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REVIEW ARTICLE

Scabies: Clinical signs, diagnosis and current treatment

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Abstract

Scabies is a parasitic infestation caused by Sarcoptes scabiei var hominis. It can spread through an indirect contact with contaminated objects as well as a direct skin-to-skin contact. In scabies, widespread itching, which gets worse at night, can be present along with a variety of lesions, including papules, vesicles, nodules and excoriations. In order to make a definitive diagnosis, mites, eggs, or faeces should be visualised by using an additional tool. Only the patient's history and physical examination are used to diagnose clinical scabies or suspected clinical scabies. It is also included in the differential diagnosis with other itchy skin diseases. Although several topical treatments such as benzyl benzoate, sulphur, and lindane are available, permethrin is still the first choice. In many countries, oral ivermectin is used as an efficient, secure, and affordable treatment for scabies despite the fact that it does not have an FDA approval for this purpose. Current studies for the treatment of scabies have been ongoing, and there are also other studies on moxidectin and isoxazoline derivative drugs. However, it is seen that some treatments fail due to various reasons such as, application errors, skipping treatment repetitions, inadequate environmental cleaning, not receiving treatment from the patient's relatives, and not providing the patient with the necessary precautions in written form. It is known that although scabies continues to be a global public health problem, it is possible to obtain good results in the treatment of it if physicians have sufficient knowledge and can manage their patients appropriately. By summarising the information that is currently available, this review aims to provide an update on the clinical characteristics, the diagnosis, the treatment, and the management of scabies.

Keywords: Scabies, Treatment, Diagnosis.

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INTRODUCTION

Scabies is a parasitosis manifested by itchy skin lesions after a direct or indirect transmission of the human mite, Sarcoptes scabiei var hominis (1–3). Scabies, which can be considered as one of the most neglected diseases by the World Health Organization, is common in overcrowded environments, particularly (2). When the adult mite burrows into the host's epidermis, the first clinical symptoms of infection are visible. In these tunnels, the fertilized adult female mite lays the eggs of the larvae that will later develop into mites. The hypersensitivity to these burrows, mites, and their byproducts leads to the clinical manifestations of scabies (1,4). An asymptomatic incubation period of 4 to 6 weeks follows the initial infestation, and the clinical symptoms begin to appear after the incubation period (5,6).

Pathogen and the Contamination

Fertilized females, which are able to move about 2.5 cm per minute on the warm body surface but cannot fly or jump, dig tunnels where they will live the remaining 4 to 6 weeks of their lives. These tunnels, which they dig between 0.5-5 mm per day, are called burrows. Every day, they lay two to three eggs in these burrows (7–10). The larvae that emerge 2 to 3 days after these eggs turn into mature mites that can mate after about 2 weeks. The males of these mature mites quickly perish while the females carry on the cycle. Transmission is usually through skin-to-skin contact. In addition, it has been demonstrated that the parasite can survive outside the skin for days. For intstance, the mite can survive for two to three days in air that is generally 21°C and with a humidity rate of 40 to 80%. Moreover, it has the ability to endure higher humidity rates and lower temperatures for longer (8). It can also spread after 15 to 20 minutes of direct contact with items like towels and clothing (11). For the transmission, there are several risk factors such as poor hygiene, malnutrition, living in crowded conditions, and sexual contact (8,12). In less than 30 minutes after infestation, the mite can penetrate the skin (8). On the other hand, when there are few mites present, there is little risk of transmission from shaking hands, hugging, or medical examinations. People who live in the same family and those who stay in communal settings are at risk under such circumstances (13). Short-term contact or even contact with dandruff can transmit crusted scabies, which includes many mites (5,9).

Clinical Features

It is known that people with scabies complain about intense and all-over itching that gets worse at night. The most recognizable lesions are linear, mite-filled, and tunnel-shaped burrows, especially between the fingers (14). A wide range of lesions, including papules, vesicles, nodules, eczematizations, excoriations, and lichenifications, can also be found in addition to tunnels. The wrists, ankles, spaces between the fingers, axilla, lumbar region, aerola in women, and genital area in men are the most frequently affected areas by lesions (2,5,15). Lesions other than tunnels are caused by toxic and antigenic secretions from the mite. Itching, which is thought to be brought on by sensitivity, typically lasts between four and six weeks. Unlike adults, among infants and children, , it is crucial to have facial and palmoplantar involvement in addition to papular and nodular lesions (5,16). There is less itching with Norwegian scabies, which is typically found in immunosuppressive or mentally or physically disabled people. Along with nail hyperkeratosis, psoriasiform and hyperkeratotic, lesions are also common, particularly in the head and the neck. These people are extremely contagious and have an average of two million mites on them (5,15). Beside scabies, other possible local complications include impetigo, abscess, cellulitis, and very rarely necrotizing soft tissue infections. It can be observed in systemic complications that are more severe, such as acute poststreptococcal glomerulonephritis and sepsis brought on by secondary bacterial infections (5).

Diagnosis

Scabies is one of the dermatological diagnoses that can be both simply and challengingly recognized. Patients who have typical-distribution pruritic lesions and have recently come into contact with someone who has pruritus should be examined (17). The way to confirm the diagnosis is to see mites, eggs, or fecal residues. For this, a skin scraping from a papule or a tunnel can be examined under a microscope. An average of five suspicious lesions are scraped with a scalpel, onto which mineral oil is dripped. The scraping material is placed on the slide and covered with a lamella. Observing the mite at any stage under a microscope is accepted as diagnostic (13,14). Except this rocedure, which is rather difficult, dermatologists have the opportunity to examine a quick, non-invasive substitute by using dermatoscopy. The sensitivity and specificity of dermatoscopy are 98.3% and 88.5%, respectively, which enable the detection of the "kite sign" and the "wake-up sign" (8,18). The head, thorax, and forelimbs of the mite

combine to form the dark triangle that is the kite sign. The wake-up call is the intracorneal air spaces in the tunnel. The term "gray-edged line mark" refers to the mite faecal matter that occasionally causes the edges of the tunnel to appear dark (19). However, it is not possible to determine whether a mite is alive or not through dermatoscopy, which enables a quick and simple diagnosis. In order to find out whether a mite is alive or not, videodermatoscopy might be used (20). For the purpose of standardising the diagnosis of scabies, some criteria have been developed. (Table 1) Mites, eggs, or faeces must be visible under a microscope, dermatoscope, or any other imaging device for a definitive diagnosis of scabies. Clinical scabies or suspected scabies are diagnosed only with the patient's history and physical examination (21).

A. Confirmed scabies (at least one of the following)
A1. Visible mites, eggs, or faeces from skin samples under the light microscope
A2. Seeing mites, eggs, or faeces using a high-power imaging device
A3. Seeing the mite using dermoscopy
B. Clinical scabies (at least one of the following)
B1. Scabies tunnels
B2. Typical lesions on the male genitalia
B3. Typical distribution and lesions, as well as two history features
C. Suspected Scabies (One of the following)
C1. Typical distribution, typical lesions, and 1 history feature
C2. Atypical distribution, atypical lesions, and 2 history features
History features
H1. Itch
H2. Positive contact history
The diagnosis is made at either the A, B, or C levels. In order to make clinical and suspected scabies diagnoses, the times when differential diagnoses are less likely than scabies should be considered.

Table 1 Consensus criteria for the diagnosis of scabies, issued by the International Alliance for the Control of Scabies (21) evidence-based definitions and diagnostic methods.

Differential diagnosis

In the differential diagnosis of scabies, other itchy skin diseases such as atopic dermatitis, contact dermatitis, folliculitis, impetigo, papular urticaria, dermatitis herpetiformis, prurigo nodularis and insect bites should be taken into consideration (22).

Treatment

There are two obvious primary goals of the treatment of scabies; to destroy the parasite in the patient and to avoid environmental contamination. Regardless of whether they have complaints or symptoms, it should be the goal to treat the patient as well as anyone else with whom they have had frequent contact within the past month. Patients and their contacts with whom they receive treatment should remain isolated until the first cure of the treatment is completed (23). Beside the drug therapy, the environment where patients and contacts reside has to be cleaned. It has been demonstrated that adult mites and eggs can be destroyed by boiling them for 10 minutes at a temperature of at least 50°C or by isolating them in plastic bags for about a week (24). It is important to provide patients with the proper instructions, so they can carry out their treatments completely. Informational brochures can make it easier for the patients to follow the instructions (14).

Moeorver, topical medications should be applied to all parts of the body, such as between the fingers, inside the nails, the navel, and the genital area, and should stay on the skin for 8 to 12 hours. During the procedure of topical medications, the drug should be applied to cool and dry skin and followed by clean clothes.

In order to consider the course of action as successful, one week after the last cure of the treatment, the number of active lesions and nighttime itching should have decreased. However, it can not be ignored that itchiness might persist for 2 to 4 weeks following a successful treatment. For this kind of persistent itching, moisturisers or topical corticosteroids can be used (6).

Alternatives for the treatment

Scabies has a variety of treatment alternatives that can be selected based on the patient, the severity of the disease, the accessibility and the cost of the treatment, and the doctor's experience and personal preferences. Whatever the alternative is, the treatment should be given not only to patients with a definite diagnosis but also in all suspicious cases and at every stage of the diagnosis (25).

Topical or systemic drugs are classified as acaricidal and ovicidal. Permethrin, when used as the first line of the treatment, has been reported in several studies to have a higher cure rate than other options like sulphur, benzyl benzoate, malation, crotamiton, and lindane (6). It was believed that topical ivermectin was the most effective treatment for itching relief and that oral ivermectin combined with topical permethrin was the most effective treatment for curing the condition (2).

For first-line therapy, many recommendations still call for the safe, easily accessible, and ovacidal 5% permethrin (26,27). When permethrin is unavailable, 10–25% benzyl benzoate and 2–10% sulphur can be used as substitutes (5). Despite not having FDA approval, oral ivermectin is frequently used to treat scabies because it is safe and well tolerated (28). Due to the fact that ivermectin is not ovocidal, a second treatment should be administered between the second and the third days of egg emergence and the seventh and fifteenth days, when fertilised female mites begin to lay new eggs.

Sulfur and permethrin are safe to be used in children older than two months and pregnant women (29,30). In the use of permethrin for pregnant women, nursing mothers and children under the age of two, it is recommended to use it for two cycles at one week intervals and for a maximum of two hours (31). Although the use of Ivermectin remains contraindicated in pregnant women and children weighing less than 15 kg, there has been a recent ongoing research on children weighing 5 to 15 kg. (1,32) Some trustworthy institutions use ivermectin as a treatment when necessary, despite the fact that its contraindication in pregnancy is based on animal studies at doses significantly higher than those used in humans. It is regarded as secure while nursing (33).

