EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 7
1-10
Year: 2019

DO PHARMACY STUDENTS POSSESS THE KNOWLEDGE AND SKILL TO ADVISE GLAUCOMA PATIENTS?

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Article Received on 25/04/2019 **Article Revised on 15/05/2019** **Article Accepted on 05/06/2019**

ABSTRACT
Glaucoma is a chronic condition that may lead to visual field loss and potential blindness. Although, it is considered to be incurable it can be managed with the aid of eye drops. However, patients are frequently non-adherent to their medication regimen and therefore experience decreased overall health outcome. It is important that healthcare professionals possess adequate knowledge to engage with patients in encouraging and educating them to increase their health literacy and adhere to their medicine regimen. This paper examines final year pharmacy students' understanding of glaucoma, its management and recognising its symptoms in a community setting. A 10 question survey was specially designed for pharmacy students, testing their baseline knowledge without the use of external sources such as a BNF or NICE guidelines. It was found that students showed inadequate knowledge of glaucoma with only 34.4% of the participants knowing the aetiology of primary open angle glaucoma. Although this study is small in sample size, it follows a pattern found in various studies using other health care professional students. Therefore, it appears a problem exists in the teaching of glaucoma in universities.

KEYWORDS: Glaucoma, open angle, primary glaucoma, closed angel, eye drops formulations.

INTRODUCTION
Glaucoma describes occular disorders that cause gradual damage to the optic nerve[1], due to the increased intraocular pressure (IOP). There are several types of glaucoma; but this study is focussed upon primary open angle glaucoma (POAG) and primary angle closure glaucoma (PACG). POAG is the most common type and usually affects both eyes, but not necessarily equally.

Production and drainage of aqueous humor play a significant role in the severity of both POAG and PACG. Aqueous humor is formed in the secretory epithelium in the ciliary body[2] and is drained from the eye by two independent pathways. The main pathway for drainage is usually called 'the conventional route' and consists of drainage of the aqueous humor through the trabecular meshwork. The alternative route also called 'the unconventional route' is via the uvea-sclera pathway. During this process, there is an equilibrium between the production of aqueous humor in the ciliary body and the outflow of aqueous humor through both conventional and unconventional pathway. However, in the event of an obstruction to the outflow of aqueous humor via the trabecular meshwork, the intraocular pressure of the eye is elevated which can cause patients to experience symptoms such as pain and redness of the eyes.

Normal IOP is 12-22mmHg[3], and measurements above 22mmHg are recognised as elevated. Patients with elevated IOP do not necessarily have glaucoma, but it is important for them to be referred to an ophthalmologist for further investigations. An IOP of $\geq$40mmHg independent of the cause is an emergency and requires urgent referral to an ophthalmologist[4] to avoid any permanent visual impairment or blindness.

POAG is caused by an imbalance of production and outflow of aqueous humor. Production of aqueous humour by the ciliary body remains constant but there is increased resistance to the exit of aqueous humour through the trabecular meshwork. This causes the IOP to be elevated. Ongoing raise of the IOP can cause loss of vision over time, it can cause the optic cups to enlarge which can be detected by a visual field test.[5] In contrast, PACG occurs when the angle of the trabecular meshwork is closed causing a rapid rise in IOP. This can cause a variety of symptoms such as blurred vision, headaches and eventual loss of sight.

According to the World Health Organisation (WHO), glaucoma is now the second leading cause of blindness globally, after cataracts.[6] Although it cannot be cured and it is impossible to reverse any vision loss, suitable measures can control the symptoms and avoid

unnecessary visual field loss such as eye drops and laser surgery. An estimated >3 million people in the world have been rendered blind by POAG and a further 2 million people a year will develop the condition.[7] In the NHS there are more than 1 million glaucoma-related hospital admissions and due to the longer life expectancy and the ageing population the cost to treat these patients is expected to increase.[8]

Ophthalmic drops are the first line treatment for POAG.[1] For many medications, ophthalmic delivery bypasses first-pass hepatic metabolism, increasing the possibility of systemic side effects.[9] Administering opthalmic drops also means the local concentration of the medication will be high resulting in a quicker onset of action. Due to the high concentration of medication in the eye drop preparations, even when instilled correctly, there is a risk of excess amounts causing systemic bioavailability when not completely absorbed in the eye.[10]

Many ophthalmic preparations require refrigeration which may be inconvenient to some patients. Patients require explanation that the medication will need to be discarded 28 days after the bottle is opened. Patients can make sure they discard the medicine by the correct date by making a note on the side of the packaging when the bottle was opened.

