Organisation for Economic Cooperation and Development (OECD) countries on the treatment of nAMD[7], in part due to minimal use of Lucentis and Aflibercept, and it has a relatively low ophthalmic workforce, with approximately 1 ophthalmologist per 38,000 people.[4] Simply asking the existing ophthalmology workforce to 'do more, faster' is not feasible, and it is increasingly recognised that ophthalmology departments will have to 'work smarter' utilising the skills of the multidisciplinary team.[8-11]

In 2012, the Auckland District Health Board (ADHB) funded a pilot study with the specific purpose of training nurse specialists to administer anti-VEGF intravitreal injections. In this paper we report the 18-month outcomes of this project.

Methods

Implementing a nurse injector scheme

Training

Nursing Council of New Zealand approval was obtained prior to the commencement of this study. The training and indemnity packages were developed jointly by the designated ophthalmologist, ADHB, and the University of Auckland Ophthalmology Department.[12] Approval from the institutional nursing supervisor and the Chief Medical Officer was also obtained prior to the study commencing. Three nurse specialists with prior operating theatre backgrounds and proficient in the delivery of sub-Tenon's anaesthesia were identified to participate in this scheme.

The intravitreal injection procedure was standardised. All intravitreal injections were performed in a designated air filtration procedure room with linoleum floors under topical anaesthesia. Half-strength povidine-iodine was used to sterilise the eye and lids. Patients wore bouffant surgical caps, and injections were performed in the superotemporal quadrant, either 3.5mm (pseudophakic eye), or 4mm (phakic eye), away from the limbus. Retinal perfusion was determined immediately post intravitreal injection by confirming a vision of at least 'count fingers'. Injections were performed under direct supervision until adequate experience (50 cases) had been acquired, after which injections were performed unsupervised. Lubricating drops were given to use post-procedure on an as needed basis for comfort. No pre-injection or post procedure antibiotics were given. The patient was not reviewed again until their next appointment, unless they presented to the emergency eye clinic with complications.

Implementation and patient safety

At all times, the designated ophthalmology consultant retained clinical responsibility for patients treated during the project. The injection clinics ran in parallel to ophthalmologists' clinics to ensure that there was always a doctor available next-door for advice or review if necessary. nurse specialists delivered intravitreal bevacizumab, ranibizumab and aflibercept injections for nAMD, polypoidal choroidal vasculopathy (PCV), diabetic eye disease, and vein occlusions. Each nurse specialist recorded details of intravitreal procedures performed, and were required to conduct an ongoing audit, which included the retrospective review of patient notes of all patients presenting to the acute clinic with complications related to intravitreal injections.

All intravitreal procedures were recorded at the time the procedures were undertaken. Each nurse specialist also maintained personal records of intravitreal procedures performed. Departmental records, together with nurse specialist personal records, were retrospectively reviewed. Complications were identified on retrospective review of clinical notes from patients who presented to the acute eye clinic with complications post intravitreal injections. The safety audit period ran from 1 July 2013 to 31 December 2014.

Ethics approval

Institutional ethics approval was obtained from the Auckland District Health Board Research Office (A+7062).

Results and impact of the nurse injector scheme

The nurse injector scheme was introduced in July 2013. One nurse specialist started on 1 July 2013, and a further two nurse specialists were involved in the scheme in 2014. During the first 18 months of the scheme, these three nurse specialists performed a total of 2,900 intravitreal injections. No cases of retinal detachment, lens damage or central artery occlusion occurred (Table 1).

Ocular hypertension was defined as a patient who symptomatically had a visual acuity of less than 'count fingers' vision immediately following intravitreal injection, with a subsequent measured

Table 1: Complication rate of nurse delivered anti-VEGF intravitreal injections in the first 18 months of the nurse-injector scheme.

Complication	Number of complications, n (%)
Ocular hypertension	5 (0.17)
Vitreous haemorrhage	2 (0.07)
Retinal detachment	0 (0)
Lens damage/cataract	0 (0)
Central retinal artery occlusion	0 (0)
Endophthalmitis	2 (0.07)
Total	**9 (0.31)**

Table 2: Comparison of the number of injections delivered over a 3-month period (January to March) between 3 consecutive years.

2013				2014				2015			
Month	Doctor n	Nurse n	Total n	Month	Doctor n	Nurse n	Total n	Month	Doctor n	Nurse n	Total n
Jan	205	0	205	Jan	239	20	259	Jan	113	249	362
Feb	168	0	168	Feb	145	122	267	Feb	29	345	374
Mar	190	0	190	Mar	152	105	257	Mar	46	385	431

Figure 1: Comparison of the percentage of intravitreal injections administered by nurse specialists and doctors over a 3-month period (January to March) between 3 consecutive years.