DRUGS

Drugs applied topically

Permethrin, benzyl benzoate, sulphur, crotamiton, malathion, and lindane are the topical medications that are most frequently used to treat scabies, respectively (5).

Permethrin

A strong insecticide and synthetic pyrethoid, permethrin is ranked first among treatment options in many countries. Permethrin 5%, which is FDA-approved for the use on adults and children older than two months, has a high level of efficacy and tolerability (5,34). Permethrin has a strong acaricidal effect and low mammalian toxicity because it is poorly absorbed through the skin, rapidly metabolised by skin esterases, and excreted in the urine. For two weeks, the cream is applied once per week to the entire body, allowing for eight hours of skin contact (14). Permethrin, which has almost no allergic side effects and can be used safely in cosmetic purposes, can be applied to the whole body, including the head, in babies. The only drawback for the drug is that it is more expensive than other topical medications for scabies (34,35).

Sulphur

The earliest treatment for scabies is sulphur, which is still in use. Beside having an unpleasant smell, it can stain clothing, and it can also lead to irritant dermatitis. In general, 6% ointment form is preferred, though mixtures between 2–10% can alos be used. Following a bath, the entire body is covered in ointment, which is then used for three nights straight. Sulfur is most easily applied in ointment form. Additionally, due to its low cost, sulphur might be the first choice in severe epidemic situations (7,14). It is a risk-free option to treat children, infants, and pregnant women (1,16).

Benzyl benzoate

Benzoic acid, an ester of benzoic acid and benzyl alcohol obtained from the balsam of Peru and tolu, has a neurotoxic effect against mites. Although it is used as a 25% emulsion, in children 12.5% emulsions might be preferred. Within 24 hours of contact time, it has to be applied three times without bathing. The medication, which is very effective if used properly, can irritate areas with thin skin, such as the face and the scrotum. Due to its side effects, the medication, which should not be used by those who are pregnant, nursing, or who have children under the age of two, has begun to lose importance. However, it can still be preferred in cases resistant to other treatments and in developing countries due to its cost advantage (6,14,34).

Crotamiton

Crotamiton (crotonyl-N-ethyl-o-toluidine) 10% is available as a cream or lotion, though some researchers do not advise the use of crotamiton due to the conflicting efficacy and toxicity data. To achieve the best results, it is recommended to be applied for five days, twice daily after taking a bath (5,7,36).

Malathion

It is an organophosphate insecticide that permanently inhibits the acetylcholinesterase enzyme. For the treatment

of scabies, it is no longer advised due to its harmful side effects (5,14).

Lindane

It is also known as lindane gamma benzene hexachloride, which is an insecticide. It affects the central nervous system (CNS) of the mite and results in excitability, convulsions, and death. It is absorbed through the mucous membranes, is transported throughout the body, reaches high concentrations in lipid-rich tissues, is metabolised, and is then eliminated through the urine and faeces (34,37). Applying 1% lindane cream or lotion for 6 hours, then repeating it after a week is sufficient (14). While the advantages are ease of administration and non-irritation, the disadvantages are the risk of causing CNS toxicity, causing convulsions and death, though rarely (2,5). Accidental ingestion results in lindane toxicity, which can cause convulsions, breathing problems, nausea, vomiting, headaches, and even death. It can affect the course of some hematological diseases such as aplastic anemia and thrombocytopenia (38,39). It is not popular in many countries due to the possibility of neurotoxicity, but for developing countries, it might be a less expensive and more practical option than permethrin (5,14).

Oral antiscabietic agent

Ivermectin

Ivermectin is an avermectin dihydro derivative that is similar to macrolides, but does not have antimicrobial properties. Its main mechanism of action is the stimulation of gamma amino bituric acid from presynaptic nerve endings and increasing its binding to postsynaptic nerve endings, thereby reducing impulse transmission in nerve-muscle synapses (14,40). Ivermectin, which is rapidly absorbed and excreted through the faeces, is relatively safe in terms of side effects and should not be used in those with ivermectin allergy, CNS disease, women who are pregnant and nursing women and children under 15 kg (2,7,9). Ivermectin, which is highly efficient, safe to use and economical, is used to treat scabies in many countries but has not received a FDA approval yet (47). A second dose should be administered 1-2 weeks after the initial 0.2 mg/kg dose because it is not ovacid (5,6).

The management of special forms of scabies

While 2–10% sulphur can be used in infants, 5% permethrin is only suitable for babies older than two months (34). Ivermectin and lindane should not be used for infants. Infants and children older than two months can use 5% permethrin and 12.5% diluted benzyl benzoate emulsion (7). Ivermectin and lindane are not advised during pregnancy or lactation, though 6% sulphur might be preferred in those situations (34). A chronic form of scabies known as nodular scabies manifests as nodular lesions in the genital area, axillae, and male genitalia. Intralesional steroid should be used in the treatment along with the scabies treatment (41). Norwegian scabies requires prolonged and repeated topical and systemic treatments which last, on average, three weeks. In this way, it will be possible for the medications to work beneath thick crusts while reducing the high mite load (6,42). Oral ivermectin is given in three, five, or seven standard doses. In addition to systemic therapy, it is advised to use a topical keratolytic agent containing 5–10% salicylic acid or urea, and permethrin or benzyl benzoate, two to three times per week for one to two weeks (8,43). It should not be forgotten that the nails should be cut short and brushed with an anti-scabicide agent (15,16). Also, in the highly contagious Norwegian scabies, hospitalisation and treatment can be planned to ensure isolation (5).

Current treatment options

New treatment researches emerge as a result of the difficulties in the applicability of multiple treatment regimens. A single dose of moxidectin, which has a similar effect to ivermectin but a longer half-life, offers a significant amount of efficacy (44). Moxidectin has been given FDA approval for the diagnosis of onchocerciasis in people over the age of 12, but its effectiveness in treating scabies has not been sufficiently established yet (44,46). In addition to moxidectin, studies have been conducted on promising oral drugs that are isoxazoline derivatives, about which the FDA has issued a neurotoxicity warning (47,49). Continued research is being done to create a scabies vaccine (49).

In addition to its antimicrobial property, tea tree oil has a scabicidal activity (50). Beside tea tree oil, there are some other substances that exhibit a scabicidal activity including Tinospora cordifolia and Ligularia virgaurea (51,52).

The reasons for the failure of the treatment

There have been several scientifically proven reasons for failures of the treatment such as application mistakes, missed treatments, incompatibility between the patient and his environment, sloppy cleaning of the patient's living space, the failure of the patient's relatives in receiving treatment, and failure to provide the patient with the necessary precautions in written form (53). The

topical drug must be applied completely to all body areas below the neck. In order to eliminate the failure of the treatment, the following malpractice scenarios should be avoided: failing to trim the nails before application; failing to ensure that the drugs are in contact with the skin for an adequate amount of time; failing to administer keratolytic treatment for crusted scabies; and failing to administer to the infant's head area. Otherwise, the disease might reoccur (13,16,26). To maintain the effectiveness of the prescribed medications, they should be administered undiluted. Contacts must also be treated in order to prevent reinfection, which is another treatment failure (16). Drug resistance is a significant factor in treatment failure, but it must be eliminated first, along with all other resistance-causing factors. Various combination therapies can be tried to prevent the resistance. Resistance to permethrin, ivermectin, and benzyl benzoate has been reported in the literature (54,55). Although it is thought to be resistant to permethrin, the genetic mutation that blocks the pharmacodynamic effect of permethrin has been shown only in dog mites. It is possible that repeated permethrin applications can induce elimination enzymes that will reduce the effectiveness of the drug on mites, which in this case might explain the permethrin resistance (56,57). In addition, it has been determined that permethrin cannot maintain its effect for a long enough time in children and people with impaired skin barrier (8). It has been demonstrated that mites can extend their survival after exposure to permethrin by increasing the transcription of glutathione-s-transferase (58). Genetic resistance to ivermectin is thought to be influenced by a polymorphism in the p-glycoprotein gene (59). Following the treatment, dying mites release antigens that continue the inflammatory response. In this situation, it causes symptoms like itching to last for a while and could be mistakenly interpreted as a failure of the treatment (60). Additionally, a psychogenic itch and an isolated delusion might occur in some patients (61).

Conclusion

Scabies is a condition that does not pose a life-threatening risk, but has a profound impact on a person's quality of life. Clinical examinations or assisting tools like a dermatoscope and a microscope are used to diagnose the disease. Permethrin is the first choice for topical treatment and is available in options such as benzyl benzoate and sulfur. Ivermectin is administered in two courses separated by 1-2 weeks during the systemic therapy. The most effective treatment in terms of cure is the use of oral ivermectin together with topical permethrin. Topical treatment and keratolytic agents should be given in addition to the systemic ivermectin treatment in highly contagious Norwegian scabies. Sulfur can be used in pregnants, lactating and infants younger than two months. Topical permethrin can be preferred in infants and children older than 2 months. It is believed to be resistant to topical permethrin. However, before it is considered that there is a resistance to the drug, it should be questioned whether the patient has been fully and completely treated, whether the contacts have received treatment, and whether the environment has been cleaned. For the treatment of the patient and the prevention of transmission, attention must be paid to environmental cleanliness along with the complete treatment of the patient and her or his contacts. It is crucial to keep in mind that it is possible to obtain successful results in scabies, which continues to be a problem in our country and a global problem all over the world, especially in developing countries. The successful results can be reached if physicians have sufficient knowledge about the treatment and if they are able to manage their patients appropriately.

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ORIGINAL ARTICLE

Comparison of ulnar, median, and sural sensory nerve conduction studies between demyelinating and axonal forms of Guillain-Barré Syndrome

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Abstract

Background: Axonal GBS and acute inflammatory demyelinating polyradiculoneuropathy (AIDP) are two important subgroups of Guillain-Barré syndrome (GBS). It was aimed to compare sensory nerve conduction studies between AIDP and Axonal GBS patients.

Methods: Patients with clinical and electrodiagnostic features compatible with GBS were included in this retrospective study. The patients were divided into two groups using neurophysiological criteria such as Axonal GBS and AIDP. Medical Research Council (MRC) scores of the patients' muscles, median/ulnar/posterior tibial/peroneal/sural nerve conduction study findings were included in the analyses. Sural sparing pattern was considered as the abnormality of median/ulnar sensory nerve action potential (SNAP) and normal sural nerve SNAP (SS-M/SS-U).