Instilling eye drops correctly is crucial to the successful management of POAG. As stated by Tatham et al., (2013) “good eye drop instillation technique can result in the potential to improve drug delivery, which would consequently increase the effectiveness of the treatment”.[11] A study by Sleath et al., (2011) investigated the correlation between medication adherence, eye drop instillation technique and the patients' level of visual field distortion. They were able to measure these parameters using video recording of patients’ eye drop technique and monitoring their medication adherence using a 10-item scale. At the end of their cross-sectional study, they found that patients who were less than 80% adherent were significantly more likely to experience compromised vision. However, there have been many instances where patients have found it difficult to administer eye drops. In the study carried out by Gupta et al., (2012) it was shown that 9 out of 10 patients with glaucoma were unable to administer their eye drops correctly, which could then affect the therapeutic effect of the medication.[13] Gurwitz et al., (1993), studied the extent to which patients over the age of 65 were non-adherent to their treatment for glaucoma and found similar results.[14] After the first measurement, 23% of patients were found to be non-adherent. According to a study done by Robin and Grover, (2011) poor adherence to the medication will result in worsening of the disease as well as increased healthcare costs.[15]

Although incorrect eye drop instillation is a major component of non-adherence in patients with glaucoma, other barriers impede patients from significantly improving their overall health outcome. These include old age, side effect, cost of the medication, inability to perceive the benefits of the medication and presence of comorbidities, such as arthritis.

People having comorbidities alongside glaucoma, has led to the development of a number of different compliance aids to help patients overcome their difficulties in administering eye drops. An example of this is Opticare Arthro® (Cameron Graham, Huddersfield UK) which is used to help patients with arthritis or other conditions that affect hand or shoulder movement.[16] It is designed to make it easier to squeeze the bottle after being positioned over the eye. This enhances the accuracy of the drops as well as potentially increasing control over how many drops are administered.

There are various sub-categories of non-adherence. Identifying intentional and unintentional adherence patterns is essential when health care professionals attempt to address non-adherence. According to the UK The National Institute for Health and Care Excellence (NICE); "unintentional non-adherence can occur when patients are willing to follow the treatment plan that was agreed upon with their physician; however, there are barriers preventing this beyond their control".[17] Examples of this can include forgetting to take the medicine at the correct time or dose or the inability to use the eye drop application correctly. Conversly, intentional non-adherence is defined by NICE as “patients refusing to follow the treatment plan or recommendations given to them by their physician”.[17]

A trial by Okeke et al., (2009) investigated the relationship between a patient's poor adherence and interventions.[18] At the end of their randomised controlled clinical trial involving a total of sixty-six patients with glaucoma who were treated with prostaglandins, they found that after 3 months of observation, patients who were put in the intervention group experienced an increase in their compliance rate of scheduled doses. This study would suggest that physicians are managing glaucoma sub-optimally and that patients would benefit from health education interventions provided by their care provider. This is backed up by a Dutch study conducted by Beckers et al., (2012) who found that glaucoma patients would benefit from some patient education.[19]

According to Cate et al., (2014) patients given tailored information about their condition and how to manage it by their health care provider demonstrate high satisfaction and have a better appreciation about their condition.[20] This provides further evidence that taking time to engage with patients and helping them understand glaucoma promotes adherence to therapy.

There are many ways healthcare professionals can assist glaucoma patients in their cognition of glaucoma. However, these efforts must be tailored to the individual. These include consultations, leaflets, telephone services, NMS (new medicine services) and MURs (medicine use reviews).

For all chronic conditions, it is beneficial when patients understand their condition, how to manage it, the advantages and disadvantages of potential treatment pathways. Patients who are considered to have a high level of health literacy will allow health care professionals to engage with themes and mutually decide on a treatment plan to provide them with the best possible health outcome. However, the degree of health literacy patients demonstrate is dependent on many factors including "age, education, income and experience".[21]

Sun et al., (2013) found that there were no significant differences in the level of health literacy in relation to gender, ethnicity and marital status. In contrast, age, education, and income were significantly correlated with demonstrated patient's health literacy.[21] Therefore, to help the population that's considered to have the lowest score in health literacy, health care professionals need to develop methods to inform and educate patients using a variety of services such as health interventions and introducing patients to support groups.