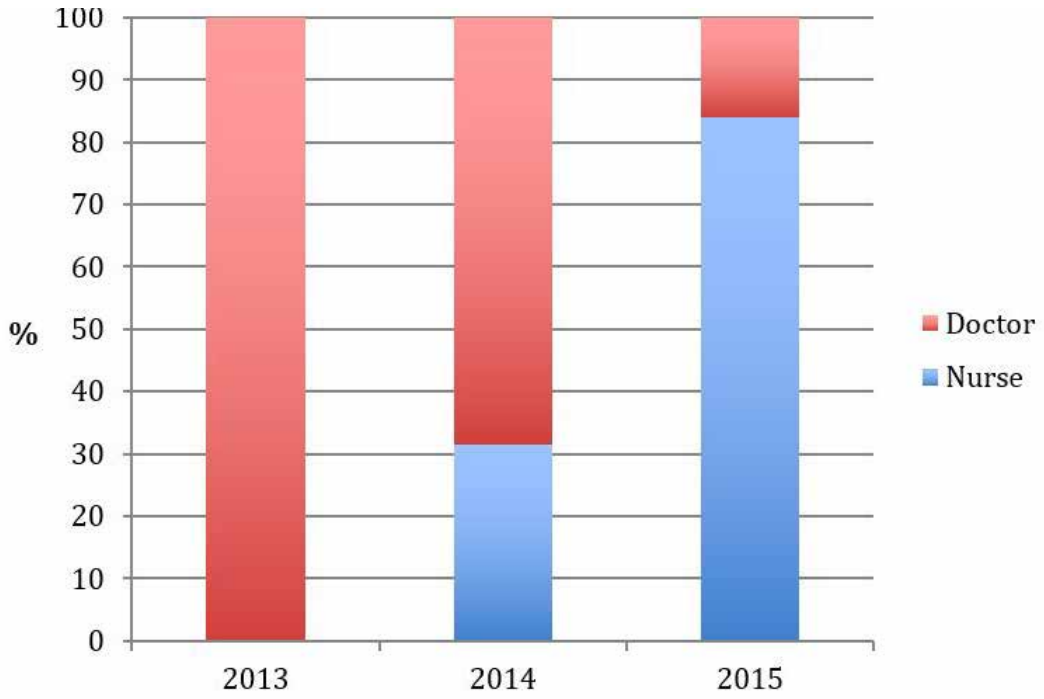

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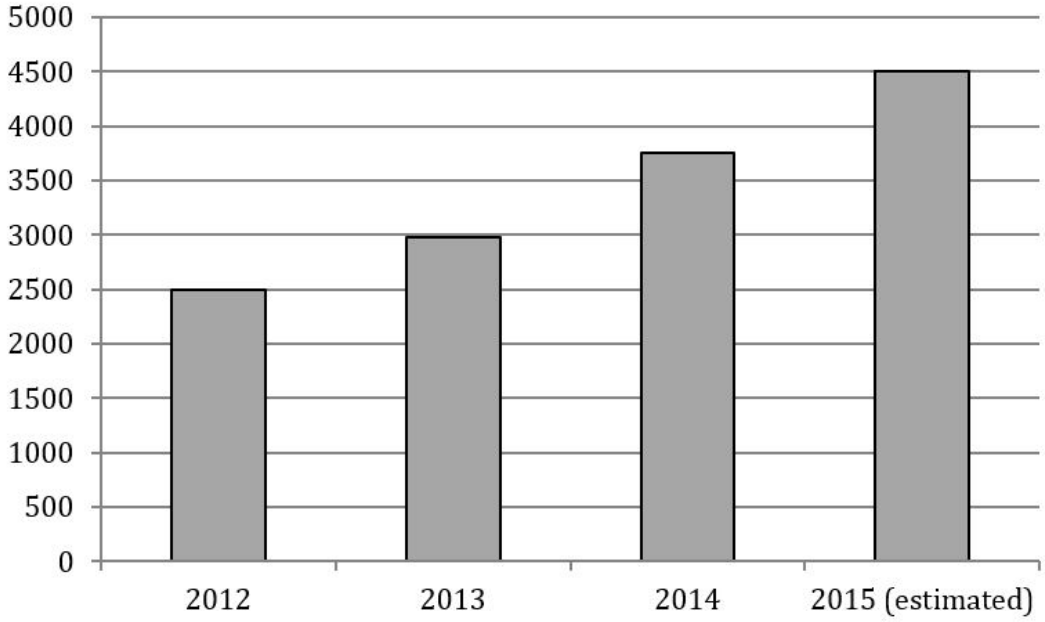
Figure 2: Total number of increased intravitreal injections per year.



intraocular pressure of greater than 30mmHg.

Two cases of vitreous haemorrhage occurred. One case was observed with no evidence of a retinal tear or hole requiring treatment, and the vitreous haemorrhage settled spontaneously. The second patient had a dense vitreous haemorrhage requiring vitrectomy, with no retinal tear or cause for the haemorrhage found at the time of surgery.