Results: Twelve AIDP and 10 Axonal GBS patients were included in the study. MRC scores were not different between the two groups (p=0.895). SNAPs of the right median and ulnar nerves were smaller in AIDP patients than in Axonal GBS patients (p<0.001, p=0.004). SNAPs of the right and left sural nerves were not different between the two groups (p=0.140, p=0.099). SS-M / SS-U was observed in 1(10%)/1(10%) and 6(50%)/4(33%) of axonal GBS and AIDP patients, respectively (p=0.074 for SS-M, p=0.323 for SS-U). There was a positive correlation between right median / ulnar nerve SNAP amplitudes and sural nerve SNAP amplitudes (p=0.003 r=0.623 / p<0.001 r=0.850). A similar positive correlation was also found in AIDP and Axonal GBS subgroups.

Conclusions: This study indicated that sensory nerve conduction studies cannot be used to differentiate AIDP and Axonal GBS. There may be a relationship between SNAPs of median/ulnar nerves and SNAPs of sural nerves.

Keywords: Acute inflammatory demyelinating polyradiculoneuropathy, Guillain-Barré syndrome, Sensory nerve conduction study, Sural sparing.

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INTRODUCTION

Guillain-Barré syndrome (GBS) is a disease that progresses with weakness and sensory abnormalities that can improve or cause disability (1,2). The diagnosis of GBS can be made by clinical features, laboratory examinations, including cerebrospinal fluid examinations, and neurophysiological tests (1-5). Nerve conduction studies, which are important neurophysiological tests, not only provide the diagnosis but also allow the determination of the type of injury or the prediction of the prognosis (1-7). GBS can be divided into axonal and demyelinating forms using neurophysiological tests or pathology, allowing for a better understanding of the disease's pathophysiology. (1-3,5,8,9). Slowing of nerve conduction velocity, reduction in compound muscle action potential and compound nerve action potential amplitudes, conduction block, abnormal temporal dispersion, and F-wave abnormalities are some of the nerve conduction study findings in GBS (3-5,10). Both sensory and motor nerves may be affected, but the sural nerve may be spared in the early period, and this is known as the sural sparing pattern (10-13). The sural sparing pattern is also one of the important nerve conduction study findings of GBS (10-13). Therefore, sensory nerve conduction studies, including the sural sparing pattern, may play an important role in the differentiation of demyelinating GBS and axonal GBS. Moreover, it may provide important clues regarding the pathophysiology of axonal and demyelinating forms of GBS. In this study, it was aimed to compare the sensory nerve conduction study findings in axonal and demyelinating GBS forms.

MATERIALS AND METHODS

Subjects

GBS patients older than 18 years of age who applied to University of Health Sciences Adana City Training and Research Hospital (ACTRH) Clinical Neurophysiology Laboratory between September 2018 and March 2022 were included in this retrospective study. Patients were divided into two groups as acute inflammatory demyelinating polyradiculoneuropathy (AIDP) and Axonal GBS patients according to the neurophysiological criteria suggested by Rajabally et al (3). These criteria are shown in Table 1. In addition, Axonal GBS patients with sensory nerve conduction study abnormalities in at least two sensory nerves were defined as having acute motor sensory axonal neuropathy (AMSAN) and the others as having acute motor axonal neuropathy (AMAN) (1-4). Patients with the following characteristics were included in the study (1-5): 1) Clinical features compatible with GBS (sensory abnormalities beginning and spreading in the extremities and/or muscle weakness) 2) Elevated protein levels without cell increase in cerebrospinal fluid 3) Patients diagnosed with Axonal GBS or AIDP according to the neurophysiological criteria suggested by Rajabally et al (3). Patients with the following characteristics were excluded from the study: 1) A disease that can cause polyneuropathy, such as diabetes mellitus 2) Neurodegenerative diseases 3) Patients who do not meet the criteria for AIDP or Axonal GBS according to the neurophysiological criteria suggested by Rajabally et al (3). Neurological examination findings, medical research council (MRC) scores, and nerve conduction study findings of the patients were recorded (14). This study was approved by the clinical research Ethics Committee of the Adana City Training and Research Hospital (Date: 21.04.2022, Number: 1902).

Table 1. Neurophysiological criteria for Axonal GBS and AIDP

AIDP	Axonal GBS
Neurophysiological findings consistent with one of the following: 1) One of the following features is present in at least two nerves: *Motor NCV slower than the reference value by more than 30% *Distal motor latency delayed more than 50% compared to the reference value *F-wave latency delayed more than 20% compared to the reference value or more than 50% delay if the distal CMAP amplitude has decreased by more than 50% of the reference limit 2) Absence of F-wave in two nerves + additional parameter in another nerve 3) Proximal CMAP/distal CMAP amplitude ratio less than 0.7 in two nerves (other than tibial nerve) + additional parameter in another nerve	**If the CMAP amplitude is less than 10% of the reference value, there may be a nerve that meets the AIDP criteria. Apart from this, motor nerves should not have demyelinating features. In addition, it must have at least one of the following characteristics:** 1) Distal CMAP amplitude reduction of 80% relative to baseline in at least two nerves 2) Absence of F-waves in the two most nerves (Distal CMAP should be greater than 20% of the reference value) 3) Absence of F-wave in one nerve (Distal CMAP amplitude should be greater than 20% of reference value) or Proximal CMAP/distal CMAP amplitude ratio less than 0.7 in one nerve (other than tibial nerve) + distal CMAP amplitude in another nerve to reference value shrinkage by more than 80% 4) Proximal CMAP/distal CMAP amplitude ratio less than 0.7 in two nerves (other than tibial nerve) Inexcitable form: Absence of distal CMAP in all nerves

AIDP: acute inflammatory demyelinating polyradiculoneuropathy; CMAP: compound muscle action potential; GBS: Guillain-Barré syndrome; NCV: nerve conduction velocity. *: It is based on the criteria suggested by Rajabally et al (3).

Twenty-two GBS patients were included in the study. Prior to GBS complaints, eight of the patients had upper/lower respiratory tract infections, six had gastroenteritis, one had a history of vaccinations (tetanus and rabies vaccinations), and two had a history of surgery. In four of the eight patients with respiratory tract infections, the cause of infection was severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). No cells were found in the cerebrospinal fluid of the patients. Polymerase chain reaction (PCR) testing was performed for SARS-CoV-2 in patients who had coronavirus disease 2019 (COVID-19) prior to GBS. In these patients, fever, dyspnea, high white blood cell count, high c-reactive protein levels, which could indicate acute infection, were not present. Five patients had no event prior to GBS.

Nerve conduction studies

Nerve conduction studies were performed in Cadwell Sierra Summit EMG unit (Cadwell Laboratories, Kennewick, Washington, USA). Nerve conduction studies were performed on at least three extremities. Nerve conduction studies could not be performed on at least three extremities in each patient due to reasons such as edema in the extremities, vascular access, or the patient's inability to tolerate the procedure. Nerve conduction studies were performed if the temperature of the extremities was above 32^0C. Cold extremities were warmed. Previously suggested methods were used for nerve conduction studies (15-17). Surface electrodes were used for both stimulation and recording. Recommended reference values were used as reference values for nerve conduction studies (15-17). Low-high filters for sensory and motor nerve conduction studies were 20Hz-2kHz and 20Hz-10kHz, respectively. In sensory nerve conduction studies, the sensitivity and sweep rate was 10 μV/division and 1 ms/division, respectively. For motor nerve conduction studies, sensitivity and sweep rate were set as 2 mV/division and 5 ms/division, respectively. Both compound muscle action potential (CMAP) and sensory nerve action potential (SNAP) amplitudes were calculated by measuring peak to peak. Sensory nerve conduction studies were performed antidromically. Sensory nerve conduction velocity was calculated using peak latency. CMAPs of median, ulnar, posterior tibial and peroneal nerves were obtained from abductor pollicis brevis, abductor digiti quinti, abductor hallucis, and extensor digitorum brevis muscles, respectively. In distal motor nerve conduction studies, the distance between the recording electrode and the stimulation point was 5 cm for the median and ulnar nerves, 10 cm for the posterior tibial nerve, and 8 cm for the peroneal nerve. Among the F-waves obtained after 10 stimulations, the minimum F-wave latency was included in the analyses. Normal sural nerve and abnormal median nerve SNAP were defined as sural sparing-median nerve abnormality (SS-M), while present sural nerve and abnormal ulnar nerve SNAP were defined as sural sparing-ulnar nerve abnormality (SS-U).

Statistical analysis

Statistical Package for the Social Sciences (SPSS IBM Corp; Armonk, NY, USA) 22.0 was used for statistical analysis. Numerical values were expressed as mean standard deviation (SD), median, and categorical variables as numbers and percentages. While the Mann-Whitney U test was used for the comparison between the groups given numerically, Pearson's Chi-squared test and Fisher's exact test were performed to compare the categorical variables between the groups. Spearman correlation test was applied for correlation analysis. A p value of <0.05 was considered statistically significant.

RESULTS

Twenty-two patients were included in the study. The mean age of the patients was 56.1±19.7 (min-max 18-88) years. Upper extremity, lower extremity and total MRC scores were 24.2±7.4 (min-max 4-30), 18.5±6.5 (min-max 4-26), 42.6±12.7 (12-56), respectively. The time interval between the onset of the complaints and the time of the nerve conduction study was 15.7±10.7 (min-max 5-45) days. There were 12 AIDP and 10 Axonal GBS patients. Clinical features of AIDP and Axonal patients are shown in Table 2. Three of the Axonal GBS patients met the diagnostic criteria of AMSAN and these patients had sensory abnormalities on neurological examination. Two AMAN patients had sensory complaints without any sensory abnormalities in the neurological examination. Two of the patients with a history of COVID-19 had AIDP and two had Axonal GBS.

Table 2. Clinical features among AIDP and Axonal GBS patients

Clinical feature	Axonal GBS (n=10)	AIDP (n=12)	p value
Age (years) mean ± SD (median)	56.3±24.4 (62.5)	55.9±15.9 (55.5)	0.668
Gender (male)	6	7	1.000
Duration of the symptoms (days)	14.7±9.3 (18.0)	16.6±12.0 (12.5)	0.842
MRC score of the upper extremities	24.0±8.3 (26.0)	24.3±6.9 (27.0)	0.866
MRC score of the lower extremities	18.4±5.2 (18.0)	18.5±7.7 (22.0)	0.688
Total MRC score	42.4±12.4	42.8±13.4	0.895

AIDP: acute inflammatory demyelinating polyradiculoneuropathy; GBS: Guillain-Barré syndrome; MRC: medical research council.