Tn the UK, providing newly diagnosed patients with a New Medication Service (NMS) will provide an understanding of how their medicine works and how they can obtain the best from it. The engagement of health care professionals has aided patients to increase their health literacy as shown by Chen, Chen, and Sun, (2009) who enrolled patients into a glaucoma club with other patients and were able to demonstrate a better understanding of glaucoma than the general glaucoma patient population.[22] This understanding included both treatment and self-management of glaucoma.

Educating patients about their condition and teaching them the correct way of instilling eye drops, will improve patient adherence and their overall outcome. A study conducted by Lazcano-Gomez et al., (2015) assessed the eye drop instillation technique of patients' pre and post a video intervention, educating the patients on the correct technique.[23] After a single education session, it was evident that patients' instillation technique had significantly improved, with 82% of patients with the correct eye drop instillation technique once the study was over.

Robin and Grover, (2011) demonstrated there are ways to increase adherence to medication by educating the patients' families as well as simplifying their regimen.[15] Consequently, it is important health care professionals are familiar with glaucoma and are able to consult patients on how to take their medication as well as what they need to monitor.

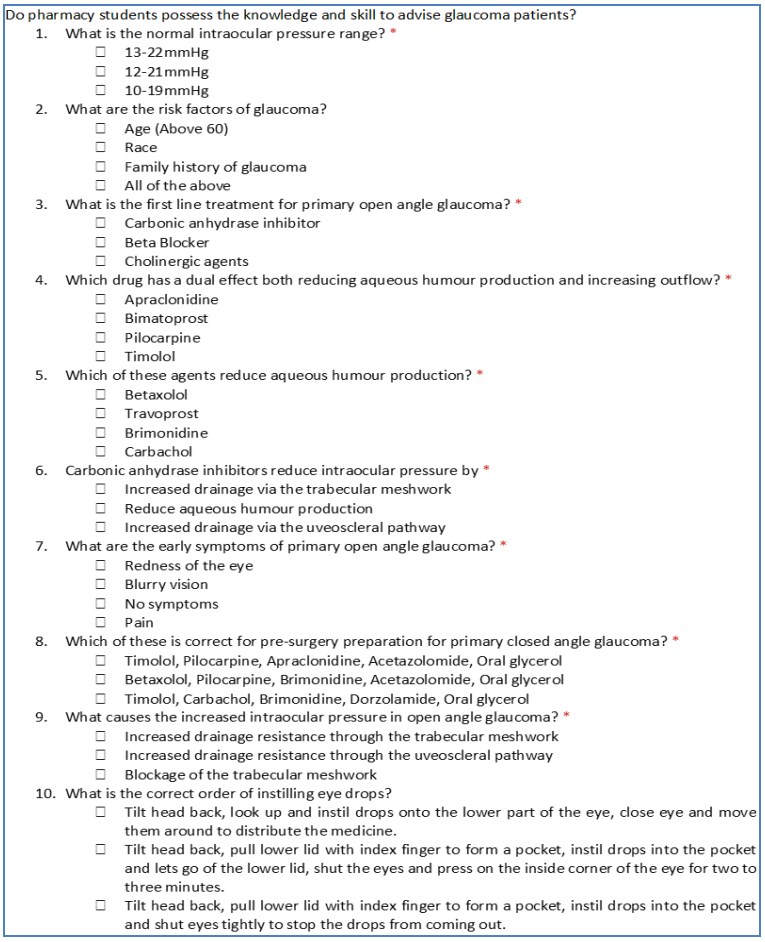
Aim

To assess pharmacy student's knowledge on glaucoma and their capability of advising patients diagnosed with glaucoma.

Method

A survey-based study was conducted to identify the knowledge and understanding of pharmacy students regarding glaucoma and its treatment. Databases such as Google® Scholar, Pubmed®, Medscape®, and ScienceDirect® were used to identify previous studies that analysed the effectiveness of pharmacists in treating glaucoma patients. The search terms used were compliance and adherence, glaucoma, management of glaucoma, eye drop instillation technique and the effect of glaucoma on patients. To narrow down the results, the date was limited to the last 25 years. This limit was chosen to exclude studies that were done prior to healthcare professionals having a better understanding of glaucoma and its effect on the body.

From an analysis of the literature, 10 questions which would provide insight on how well pharmacy students understood glaucoma and whether they had sufficient knowledge concerning its treatment were developed. Each question was specifically designed for pharmacy students (Figure 1).