One case of sterile endophthalmitis, and one culture-positive (*Staphylococcus epidermidis*) endophthalmitis occurred during the 18-month audit period. Both patients that developed endophthalmitis were diabetic. The patient with sterile endophthalmitis had previously had a similar reaction to bevacizumab and has subsequently been switched to ranibizumab. The patient with culture-positive endophthalmitis underwent vitrectomy with a final Snellen visual acuity of 6/7.5.

Clinical capacity

Since the introduction of this scheme, there has been a progressive increase in the number of intravitreal injections delivered at our institute (Table 2). Once the scheme was well established, nurse specialists were delivering the majority of anti-VEGF intravitreal injections (Figure 1). Mid-way through the project, in the first 3 months of 2014, 32% of all injections were delivered by nursing staff. In same 3 months in 2015, 84% of all injections were delivered by nursing staff. More recently, from May 2015 to July 2015, nurse specialists have delivered approximately 92% of all intravitreal treatments at our institute.

Discussion

The annual burden of anti-VEGF treatment for nAMD alone has been estimated at 2,400 injections per 100,000 persons aged over 60 years.[13] As the population of New Zealanders over the age of 60 increases, the cumulative number of treatments needed across the country will increase markedly. The prevalence of AMD in New Zealand in 2014 was 184,400, and is similarly expected to rise markedly through to 2026.[3] In the year 2013–2014, our institute served 90,000 patients and performed just under 4,000 anti-VEGF injections. Eighty percent of these treatments were for the treatment of nAMD.

Since 2013, the indications for anti-VEGF treatments have continued to expand into a spectrum of chronic diseases that include diabetic eye disease, retinal vein occlusion and pathological myopia. As a result of these pressures, our institution has experienced on average a 30–40% increase in the total number of intravitreal injections required per year (Figure 2).

The expanded nurse injector role initiative was an attempt to address whether nursing staff could safely deliver

these treatments and thus address the dilemma of how, within the public sector, these cost-effective treatments could continue to be delivered to our patients.

At the inception of this project in early 2012, the utilisation of nursing staff to administer intravitreal injections was unknown in New Zealand. There was, however, a scheme in operation in the South West of England, and although there was no published data, their early audit data appeared to demonstrate that suitably trained nursing staff could safely administer these treatments.[14]

Furthermore, extension of the traditional nursing role to deliver patient care had already been shown to be beneficial in other areas of ophthalmology, including the delivery of sub-Tenon's anaesthesia,[15] glaucoma assessment,[10] and chalazion management.[9]

Our data reveals that suitably trained nursing staff can safely deliver intravitreal treatments in a large, public sector institution. The complication rates recorded in our continuous audit were low, and both the range and likelihood of complications were comparable with other published data. The most feared complication of intravitreal injections is post-injection endophthalmitis. The rate of endophthalmitis in our study was 0.07%, and this is comparable to other published data with reported rates of endophthalmitis after intravitreal injection of between 0.02% to 0.7%.[16-27] One of our two cases was a patient who presented at day 2 with a painless panuveitis. Although treated as an infectious endophthalmitis, the patient was culture negative on vitreous biopsy, and the event was likely to have been a sterile uveitis related to bevacizumab. Since this event, the process of compounding bevacizumab has been brought 'in house' to the hospital pharmacy, and we have had no further episodes of sterile endophthalmitis.

Recently published data from the National Health Service in the UK provides evidence that suitably trained nursing staff can safely deliver intravitreal injections,[28-30] with no significant difference in the rate of endophthalmitis between nurses and physicians in training.[27] As a consequence, the Royal College of Ophthalmologists has recently changed its policy on the delivery of anti-VEGF treatments, and now states that the delivery of anti-VEGF agents by non-medical health care practitioners is reasonable, provided that certain conditions are met—including appropriate training and supervision.[31]

As envisaged, the nurse injector scheme has had a positive impact on the medical retina service. Clinical nurse specialists delivered intravitreal injections safely, and both clinicians and patients now accept the use of nursing staff to deliver these treatments based on informal feedback. Capacity within the medical retina service has also increased as a consequence of the reduced reliance on medical staff for the administration of intravitreal injections. Furthermore, the nursing staff are now delivering the same number of treatments per clinical session as was previously being delivered by the Medical SMO team (14 treatments). In effect, we have successfully transferred the responsibility of delivering these 'routine' treatments to the nursing team, and in keeping with the 'work smarter not harder' ethos, this transfer of 'routine' tasks has been realised both as a cost-saving per treatment delivered, and better utilisation of medical staff time.[32]

In conclusion, our data adds to the growing body of evidence which demonstrates that appropriately trained nurse specialists can safely administer anti-VEGF intravitreal injections. The utilisation of suitably trained nursing staff to deliver these treatments has had a positive impact on the medical retina service, allows for better utilisation of medical staff, and has improved accessibility to the service for our patients.

Competing interests:
Nil

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