Motor and sensory nerve conduction studies were performed on 117 and 81 nerves, respectively. Motor nerve conduction study findings of 29 median nerves (21 right side, eight left side), 29 ulnar nerves (21 right side, eight left side), 36 posterior tibial nerves (22 right side, 14 left side) and 23 peroneal nerves (18 right side, 5 left side) were included in the analyses. The grouping of motor nerve conduction study findings according to axonal and demyelinating features is shown in Table 3. Sensory nerve conduction studies were performed on 24 median nerves (21 right side, three left side), 25 ulnar nerves (21 right side, four left side) and 32 sural nerves. Sensory nerve conduction study findings among AIDP and Axonal GBS patients are shown in Table 4. Right and sural nerve SNAP amplitude mean (min-max) values in all GBS patients were 12.0±11.9 (0-39.1) μV and 8.9±9.3 (0-23.8) μV, respectively. The sural nerve SNAP amplitude was either absent or above 5 μV. Figure 1 shows the comparison of number of patients with median, ulnar, sural SNAP amplitude abnormalities between AIDP and Axonal GBS patients. The number of patients with at least one abnormality in the ulnar, median, and sural nerve SNAPs was 12 (54.5%), 14 (63.6%), and 7 (31.8%), respectively. The number of patients with at least one ulnar, median, and sural nerve SNAP abnormality in the axonal GBS group was 3 (30%), 3 (30%), and 2 (20%), respectively, and the number of patients with at least one ulnar, median, and sural nerve abnormality in the AIDP group was 9 (75%), 11 (92%), and 5 (42%), respectively (p=0.084 for ulnar nerve SNAP, p=0.006 for median nerve SNAP, p=0.381 for sural nerve SNAP). SS-M and SS-U were found in 7 (31.8%) and 5 (22.7%) patients, respectively. SS-M was present in one (10%) Axonal GBS patient and six (50%) AIDP patients (p=0.074). SS-U was found in one (10%) Axonal GBS patient and four AIDP (33%) patients (p=0.323). The correlation between right sural nerve SNAP/NCV and clinical findings/median-ulnar nerve conduction study findings is shown in Table 5.

Table 3. Motor nerve conduction study findings according to axonal and demyelinating characteristics

	Number of nerves			
Motor nerve	Axonal	Demyelinating	Mild slowing or Mild reduction of CMAP amplitude	Normal
Right / Left Median nerve	6 / 1	9 / 3	4 / 3	2 / 1
Right / Left Ulnar nerve	11 / 3	7 / 3	2 / 0	1 / 2
Right / Left Posterior nerve	13 / 8	9 / 6	0 / 0	0 / 0
Right / Left Peroneal nerve	10 / 3	7 / 2	0 / 0	1 / 0

CMAP: compound action potential.

Table 4. Comparison of sensory nerve conduction studies between Axonal GBS and AIDP patients

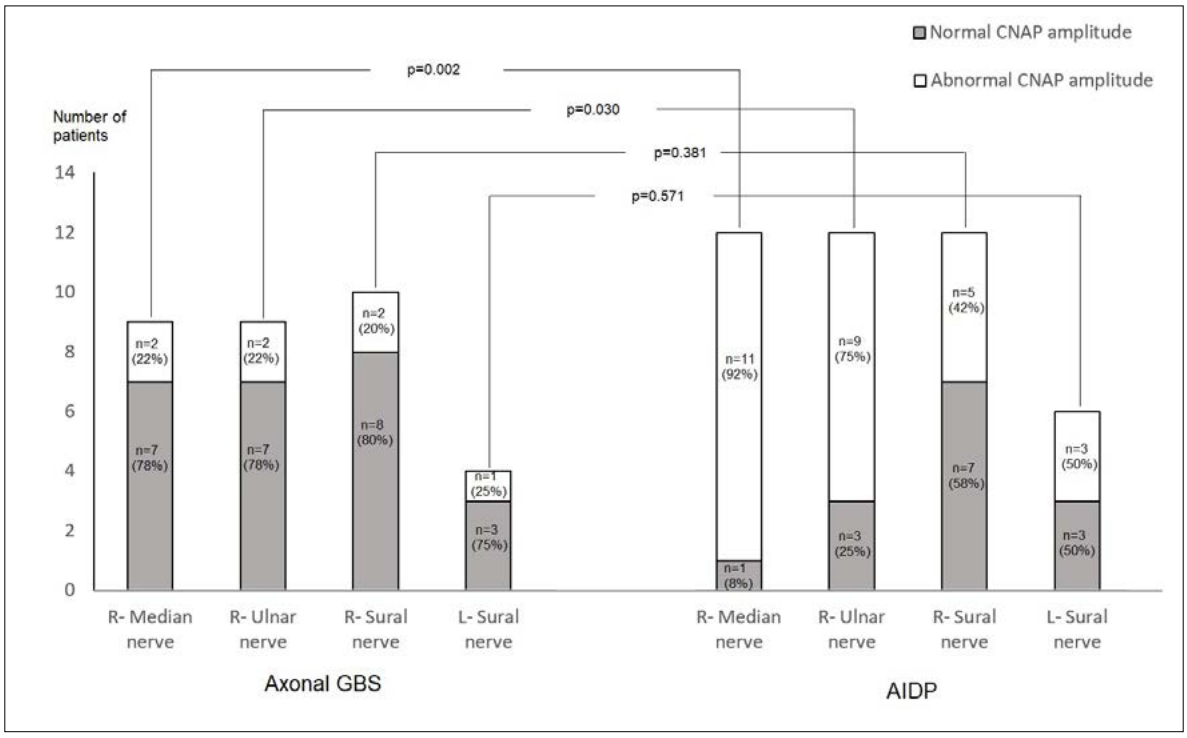
Sensory nerve conduction study	Axonal GBS Mean ± SD (median) (number)	AIDP Mean ± SD (median) (number)	p value
Median nerve			
R- SNAP amplitude (μV)	28.0±15.4 (36.8) (n=9)	2.6±5.8 (0) (n=12)	**<0.001**
R- NCV (m/s)	42.9±6.3 (45) (n=9)	36.7±12.7 (43) (n=3)	0.350
L- SNAP amplitude (μV)	7.7±6.7 (10.8) (n=3)	*	
L- NCV (m/s)	34.0±5.7 (34.0) (n=2)	*	
Ulnar nerve			
R- SNAP amplitude (μV)	27.6±17.7 (31.6) (n=9)	7.2±10.5 (0) (n=12)	**0.004**
R- NCV (m/s)	40.4±6.7 (39.0) (n=9)	37.2±8.3 (38.0) (n=5)	0.502
L- SNAP amplitude (μV)	9.9±6.9 (12.2) (n=4)	**	
L- NCV (m/s)	35.0±4.4 (37.0) (n=3)	**	
Sural nerve			
R- SNAP amplitude (μV)	16.6±13.2 (18.4) (n=10)	8.2±9.8 (6.9) (n=12)	0.140
R- NCV (m/s)	39.3±2.6 (39.5) (n=8)	40.1±4.6 (42.0) (n=7)	0.484
L- SNAP amplitude (μV)	14.9±10.3 (17.9) (n=4)	4.9±6.7 (3.1) (n=6)	0.099
L- NCV (m/s)	40.0±2.0 (40.0) (n=3)	37.0±1.7 (38.0) (n=3)	0.105

AIDP: acute inflammatory demyelinating polyradiculoneuropathy; SNAP: sensory nerve action potential; GBS: Guillain-Barré syndrome; NCV: nerve conduction potential. *: Nerve conduction studies were performed in five AIDP patients and SNAPs could not be achieved from these patients. **: Nerve conduction studies were performed in three AIDP patients and SNAPs could not be achieved from these patients.

Table 5. Correlation between clinical findings and sensory nerve conduction features, and right sural nerve NCV/SNAP

Clinical / Nerve conduction study feature	Right Sural SNAP amplitude (μV)	Right sural sensory NCV (m/s)
GBS patients		
MRC score of upper extremities	p=0.170, r=-0.303 (n=22)	p=0.093, r=0.449 (n=15)
MRC score of lower extremities	p=0.813, r=-0.054 (n=22)	p=0.258, r=0.312 (n=15)
Total MRC score	p=0.568, r=-0.129 (n=22)	p=0.090, r=0.453 (n=15)
Right median SNAP amplitude	p=**0.003**, r=0.613 (n=21)	p=0.677, r=-0.117 (n=15)
Right median sensory NCV	p=0.118, r=0.475 (n=12)	p=0.862, r=0.063 (n=10)
Right ulnar SNAP amplitude	p< **0.001**, r=0.850 (n=21)	p=0.954, r=-0.016 (n=15)
Right ulnar sensory NCV	p=0.065, r=0.506 (n=14)	p=**0.010**, r=0.682 (n=13)
AIDP patients		
MRC score of upper extremities	p=0.436, r=-0.227 (n=12)	p=0.376, r=0.364 (n=8)
MRC score of lower extremities	p=0.825, r=-0.065 (n=12)	p=0.583, r=0.230 (n=8)
Total MRC score	p=0.809, r=-0.071 (n=12)	p=0.513, r=-0.273 (n=8)
Right median SNAP amplitude	p=0.573, r=0.173 (n=13)	p=0.601, r=-0.220 (n=8)
Right median sensory NCV	p=0.684, r=0.316 (n=4)	p=1.000, r=0.000 (n=3)
Right ulnar SNAP amplitude	p=**0.005**, r=0.731 (n=13)	p=0.955, r=-0.024 (n=8)
Right ulnar sensory NCV	p=0.623, r=0.257 (n=6)	p=**0.024**, r=0.870 (n=8)
Axonal GBS patients		
MRC score of upper extremities	p=0.250, r=-0.402 (n=10)	p=0.129, r=0.584 (n=10)
MRC score of lower extremities	p=0.580, r=-0.200 (n=10)	p=0.444, r=0.317 (n=10)
Total MRC score	p=0.496, r=-0.245 (n=10)	p=0.130, r=0.582 (n=10)
Right median SNAP amplitude	p=**0.037**, r=0.697 (n=9)	p=0.342, r=0.388 (n=8)
Right median sensory NCV	p=0.262, r=0.419 (n=9)	p=0.861, r=0.075 (n=8)
Right ulnar SNAP amplitude	P=**0.004**, r=0.849 (n=9)	p=0.393, r=-0.352 (n=8)
Right ulnar sensory NCV	p=0.079, r=0.613 (n=9)	p=**0.384**, r=0.358 (n=8)

AIDP: acute inflammatory demyelinating polyradiculoneuropathy; SNAP: sensory nerve action potential; GBS: Guillain-Barré syndrome; MRC: medical research council; NCV: nerve conduction velocity.