Do pharmacy students possess the knowledge and skill to advise glaucoma patients?

1. What is the normal intraocular pressure range? *
   - ☐ 13-22mmHg
   - ☐ 12-21mmHg
   - ☐ 10-19mmHg
2. What are the risk factors of glaucoma?
   - ☐ Age (Above 60)
   - ☐ Race
   - ☐ Family history of glaucoma
   - ☐ All of the above
3. What is the first line treatment for primary open angle glaucoma? *
   - ☐ Carbonic anhydrase inhibitor
   - ☐ Beta Blocker
   - ☐ Cholinergic agents
4. Which drug has a dual effect both reducing aqueous humour production and increasing outflow? *
   - ☐ Apraclonidine
   - ☐ Bimatoprost
   - ☐ Pilocarpine
   - ☐ Timolol
5. Which of these agents reduce aqueous humour production? *
   - ☐ Betaxolol
   - ☐ Travoprost
   - ☐ Brimonidine
   - ☐ Carbachol
6. Carbonic anhydrase inhibitors reduce intraocular pressure by *
   - ☐ Increased drainage via the trabecular meshwork
   - ☐ Reduce aqueous humour production
   - ☐ Increased drainage via the uveoscleral pathway
7. What are the early symptoms of primary open angle glaucoma? *
   - ☐ Redness of the eye
   - ☐ Blurry vision
   - ☐ No symptoms
   - ☐ Pain
8. Which of these is correct for pre-surgery preparation for primary closed angle glaucoma? *
   - ☐ Timolol, Pilocarpine, Apraclonidine, Acetazolomide, Oral glycerol
   - ☐ Betaxolol, Pilocarpine, Brimonidine, Acetazolomide, Oral glycerol
   - ☐ Timolol, Carbachol, Brimonidine, Dorzolamide, Oral glycerol
9. What causes the increased intraocular pressure in open angle glaucoma? *
   - ☐ Increased drainage resistance through the trabecular meshwork
   - ☐ Increased drainage resistance through the uveoscleral pathway
   - ☐ Blockage of the trabecular meshwork
10. What is the correct order of instilling eye drops?
    - ☐ Tilt head back, look up and instil drops onto the lower part of the eye, close eye and move them around to distribute the medicine.
    - ☐ Tilt head back, pull lower lid with index finger to form a pocket, instil drops into the pocket and lets go of the lower lid, shut the eyes and press on the inside corner of the eye for two to three minutes.
    - ☐ Tilt head back, pull lower lid with index finger to form a pocket, instil drops into the pocket and shut eyes tightly to stop the drops from coming out.

Figure 1: Questionnaire used to explore pharmacy students' knowledge level. *Correct answers.

Ethics approval was obtained from the University of Wolverhampton, School of Pharmacy Ethics Review Board. All final year pharmacy students who were enrolled into a WhatsApp® group (n=51) were sent an information sheet and an invitation. The participant information sheet provided an overview of the study and what to do if they were interested in participating. The sheet also outlined that by clicking on the link to the survey they would be were giving consent to take part in the study. Total responses received were 32.

RESULTS

The first question assesses students' knowledge on whether they know the normal intraocular pressure. Only 75% knew the correct answer.

Next participants were asked if they understood the patient risk factors that could lead to an increase in the likelihood of glaucoma (Figure 2). A total of 84.4% of the student were able to identify the risk factors of glaucoma. This is important as it will benefit pharmacists in a community setting to refer patients who are presenting with glaucoma symptoms as well as having one or more of these risk factors.

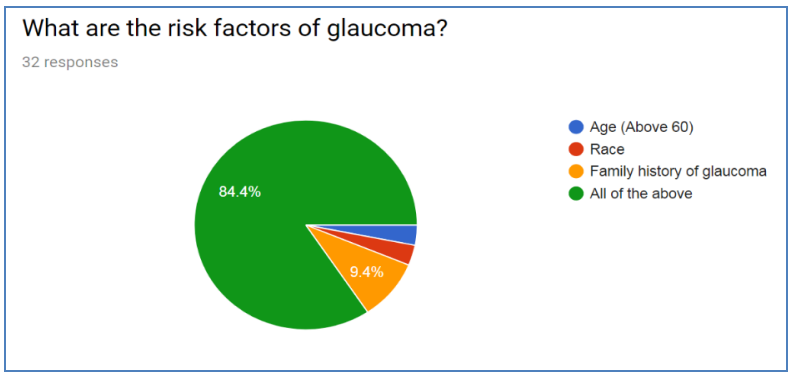


Figure 2: What are the risk factors of glaucoma?