AIDP: acute inflammatory demyelinating polyradiculoneuropathy; SNAP: sensory nerve action potential; GBS: Guillain-Barré syndrome.

Figure 1. Comparison of number of patients with median, ulnar, sural SNAP amplitude abnormalities between AIDP and Axonal GBS patients

DISCUSSION

GBS progresses with flaccid paralysis, which can lead to disability and even threaten life (1,2). Therefore, it is important to diagnose this important disease and treat it appropriately. Nerve conduction studies play a key role in the diagnosis of GBS. Nerve conduction studies are important not only for diagnosis but also for distinguishing between axonal and demyelinating forms of GBS (3-5). Although the separation of GBS into axonal and demyelinating forms may not be important for treatment, it will undoubtedly contribute to the understanding of the pathophysiology of GBS (3-5,8,9,18). In this current study, we divided GBS patients into axonal GBS and AIDP according to the proposed criteria of motor nerve conduction study. Therefore, we were able to compare the sensory nerve conduction study findings between these two forms. This was the reason why we did not use the proposed criteria, which included sensory nerve conduction studies.

Abnormalities of median and ulnar nerve SNAPs were more prominent in AIDP, which is the demyelinating form, and we concluded that the sural nerve conduction study findings were not different from each other in both forms. In addition, previous study showed that the absent median nerve and the present sural nerve pattern could not be used to differentiate AIDP from axonal GBS (13). The positive correlation between sural nerve SNAP amplitude / NCV and median / ulnar nerve SNAP amplitude / NCV in patients with AIDP and Axonal GBS may mean that other SNAPs are affected when sural SNAP is affected in some Axonal GBS, like AIDP. These findings suggest that there may be sensory abnormalities in both forms of GBS. On the contrary, there was a study suggesting that sural sparing would be useful in distinguishing between axonal and demyelinating forms of GBS (11). These findings indicate that more studies are needed on this subject. However, it should be noted that the time interval between the nerve conduction study and the onset of the complaints was different in our study,

and that nerve conduction study was not performed in every patient in the first days, and this is a weakness of our study. Similar to the median nerve, we found that the ulnar nerve SNAP was more significantly affected in AIDP than in axonal GBS. Considering all patients, the existence of an association between median/ulnar SNAP amplitude and sural nerve SNAP indicates a widespread involvement in GBS. However, sural sparing is a known condition in the acute phase of GBS (10-13,19).

In this study, sural sparing was present in approximately 30% of GBS patients and 50% of AIDP patients. These rates were similar to those in previous studies (10-13,19). Our findings showed that sural sparing or normal sural nerve SNAP could be in either form. In addition, median/ulnar nerve conduction studies were more prominently affected in AIDP compared to Axonal GBS. Although it is difficult to explain this situation, these findings can be explained by the reversible conduction failure seen in axonal GBS (4,5,18,20,21). Improvement of conduction failure in motor and sensory nerves may result in improvement of nerve conduction studies. Another explanation might be that many of the patients with Axonal GBS have acute motor axonal neuropathy. Similarly, the high rate of Axonal GBS patients in this current study can be explained by reversible conduction failure. In some patients, motor conduction block in AIDP and reversible conduction failure in Axonal GBS may have been misinterpreted (3-5,20), resulting in a high proportion of Axonal GBS patients. However, it should be noted that we used the recommended GBS diagnostic criteria.

For some, the axonal form of GBS may have a worse prognosis, but for others it may not be (6,7). According to some, recovery of axonal GBS is delayed or some AIDP patients may be misdiagnosed with Axonal GBS (4-7,20,21). For these reasons, the prognosis of axonal GBS may be misinterpreted. In this study, the patients were not followed up, but they had examination findings in the acute-subacute period and MRC scores were not different between axonal GBS and AIDP patients. Prospective studies involving the follow-up of axonal and demyelinating GBS patients are needed to elucidate this situation.

An important result found in our study was that four of the patients had COVID-19 prior to GBS. Cases of GBS associated with COVID-19 have been reported (22-24). Although the exact cause is unknown, GBS associated with COVID-19 may be associated with excessive cytokine release or immune reactions (22-24). Although cases of GBS associated with acute COVID-19 have also been reported (22), acute COVID-19 infection was not present in the cases in this study. PCR testing for SARS-CoV-2 was not performed in the cerebrospinal fluid but no cells were present in the cerebrospinal fluid. The findings in this current study may mean that GBS does not develop during acute infection and that GBS is not due to excessive cytokine release, and that previous COVID-19 triggers immune reactions. However, more studies are needed for the accuracy of these results.

This study had several limitations. Since it is a retrospective study, although the time interval between the time the nerve conduction study was performed and the onset of complaints did not differ between axonal GBS and AIDP patients, this interval was different between patients. Other limitations were the lack of follow-up of the patients and the low number of patients. Again, due to the small number of patients, AMAN and AMSAN patients could not be included in the analysis separately. The fact that this distinction was not made may have affected our results. We think that future studies involving these subgroups will be useful. One of the limitations was that anti-ganglioside antibodies were not available. Finally, not performing nerve conduction studies in all four extremities on every patient may be a limitation. However, it should be noted that some patients have a catheter or edema.

In conclusion, this study showed that sural nerve SNAP and sural sparing were not different between AIDP and Axonal GBS, but median/ulnar nerve SNAPs were different between AIDP and Axonal GBS. In addition, it was concluded that there is a positive correlation between median/ulnar nerve SNAP amplitudes and sural nerve SNAP amplitudes in GBS patients.

Declarations

The authors have no conflicts of interest to declare. The authors declared that this study has received no financial support.

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YouTube is an important resource for hyperhidrosis patients

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Abstract

Background: YouTube is one of the most used information sources. Hyperhidrosis is a disease that needs treatment mostly due to social complaints.

Methods: Search titles 'Hand sweating, Excessive sweating, Armpit sweating, and Hyperhidrosis' were searched for separately on YouTube. A total of 400 videos, consisting of 100 under each title, were evaluated. Data such as who uploaded the video, which treatment plan it contained, the upload date, country of upload, duration, number of times watched, and rating were recorded. The Video Power index (VPI) was used to evaluate the popularity of the videos in the study.

Results: The number of views, number of likes, and VPI of the video group with a duration of 232 s or more were found to be significantly higher than the video group with a shorter duration ($p=0.001$, $p<0.001$, and $p<0.001$). In commercial videos, the rate of videos featuring non-surgical treatment was found to be the highest at 92.1%. It was found that the videos containing surgical treatment were older than the videos containing non-surgical treatment ($p=0.028$).

Conclusions: The internet is an important source of information in diseases such as hyperhidrosis that cause social dysfunction in young patients and the treatment decision is determined entirely by the level of complaint the patient feels. On the YouTube platform, which is one of these sources of information, it was seen that video-assisted thoracoscopic surgery, which is the definitive and permanent treatment of hyperhidrosis, has started to lose its place to alternative methods in recent years.

Keywords: Hyperhidrosis, Sweating, Symphatectomy, YouTube.

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INTRODUCTION

As of March 3rd, 2020, more than half of the world's population has internet access and internet usage has increased, especially with the pandemic period. Of these internet users, it was determined that 81% try to access health-related information over the internet (1). This has led to an increase in the use of the internet by health professionals for the purpose of education and information sharing. In a study in 2020, it was reported that YouTube is the most used social media platform worldwide (2, 3).While easy to upload videos, being free, and the popularity of the platform make YouTube stand out, the unsupervised publishing of videos and the expansion of the domain according to likes and comments are among its disadvantages. (1–3).

Hyperhidrosis is excessive sweating that occurs without an underlying cause or due to secondary causes. While it has been reported that 2% of the world's population has hyperhidrosis, this ratew as observed between 2.8%–4.8% in the USA, and it is seen with equal frequency in men and women. The concentration of internet use in the same age range and the determination of the treatment of hyperhidrosis with social indications and patient demand make the internet one of the first application areas for the treatment process of the patients (4,5).

In this study, it was aimed to analyze the videos about hyperhidrosis and evaluate which treatment modalities on the YouTube platform came to the forefront and attracted attention.

MATERIALS AND METHODS

Characteristics of videos

By logging out of personal accounts, the search algorithm does not list videos based on their viewing history. Search titles 'Hand sweating, Excessive sweating, Armpit sweating, and Hyperhidrosis' were searched for separately. Since users do not look beyond the first 10 pages in 95% of internet searches, the first 100 videos in the list were evaluated for each search word from the videos up to September 1st, 2022 (6). A total of 400 videos were analyzed by 5 surgeons. After excluding videos that were not in the English language, were not compatible with the search words, and 'YouTube Shorts' were excluded from the research, 268 videos were evaluated. Ethics committee approval is not required. This study was conducted with public acces information from YouTube.

Assessment of quality of videos

Data such as who uploaded the videos (health professional, patient experience, advertisement, health organization), which treatment plan it contained (surgery, non-surgical options, anti-treatment, all), the upload date, country of upload, duration, number of times watched and rating were recorded. Since the popularity of YouTube videos within the platform increases with the number of comments, likes and views rather than the value of the content, the video power index (VPI; like rate × view rate/100) was used to evaluate the popularity of the videos in the study (3,7).

Statistical Analysis

The IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, NY, USA) computer package program was used for statistical analysis of the research data. Descriptive statistics were given as the number of units (n) and percentage (%). $p<0.05$ was considered statistically significant.

RESULTS

Data on who uploaded the videos, which treatment method was prominent in the content, and the country where the video was uploaded are given in Table 1. The time elapsed from the upload of the videos to September 1st, 2022, the duration of the videos, the number of views and likes, and the median and average VPI values are shown in Table 2.

Table 1. Characteristics of videos

		Number of videos	%
Uploader	Healthcare Professional	104	38.8
	Patient Experience	62	23.1
	Health Organization	55	20.5
	Advertisement	45	16.8
	Other	2	0.8
Treatment Option	Botox	95	35.5
	Surgical Treatment	49	18.3
	Iontophoresis	28	10.4
	Botox + Iontophoresis	23	8.6
	Microwave	22	8.2
	All (Surgical+non-surgical)	20	7.4
	Topical Treatments	14	5.3
	Other treatments	12	4.5
	Anti-treatment	5	1.8
Source Country	USA	153	57.1
	India	31	11.6
	United Kingdom	22	8.2
	Australia	13	4.9
	Canada	10	3.7
	Other	39	14.5

Table 2. Numerical values for videos

	Mean(±std deviation)	Median (min-max)
Upload date (month)	**51.46** (±39.20)	**36** (1-168)
Video duration (seconds)	**337.59** (±340.30)	**232** (28-1940)
Views	**78069.07** (±255280.09)	**13696.50** (6-3553277)
Number of likes	**1110.53** (±3954.93)	**102.50** (0-44000)
Video Power Index	**8.16** (±102.70)	**0.94** (0.17-223527)

When the video durations were compared, no significant difference was found in the video durations between the groups (p=0.744). Two groups were formed over the video durations according to the median value. The number of views, the number of likes, and the VPI of the video group with a duration of 232 s or more were found to be significantly higher than the video group with a shorter duration (p=0.001, p<0.001, and p<0.001 respectively) (Table 3). When the relationship between the content of the 268 uploaded videos and the VPI was evaluated, no statistically significant difference was found between the groups (p=0.312).