Asked to identify which drug class is considered to be the first line treatment for glaucoma (Figure 3), some 62.5% of students stated that beta blockers were the first line of treatment in glaucoma.

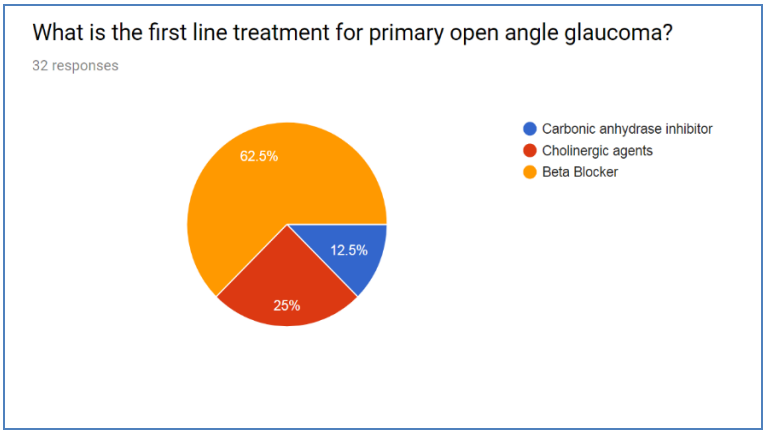


Figure 3: Which drug has a dual effect?

The next question assessed the students understanding of the mode of action of drugs used in the treatment of glaucoma. Only 18.8% of students gave the correct answer. This is particularly important as pharmacy students should be able to explain to patients how the medication will alleviate their symptoms. The majority of the participants 46.9% answered bimatoprost which was incorrect as prostaglandin analogues are used primarily to increase aqueous humour outflow without reducing its production (Figure 4).

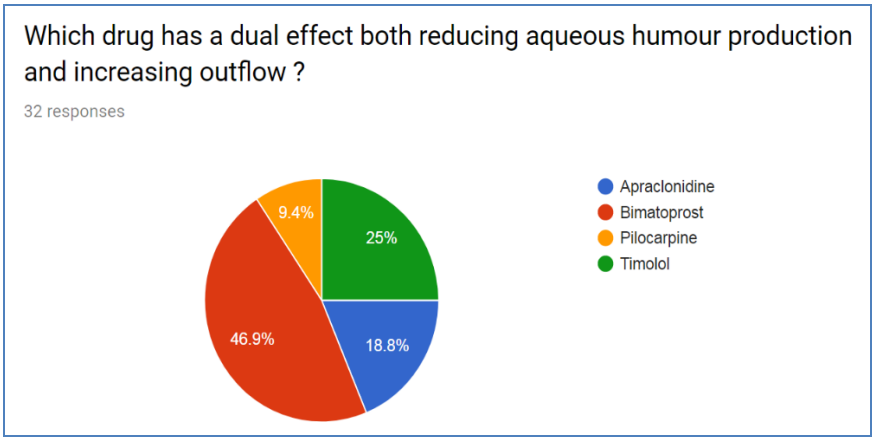


Figure 4: Which agent reduces aqueous humour production?

Students were asked if they knew which of the glaucoma drugs is used solely to reduce the production of aqueous humour. The majority of the students were unable to select the correct option, which was betaxolol, with only 21.9% of the responses. (Figure 5).

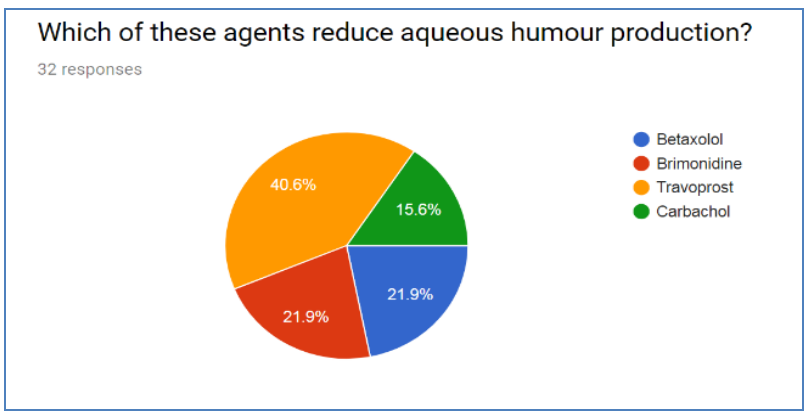


Figure 5: What is the role of carbonic anhydrase inhibitors?

Students were then asked if they understood the mode of action of carbonic anhydrase inhibitors with only 34.4% of the students answering correctly. The Majority of the students (43.8%) believed that carbonic anhydrase inhibitors worked by increasing the drainage of aqueous humour through the trabecular meshwork which is actually the action pf prostaglandin analogues (Figure 6).

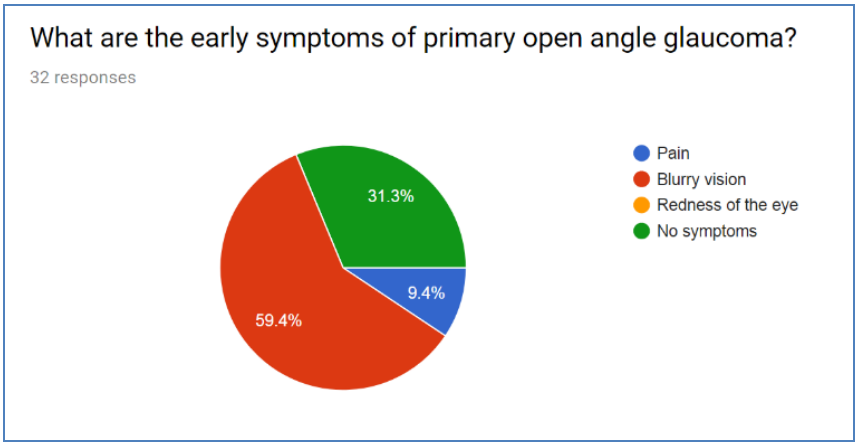


Figure 6: What are the early symptoms of glaucoma?

Only 31.3% of the participants understood that patients in the early stages of POAG are usually asymptomatic with the rest believing patients will suffer from blurry vision and pain. Due to the criticality of the condition, patients suffering from PCAG experience, pharmacy students should be able to recall all the drugs that need to be administered urgently before the patient can have surgical treatment. These drugs are necessary as they lower the IOP as well as decreasing the associated inflammation (Figure 7).

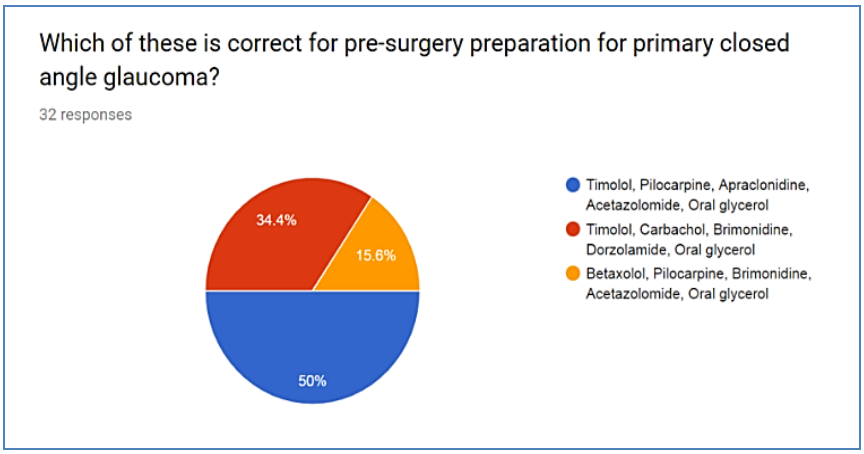


Figure 7: Pre- surgery prep for primary closed angle glaucoma.

Participants seemed to find this question difficult as it involved recalling numerous agents. However, 50% managed to choose the correct sequence of drugs. The other 16 participants selected a sequence which included an anticholinergic agent. This is particularly important as they are known to be contraindicated in patients with PCAG (Figure 8). The next question provides insight into the fundamental understanding of pharmacy students and what they believe is the pathophysiology of POAG. Only 34.4% of the students understood that POAG occurs due to increase drainage resistance through the trabecular meshwork. Majority of the students may have confused this question with the pathophysiology of PCAG.