Table 3. Statistical comparisons between groups

	n	Median	Min-max	z	p
Treatment option					
Surgical	49	188.00	42.00-1826.00		
Non-surgical	194	239.50	28.00-1940.00		0.744
All	20	239.50	82.00-1422.00		
Anti-treatment	5	344.00	173.00-648.00		
Views					
<232 seconds	134	5249.50	6.00-518811.00	-3.241	**0.001**
>232 seconds	134	22412.50	33.00-3553277.00		
Number of likes					
<232 seconds	134	39.50	0.00-32066.00	-4.379	**<0.001**
>232 seconds	134	298.00	0.00-44000.00		
Video Power Index					
<232 seconds	134	0.66	0.00-1679.23	-5.651	**<0.001**
>232 seconds	134	1.36	0.00-12.45		

In commercial videos, the rate of videos featuring non-surgical treatment was found to be the highest at92.1%. It was found that the videos containing surgical treatment were older than the videos containing non-surgical treatment (p=0.028) (Table 4).

Table 4. Comparison of surgical and non-surgical videos by upload date

		Upload date			
Treatment option	Number (n)	Mean	Standard deviation	t	p
Surgical	49	64.24	47.19	2.243	**0.028**
Non-surgical	194	48.06	35.93		

The video content and who uploaded the video did not make a statistically significant difference on the number of video views (p=0.200 and p=0.800 respectively).

DISCUSSION

Hyperhidrosis is a common and locally seen pathology. Treatment seeking is usually seen in local hyperhidrosis. Local hyperhidrosis can be seen in one or more of different places, such as the hands, armpits, feet and face. Treatment options differ in the branches of plastic surgery, dermatology, and thoracic surgery. While there may be local and temporary treatments, such as Botox, treatment plans can be drawn with recently popular cosmetic procedures (8). In addition, the permanent and definitive treatment is surgical sympathectomy (9).

The fact that different branches offer treatment options, the patients' need for treatment for social reasons, the prevalence of internet use in young patients, and the lack of a treatment algorithm bring uncertainty in the evaluation of the treatment option. All of the treatment options have certain advantages and complications. In particular, the internet platform can play an important role in the patient's decision on the treatment option (10).

The fact that the number of views, likes and VPI values of long-term (>232 s) videos were statistically significantly higher than short-term videos (<232 s), suggests that a person doing research on a medical subject on the internet is due to the desire to reach more information. As stated in the studies in the literature, the correct medical information obtained from the internet contributes to many areas, from directing the patients to the diagnosis and treatment process, to increasing the quality of care of the patient during the treatment to its positive effect on the health economy. Although there is a platform with many surgical training videos, YouTube is the preferred first place. This may also contribute positively to medical education (2,3). It is our belief that increasing the number of videos supporting the surgical treatment of hyperhidrosis without time limitation is therefore important in accessing the right information and providing the correct guidance of the patients on the way to treatment.

The convenience provided by the YouTube platform in uploading and disseminating videos provides convenience for the advertisement of the services offered to patients in the health sector (3). It has been reported in studies that endoscopic thoracic sympathectomy (ETS) is the best option, especially in the treatment of palmar and axillary hyperhidrosis, against non-surgical alternative treatments that need to be repeated continuously (11,12). It is our belief that the reason for the high number of videos in which non-surgical treatments were recommended in the videos that were considered as advertising videos is because the materials used in the treatment are presented as an alternative to the surgical option, which is the definitive treatment, and more-strong advertising is needed. The fact that non-surgical treatment videos were significantly more recent can be interpreted as concrete evidence that thoracic surgeons should pay more and more attention to information sharing on YouTube for the substantial number of patients accessing medical information online.

The fact that the number of views and likes was independent of the uploader or the content of the video is also valuable in that it shows that producing more surgical content can be parallel to more information about surgical treatment. Considering the existence of studies in the literature in which ETS gives excellent results, especially in palmar and axillo-palmar hyperhidrosis, and no recurrence has been reported, it is proof that watching videos more or less and having a high number of likes do not always indicate correct information (4,12). No statistically significant difference was observed in the comparison of VPI values for the contents. This also supported our thinking.

The value of the study is that it is one of the rare studies in which the guidance of the YouTube platform was

evaluated in a disease that is treated with social indications and treatment alternatives include different branches. The main limitation of our study is that the widely used scoring is no longer valid because the Youtube platform has removed the dislike number from all videos. For this reason, another and relatively weak scoring system evaluated in the literature was used.

In conclusion, the internet is an important source of information in diseases such as hyperhidrosis that cause social dysfunction in young patients and the treatment decision is determined entirely by the level of complaint the patient feels. On the YouTube platform, which is one of these sources of information, it was seen that surgery, which is the definitive and permanent treatment of hyperhidrosis, has started to loseits place to alternative methods in recent years.

Declarations

The authors have received no financial support for the research and/or authorship of this article. There is no conflict of interest.

Ethics committee approval is not required. This study was conducted with public acces information from YouTube.

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ORIGINAL ARTICLE

Comparison of the oral and dental health awareness of pregnant individuals: A pilot study from Turkey

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Abstract

Background: In this study, it was aimed to investigate the sociocultural and socioeconomic status of pregnant patients who applied to the department of oral and maxillofacial surgery for tooth extraction as well as their level of awareness about oral and dental health.

Methods: A questionnaire including a total of 16 questions about their awareness, practices, and attitudes toward oral and dental health was filled out by 193 pregnant volunteers, and the results were evaluated statistically.

Results: When the attitudes of pregnant women towards oral and dental health were examined according to their monthly income, it was found that there was no statistically significant difference ($p>0.05$). However, it was determined that the attitudes of pregnant women with a middle income towards oral and dental health were better. In addition, it was determined that there was a statistically significant difference in the level of consciousness between those who had a dental examination during pregnancy and those who did not ($p<0.05$).

Conclusions: Not all pregnant women are always aware that they may have problems with their oral and dental health during their pregnancy and they are not always well informed by the health personnel. It seems there is a lack of dental health controls in Turkey for pregnant individuals. This pilot study indicates that oral health screening needs to be a routine procedure of antenatal clinics in order to inform pregnant individuals in detail, regardless of their sociocultural and socioeconomic status to reach better oral health and consequently better pregnancy outcomes.

Keywords: Oral health; Dental health; Pregnancy.

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INTRODUCTION

Pregnancy is a natural process that progresses through hormonal changes in the patient and may cause physical and psychological changes (1). Increasing physical and emotional changes during pregnancy may contribute to neglecting of oral hygiene and that may cause poor oral and dental health. Subsequently, inadequate oral hygiene and hormonal changes can increase the risk of oral and dental health problems such as gingivitis and periodontitis. Pregnant women may experience gingivitis that starts in the 2nd or 3rd month of pregnancy and may get severe during pregnancy (2).

Unfortunately, oral health screening is not a routine procedure in antenatal clinics in Turkey and there is no standard guideline that ensures that all pregnant women are routinely screened, treated, or referred to a dentist as part of prenatal care (3). Prevention of complications during pregnancy due to oral and dental health problems is possible by giving oral health education by enhancing the knowledge, attitudes, and practices of pregnant women (4). Thomas et al. (5) reported a higher risk of periodontal disease in pregnant women with less education and lower socioeconomic status compared to pregnant women with higher education level and higher socioeconomic status. Therefore, they concluded that more studies are needed to find out whether more intensive dental health education during pregnancy can lead to better oral health and consequently better pregnancy outcomes. Educational programs should be designed based on a comprehensive program, including informative seminars on specific risks during pregnancy, to motivate oral health and implement the necessary prophylactic measures. Improving oral health during pregnancy will also help to improve the oral health of the baby. However, in terms of dental health, many pregnant women tend to avoid seeing a dentist , because they think they or their fetus would be harmed as a result of the radiograph, dental procedures or medication (6).

Thus, this study aimed to evaluate the sociocultural and socioeconomic status of pregnant individuals and the level of awareness regarding oral and dental health through the questionnaires.

MATERIALS AND METHODS

Study design

This study was carried out on pregnant dental patients who applied to Gazi University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery for tooth extraction.

Ethical approval

Ethics committee approval for the study was obtained from Gazi University Faculty of Dentistry Clinical Research Ethics Committee on 09.01.2020 (No: 21071282-050.99-).

Participants

The study was conducted on 193 pregnant women various weeks of pregnancy, over 18 years old, and wanted to participate in the survey voluntarily.

Data collection tools

Volunteers were asked about their awareness, practices, and attitudes toward oral and dental health.

Informed Consent

The informed consent form was obtained from all the participants. Questionnaire included a total of 16 questions to determine the level of practice, attitudes, and knowledge of the volunteers (Table 1).

Table 1. The questionnaire

EVALUATION OF AWARENESS, PRACTICES AND ATTITUDES OF PREGNANT WOMEN TOWARDS ORAL AND DENTAL HEALTH

Age:
City/district where you live:
Pregnancy Period (Week):
Number of Children:

Please choose the appropriate option for you.

A) SOCIOECONOMIC STATUS

Education Status: Literacy / Primary School / High school / University / Post graduate
Working Status: Housewife / Civil servant / Self-employed / Worker / Private sector employee
Monthly Income: 500$ and less / 501-600 / 601-700 / 701$ and higher

B) DENTAL HEALTH PRACTICES

1) How frequent you brush your teeth?
None / 1 a day / 2 times a day / More than 2 times a day
2) How often do you change your toothbrush?
a month / in 3 months / in 6 months / a year
3) What are the tools you use other than toothbrushes for your oral and dental care? (You can select more than one option)
Floss / Decoupage brush / Mouthwash / None of them
4) Do you brush your teeth after each meals?
Always / Often / Sometimes / Never

C) ATTITUDES OF PREGNANT WOMEN TOWARDS ORAL AND DENTAL HEALTH

1) How often do you go to the dentist?
1 in 6 months / 1 in a year / When I have a complaint / I never go
2) When was the last time you went to the dentist?
In the last 6 months / 6 months-1 year / 1 year ago / none
3) Have you ever been a dental check-up just before pregnancy or in the first weeks of pregnancy?
Yes / No

4) What are the difficulties for you to go to the dentist?