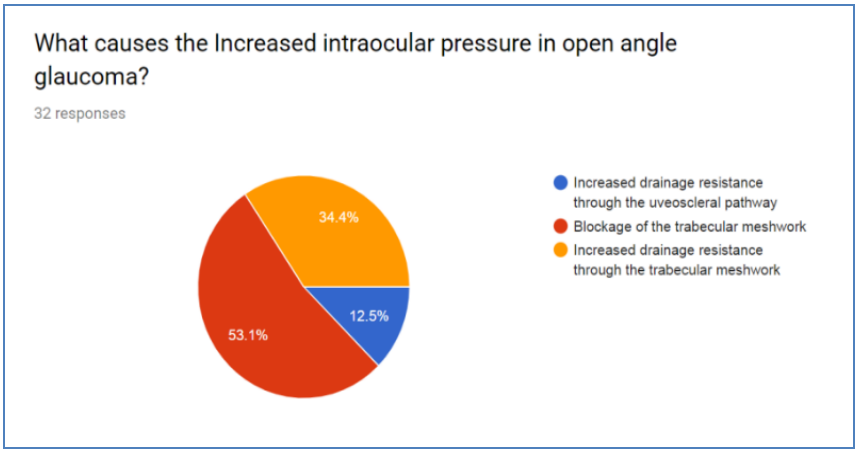


Figure 8: Cause of POAG.

As a health care professional who may have to advise patients who are unfamiliar with the technique to instill an eye drop, knowing and being able to instruct on the correct technique is paramount. In this study 90.6% of the participants were able to recognise the correct method of administering eye drops. t (Figure 9).

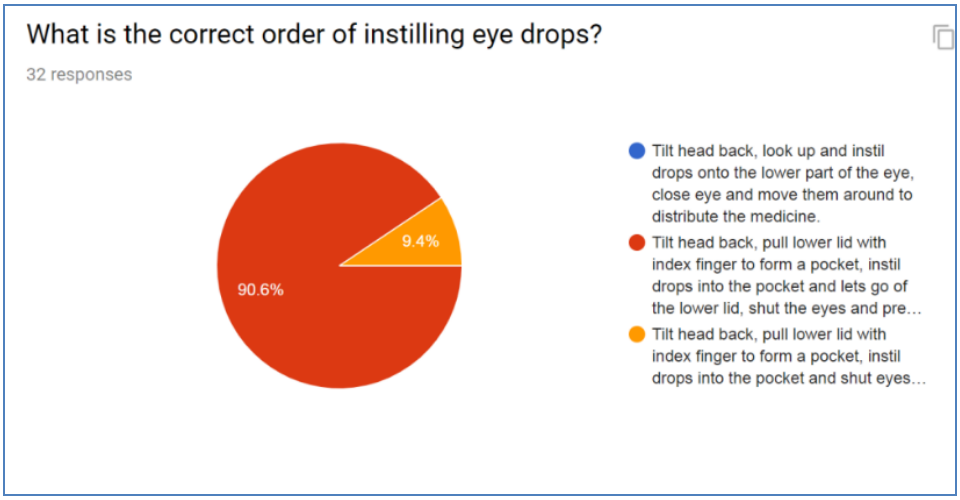


Figure 9: Correct order of instilling eye drops.

DISCUSSION

There are many benefits to conducting a survey-based study; low cost, ease of collection of a large sample quickly, avoiding transcription through online collection. However, there were also a number of limitations some of which may have had a negative impact on the findings of the study. The sample size of the study was not large enough to make generalized statements. A further study would be required to extend these findings.

A further limitation was the inability to be present when participants were completing the survey. Participants may have used external sources such as the internet, textbooks and other school resources to aid them in answering the questions. This goes against the nature of the study as it was designed to assess the knowledge pharmacy students have on glaucoma without the use of additional resources. The impact that this may have on the study in relation to the overall findings is that on average pharmacy students have a higher competency level than anticipated. The use of multiple choice questions may also have negative implications as it may have encouraged the students to guess the answer to a question they would not have known. This limitation, however, could easily be overcome if the survey allowed for open questions which improve the accuracy of the data and also bring insight as to why they have selected that particular response. The responses given had varying levels of appropriate answers however, it is clear that the participants displayed insufficient knowledge on glaucoma which signifies the need to enhance the content taught in universities regarding glaucoma.