	YES	NO
Higher fees for dental examination and treatment		
No priority for oral and dental health		
Worried to harm the pregnancy		
Fear of dental treatment		
Not knowing the importance of oral and dental health during pregnancy		

D) ORAL AND DENTAL HEALTH AWARENESS IN PREGNANTS

	I strongly disagree	I do not agree	I'm not sure	I agree	Absolutely I agree
Changing hormone levels during pregnancy can affect oral and dental health					
Poor oral and dental health during pregnancy does not affect the health of the unborn baby					
Poor oral and dental health during pregnancy can cause the baby to born prematurely.					
Poor oral and dental health during pregnancy can cause low birth weight.					
Pregnancy can cause tooth loss.					
Pregnancy can cause bleeding and swelling of the gums					
Gum disease or tooth loss during pregnancy may be due to hormonal changes.					
Gum disease or tooth loss during pregnancy can be caused by malnutrition.					

Statistical analysis

The data obtained in the research were analyzed using the SPSS 25.0 (Statistical Package for Social Sciences) program. Descriptive statistical analysis was used to figure out the standard deviation, and minimum and maximum values. In addition, the normal distribution of the data was tested using Kolmogorov Smirnov test. The homogeneity of the variance assumption was tested by the Levene Test and the methods were determined. Parametric tests were used for normal distribution while nonparametric tests were used for for non-normally distributed values. F-test (ANOVA) was used for normally distributed measurements in comparison of the more than two groups for quantitative data, and Kruskal Wallis analysis was applied for non-normally distributed measurements.

RESULTS

The distribution of the participants by the reason for not going to the dentist is given in Table 2. While most of the volunteers stated that they were 'worried to harm the pregnancy' by going to the dentist during their pregnancy (53.9%), the least reason for not going to the dentist was stated by the volunteers that 'their oral and dental health was not their priority' (28%).

Table 2. Distribution of difficulties going to dentist

		n	%
Higher fees for dental examination and treatment	Yes No	91 102	47.2 52.8
No priority for oral and dental health	Yes No	54 139	28.0 72.0
Worried to harm the pregnancy	Yes No	104 89	53.9 46.1
Fear of dental treatment	Yes No	98 95	50.8 49.2
Not knowing the importance of oral and dental health during pregnancy	Yes No	78 115	40.4 59.6

Kolmogorov-Smirnov test was used to test whether there was a statistically significant difference in the "pregnant women's attitudes towards their oral and dental health during pregnancy" according to their monthly income. Participants were divided into 4 groups according to their monthly income as: 500$ and less, 501-600, 601-700, 701$ and higher (mean ± standard deviation: 7.61 ± 1.67, 7.38 ± 1.83, 7.22 ± 1.72, 7.13 ± 1.36, respectively). It was determined that there was no normal distribution ($p<0.05$). Kruskal Wallis test was used to analyze whether there was a statistically significant difference between the mean value of the scores obtained from the "pregnant women's attitudes towards oral and dental health" according to their monthly income. It was determined that there was no statistically significant difference according to their monthly income ($p>0.05$) (Table 3).

Table 3. Comparison according to monthly income

Monthly income	n	Mean	St.Dev.	X2	p
500$ and less	38	7.61	1.67	2.342	0.505
501-600	71	7.38	1.83		
601-700	54	7.22	1.72		
701$ and higher	30	7.13	1.36		

X2: Test statistics

In addition, the normality assumption was checked by Kolmogorov-Smirnov test to determine whether there was a statistically significant difference between the scores of the participant's awareness level for the "oral and dental health" according to their educational level. It was determined that there was a normal distribution ($p>0.05$). The homogeneity assumption was tested by Levene ($p>0.05$). There was found to be a statistically significant difference between the education levels of the participants in terms of the mean scores of the "oral and dental health awareness level in pregnant women" ($p<0.05$). Participants were divided into 3 groups according to their educational status as: Primary education or literacy, High School, University and Master's (mean ± standard deviation: 25.83±4.72, 27.64±4.15, 28.97±5.12, respectively). Bonferroni analysis was also performed to determine the difference and found that the oral and dental health awareness of participants with a university and a master's degree was higher than those with primary education and literate education level ($p<0.05$)(Table 4).

Table 4. Comparison of awareness according to educational status

Education status	n	Mean	St.Dev.	F	p	Bonferroni
Primary education or literacy	41	25.83	4.72	8.474	0.014*	
High school	78	27.64	4.15			3>1
University and Master's	74	28.97	5.12			

F: Test statistic, *p<0.05

DISCUSSION

Many studies have been reported on the protection of oral and dental health during pregnancy. However, research on pregnancy and pregnancy tooth loss is still ongoing. In this study, it was aimed to investigate the sociocultural and socioeconomic status of pregnant patients who applied to the department of oral and maxillofacial surgery for tooth extraction as well as their level of awareness about oral and dental health.

In the study including Michigan PRAMS 2004-2008 data, only 26% of women reported that they needed dental treatment during their pregnancy, however, only 58.4% of them were keen for treatment (7). One of the reasons why pregnant women avoid dental treatment was the higher fees for dental examination and treatment. In Turkey, the fact that the private health insurance system does not cover dental treatment fees might be one of the possible reasons why pregnant women do not go to dentists routinely. This situation may be one of the factors for a certain part of the population to find dental services expensive and avoid this service. In this study, it was found that the percentage of going to the dentist during pregnancy was 26.9%, and when pregnant women were asked about the difficulties of going to the dentist, the rate of pregnant women who did not go to the dentist due to high fees was 47.2%. Type of insurance has also been associated with the use of dental services during pregnancy. It has been reported in previous studies that pregnant women with private or state-provided general health insurance are more likely to have dental treatment or dental care during pregnancy than pregnant women who do not have general health insurance (8,9). In one of the PRAMS studies, it was reported that the probability of receiving dental services in pregnant women with general health insurance was 53% less than those covered by private insurance (10). Besides that, this study also indicated that middle-income pregnant women had better attitudes towards their oral and dental health.

In addition, recent research has shown that health professionals may provide inadequate guidance to pregnant women on the importance of oral and dental health during pregnancy (11). If the consciousness level of the pregnant individual is increased and better cooperation is established between dentists and gynecologists, dental examinations can become routine from the beginning of the pregnancy process. In this case, the oral hygiene of pregnant individuals can be improved and the possible negative effects of periodontal disease during pregnancy can be eliminated. Strafford et al. reported that only 40% of pregnant women were advised by obstetricians to visit their dentist during pregnancy for a check-up; however, 10% of them are refused by the dentist to give dental treatment during their pregnancy because they fear to cause harm to the unborn (12). In addition, another study revealed that some gynecologists believed that x-ray devices (73%) and local anesthetics (59%) were not safe for pregnant women (13). In the present study, a total of 193 pregnant women were included, and 78 of them stated that they do not know the importance of oral and dental health during pregnancy. This result emphasizes the necessity of including dental examinations in routine health controls during pregnancy and the importance of healthcare professionals guiding pregnant women. In a survey conducted in the United States including 60 deans of different dental schools and 240 obstetrics and gynecology residency program administrators, it was determined that only 65% of the deans and administrators, and only 45% of residents were aware of the prenatal oral health guidelines. On the other hand, only 39% of the residents guided prenatal oral health (14). Accordingly, it was highly recommended that pregnant women should be given training about the importance of oral and dental health to improve their oral hygiene (15,16).

Health professionals may not be able to provide adequate counseling to pregnant women about the importance of

oral and dental health during pregnancy. According to a study that included PRAMS data for 10 states of USA between 2004-2006, only 41% of pregnant women received oral and dental health education (17). Better awareness is needed for this type of education on oral and dental health. In the present study, it was determined that there was a statistically significant difference in terms of consciousness level between those who had a dental examination during pregnancy and those who did not ($p<0.05$). It has been determined that the level of consciousness of pregnant women with primary education and literate education level is lower than those with university and higher graduate education.

This study determined that pregnant women are not adequately motivated to use available oral health services throughout their pregnancy in our country and also all over the world because they are not well informed by the healthcare professionals. Therefore, pregnant women need to be informed about preventive measures to achieve optimal oral and dental health routinely. Even more, oral health education should be given in advance, especially to women of childbearing age. The limitation of this study is that it was conducted in a single center. Multicenter studies with a higher number of participants can be conducted.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the clinical research Ethics Committee of the Gazi University Faculty of Dentistry (Date: 09.01.2020, Number: 21071282-050.99).

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ORIGINAL ARTICLE

The effect of COVID-19 pandemic on emergency department admissions

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Abstract

Background: This study has been conducted to evaluate the emergency department (ED) admissions during the pandemic period.

Methods: The study is a multicentre, retrospective study. ED admissions in two hospitals between April 1st, 2019 and May 31st, 2019 (pre-COVID-19 period); and between April 1st, 2020 and May 31st, 2020 (the period of COVID-19) have been compared.

Results: Among 47888 ED admissions, 22854 (47.7%) females and 25034 (52.3%) males, with a mean age of 40.9±19.6 years have been included in the study. Of all patients, 30.1% (14440) were admitted to the EDs during the pandemic period in 2020. When the processes have been compared, it can be seen that while more laboratory examinations were requested from the EDs in the pre-pandemic period, more radiological examinations were requested during the pandemic period. Patients were consulted approximately 5 times more during the pandemic period than in the previous year. There has been a statistically significant difference between the periods in terms of consultation ($p< 0.001$). When the patients have been evaluated in terms of hospitalization, it can be seen that 5.1% of the patients were hospitalized in pre-pandemic period and 9.7% of the patients in the pandemic period ($p<0.001$).

Conclusions: A significant decrease has been observed in the number of ED admissions during the pandemic in both hospitals. The most important reason for this decrease might be that patients prefer not to apply to the ED in case of an illness that can be resolved with a simple intervention and the restrictions applied due to Covid-19.

Keywords: COVID-19, Pandemic, SARS-CoV-2, Emergency, Admission.

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INTRODUCTION

Emergency departments (ED) are the departments where healthcare service providers are in close contact with the public and have the most interaction with the community. The most important feature of ED is the uninterrupted and prompt delivery of healthcare. For a high-quality ED, in addition to the physical adequacy of the buildings, a trained personnel force is also crucial. Additionally, the proper use of the ED is another important factor to provide a quality service. Improving these conditions can result in an increase in the quality of care and as a result an increase in employee satisfaction can also be achieved (1).