Participants had a particular problem identifying the cause of glaucoma (65.6% incorrect answer), this is similar result to that concluded by Boadi-Kusi et al., (2014) who discovered 65.9% of their participants mistook POAG for PCAG. Their study is particularly relevant to this one as it measured the awareness and knowledge of final year health science students. However, their research had a much larger sample size of 273 participants. This would indicate that regardless of the small sample size in my survey the results would not have been affected.[24]

Irrespective of the difficulties the survey presented, the participants were able to identify risk factors associated with glaucoma with 84.4% of them understanding that age, race and a family history of glaucoma are all connected to an increased likelihood of a glaucoma diagnosis. This is a statistic that disagrees with the study done by Ichhpujani (2012).[25] After conducting a questionnaire for 119 hospital staff members they found that 24% of physicians and nurses were unaware of the relation between the potential diagnosis of glaucoma and having a family history of glaucoma.

Various studies suggest these results follow a similar pattern found by other researchers. A study conducted by Nageeb, (2015) explored the awareness of health professionals including doctors and paramedics regarding their knowledge of glaucoma.[27] They found that those future health care professionals had unsatisfactory levels of awareness which justifies the logic behind the need for improved eye health education.

Practicing health care professionals should be able to recognise symptoms of glaucoma such as headaches and dizziness which can help prevent patients from suffering unnecessary visual impairment due to misdiagnosis. Health care professionals will also need to acknowledge the risk factors associated with glaucoma and advise or refer the appropriate patients for investigative screening to prevent visual impairment.

Health care professionals will also need to adjust their way of engaging with patients by individualising their approach depending on the ability of the patient to understand the condition. A study by Paterick et al., (2017) stated that health literacy can be improved by changing the approach used to communicate with patients and being more "enthusiastic, motivated and responsive" to the patient.[26] By implementing this the physician-patient relationship will grow and allow patients to trust their health care provider which will increase the likelihood that they will adhere to the treatment plan.

It is crucial for health care professionals to recognise that patients have understood the topic of conversation after a consultation. This can be done by implementing what's known as the teach-back method. The teach-back method asks patients to describe "what has been discussed and what instruction have been given to them".[27,28] Another way health literacy can be improved is by increasing the allotted time afforded to each patient. This would encourage them to ask any questions they have freely without feeling rushed.

Although the responsibility of health literacy is largely placed with the health care professional, patients can contribute to the lack of health literacy in the community. According to Paterick et al., (2017) "the partnership between a physician and patient requires dual responsibility". This means that although the health care professional instructs patients on their medication it is the responsibility of the patient to adhere to it.

Health care students would benefit from an amended syllabus which would amplify the importance of understanding glaucoma and its management. Pharmacy students will need to be able to comprehend the mode of action of glaucoma drugs. This will help with advising patients on the importance of adhering to their medication. Students may also benefit from a potential hospital placement in an ophthalmology department as this would ensure students were able to recognise presenting symptoms as well as the severity of glaucoma. Other ways a pharmacist can aid in the management of chronic conditions such as glaucoma is to clearly state the role they can play to the community. This includes answering general questions patients may have, performing medicine use reviews in order to ensure patients are adhering to the medicine regimen and providing advice to patients who are having difficulties with their current treatment therapy.

CONCLUSION

Glaucoma is a chronic condition which has long lasting effects on a patient's lifestyle and day to day activity. Therefore, educating patients about their condition will be beneficial to the management of chronic conditions and the general health outcome of the patient. A common problem found is the difficulty of administering the eye drop correctly. Although, this is seen as a patient non-adherence issue, fault can also be placed with the health care professionals. This can be due to many reasons including ineffective communication skills and a time limit on patient appointments. Encouraging patients to have a better relationship with their carershrelps to improve medicine therapy compliance. Another way in which health care professionals can aid glaucoma patients is to implement a patient centred education system which would ensure patients understand their condition by using a variety of methods.

Improving how health care professionals engage with patients has shown to be a way to increase patient compliance and improve health literacy. However, before this can be done universities will need to alter the way health care students are taught about glaucoma. It is evident from the survey results that pharmacy students in this university lack sufficient competence to demonstrate an understanding of glaucoma with only 34.4% of students correctly identifying the aetiology of POAG.

A lack of research literature available to indicate a concern in the competency level of pharmacy students regarding glaucoma and therefore, more research will need to be done to enable a better understanding on how pharmacy students can contribute to enhancing the management of glaucoma patients.

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