In recent years, due to the rapid population growth and migration, EDs have experienced excessive patient density, which has led to a disruption in the quality of the service in these departments (2, 3). EDs are considered as easily accessible areas where non-appointment-seeking patients can receive immediate healthcare services, easily utilize laboratory services, and have faster access to diagnostic and treatment procedures. As a result, these areas are becoming increasingly crowded and are also being increasingly misused. Recent studies in Turkey have reported that a large proportion of patients who apply to EDs do not have urgent pathologies, and therefore, adequate service cannot be provided to real emergencies (4-6). In the study by Kılıçaslan et al. (1), it has been reported that 47.4% of patients applying to the ED were in the non-urgent category, while in the study by Aydın et al. (7), this percentage has been reported as 62.3%.

During epidemics, such as the COVID-19 pandemic, EDs continue to provide uninterrupted service as they do at other times. They play a critical role in both identifying and managing COVID-19 suspected cases and continuing the diagnosis and treatment process of other medical emergencies. In a period where transmission occurs through droplets, only real emergency patients are expected to apply to the ED. Therefore, our study has been conducted in order to evaluate ED admissions during the pandemic period.

MATERIALS AND METHODS

This study has received ethics committee approval from the Gazi University Ethics Committee (Date and Number: 23.07.2020 – E.78134)

For this study, the applications to Gazi University Hospital ED and Kastamonu Training and Research Hospital ED between April 1st, 2019 and May 31st, 2019 have been compared to the same hospitals' applications between April 1st, 2020 and May 31st, 2020. As the study has been conducted in these two hospitals in two different cities, it can be said that it is a multicentre retrospective study. The Kastamonu Training and Research Hospital is the only state hospital in the province of Kastamonu, which is one of the largest in the Western Black Sea region. Every year, approximately 160000 patients are admitted to the hospital's ED. Gazi University Hospital is one of the largest university hospitals in Ankara, with approximately 70,000 ED visits per year. The number of patients admitted to the EDs in April and May 2020 (during the COVID-19 period) was determined and compared to the number of patients admitted in April and May 2019 (pre-COVID-19 period). In addition to the patients' demographic information, their complaints, ICD-10 diagnoses, tests performed, consultation status, and discharge status were recorded on the data collection form. Only patients aged 18 and over (only trauma patients under 18 have been considered) have been included in the study and patients with incomplete data in electronic and manual records and those with COVID-19 suspicion have been excluded from the study.

Statistical analysis

The data is summarized, and graphs are drawn by using the MS Office Excel program. By using SPSS 26 software, it is determined that the data do not follow a normal distribution. Since the aim of the study is to compare ED admissions in the pre-pandemic (2019) and pandemic (2020) periods, there is no continuous dependent variable, and therefore parametric statistical methods cannot be used. Cross-tabulations are created by using SPSS 26 software, where the dependent and independent variables can be continuous or categorical, for the most frequently observed ICD diagnoses and procedures requested by physicians, and these findings are described in the result section.

RESULTS

Among 47888 ED admissions, 22854 (47.7%) females and 25034 (52.3%) males, with a mean age of 40.9±19.6 years have been included in the study. Of the patients included

in the study, 30.1% (14,440) visited the ED during the pandemic period in 2020, while 69.9% (33,448) visited the ED in the pre-pandemic period in 2019. The basic characteristics of the patients are presented in Table 1. The mean age of patients visiting the ED is 39.8±19.8 years in the pre-pandemic period, while the mean age of those visiting during the pandemic is 43.5±18.9 years (p<0.005). A detailed comparison of the two periods is presented in Table 1. When the procedures are compared, it can be seen that while more laboratory tests were requested in the pre-pandemic period, more radiological tests were requested during the pandemic, and patients were consulted with other departments approximately five times more than in the previous year.

Table 1. Main Characteristics of The Patients and A Comparative Summary of The Pre (2019) and During Pandemic (2020) Periods

	Feature	N(%)	Pre-pandemic (n=33448)	Pandemic (n=14440)	p
Gender (n, %)	Female	22854 (47.7)	16276 (48.7)	6668 (46.2)	<0.001
	Male	25034 (52.3)	17262 (51.3)	7772 (53.8)	
Hospital (n, %)	Kastamonu Training and Research Hospital	32008 (66.8)	22907 (68.5)	9101 (63.0)	<0.001
	Gazi University Hospital	15880 (33.2)	10541 (31.5)	5339 (37.0)	
Requests (n, %)	Laboratory examination	29231 (61)	25819 (77.2)	3412 (23.6)	<0.001
	Radiological examination	10908 (22.8)	6530 (19.5)	4378 (30.3)	<0.001
	Consultation	4320 (9)	1290 (3.9)	3030 (21.0)	<0.001
Outcome (n, %)	Discharge	44436 (92.8)	31562 (94.3)	12894(89.3)	<0.001
	Hospitalization	3110 (6.5)	1713 (5.1)	1397 (9.7)	<0.001
	Referral to another centre	96 (0.2)	48 (0.1)	48 (0.3)	<0.001
	Exits	213 (0.4)	116 (0.3)	97 (0.7)	<0.001
	Withdrawal from treatment	13 (0.0)	9 (0.0)	4 (0.0)	0.961

During the pre-pandemic period, 88.5% of patients were discharged from the ED. On the other hand, during the pandemic period, 76.2% were discharged from the ED. When the patients are evaluated in terms of hospitalization rates, it is seen that the hospitalization was determined to be 5.1% in the pre-pandemic period and 9.7% in the pandemic period (p<0.05). Similarly, a statistically significant difference has also been found between the laboratory and radiology requests of physicians in the 2019 and 2020 periods (p<0.001).

The most common diagnosis upon presentation was R51 (headache) in both periods. However, during the pandemic period, there was an increase in the percentage of diagnosis codes R10 (abdominal and pelvic pain), R52.9 (pain, unspecified), and W19 (unspecified fall) compared to the previous year. There has been a statistically significant difference in the most commonly observed ICD diagnoses between the periods (p<0.001). The comparison of the most common ICD diagnoses by year is presented in Table 2.

Table 2. The Comparison of The Pre (2019) and During Pandemic (2020) Periods in Terms of ICD-10 Codes

		2019 (n=33448)	2020 (n=14440)	p
ICD-10 codes (10 most common) (n, %)	1.R51 (Headache)	23271 (69.6)	5765 (39.9)	<0.001
	2.R07.0 (Sore throat)	2088 (6.2)	894 (6.2)	0.830
	3.R10 (Abdominal and pelvic pain)	1562 (4.7)	1115 (7.7)	<0.001
	4.R52.9 (Pain, unspecified)	992 (3.0)	547 (3.9)	<0.001
	5.W19 (Fall, unspecified)	406 (1.2)	448 (3.1)	<0.001
	6.T11.9 (Unspecified injury of upper extremity, level unspecified)	489 (1.5)	227 (1.5)	0.362
	7.T13.9 (Unspecified injury of lower extremity, level unspecified)	573 (1.7)	187 (1.3)	<0.001
	8.R05 (Cough)	394 (1.2)	397 (2.7)	<0.001
	9.M54 (Dorsalgia)	379 (1.1)	174 (1.2)	0.499
	10.R11 (Nausea and vomiting)	274 (0.8)	242 (1.7)	<0.001

DISCUSSION

In the literature, there are various publications on the misuse of EDs in Turkey and in the world. In situations with high infectivity with droplets like COVID-19, only real emergency patients are expected to apply to the ED. In our study, a significant decrease is observed in the number of ED admissions during the pandemic in both hospitals. The reasons for this decrease might be unnecessary admissions to the ED in the pre-pandemic period as well as the restriction measures applied during the pandemic and patients' fear of COVID-19 transmission during a hospital visit.

In our study, an increase in consultation and hospitalization rates has been observed compared to the pre-pandemic period. Additionally, it is seen that during the pandemic period, emergency physicians required less laboratory examinations and more radiological examinations. In a study conducted in Thailand, in which pandemic and pre-pandemic applications have been evaluated, an increase in hospitalization rates is found to be decreased in ED admissions (8). In another study conducted in the USA, it is determined that hospitalizations increased during the pandemic period, consultation rates for infectious diseases increased, and other departments mostly remained the same (9).

In this study, when ED patients are evaluated according to their gender, it has been observed that the rate of male patients that applied to the ED is 52.3%. In another study conducted by Aydın et al., it has been determined that 51.5% of ED patients are male (7). Although the difference between the genders has been statistically significant in both periods, it is not clinically significant.

In various studies conducted in Turkey, the average age of patients admitted to the ED has been reported as 40-42 years, while according to the data from the United States in 2020, it has been 35.6 years (1, 7, 10). The average age of the patients included in our study has been determined as 40.9±19.6, and a statistically significant difference is found between the periods in terms of age. However, this difference is not at a level to change the patient management.

After the declaration of COVID-19 as a pandemic by World Health Organization (WHO), the admission rates to ED in many hospitals around the world have significantly decreased. In the early stages of the pandemic, ED visits in the US decreased by 42% compared to the same period in the previous year (March-April), with the biggest drop observed in April 2020 (11). The same study has reported a significant decrease in the number of patients applying to the hospital for reasons such as otitis media, superficial cuts, and muscle pain. This is thought to be because non-emergency cases might have been managed at home. Additionally, some studies have reported that patients might have neglected going to the hospital

when experiencing symptoms of a possible myocardial infarction (11-13). In a study conducted by Li-Heng Tsai et al. at the ED of the third largest hospital in Taiwan, it has been found that the daily number of ED visits decreased by 33.45% compared to the pre-pandemic period, but there has been no significant decrease in the number of critical patients (14). In a study by Butt et al., it has been reported that there has been a significant decrease in the number of confirmed cardiac patients compared to the previous year during the pandemic period (12).

During pandemic period, there was an increase in the percentage of diagnosis codes R10 (abdominal and pelvic pain), R52.9 (pain, unspecified), and W19 (fall, unspecified) compared to the previous year, while the percentage of diagnosis code R51(Headache) decreased. There could be many different reasons for this. Patients with conditions which could be treated with simple interventions at home might have preferred to visit the hospital less. Moreover, there might have been concerns about going to the hospital due to the risk of infection and strict quarantine measures and lockdowns (15, 16).

In conclusion, the lower rates of hospitalization, consultation, and death rate (relatively) in the pre-pandemic period suggest that unnecessary ED visits are made more frequently in the pre-pandemic period. The most important reasons are probably that patients prefer not to visit the ED in cases of illness that can be resolved with a simple intervention, the restrictions applied due to Covid-19 and patients' fear of COVID-19 transmission during a hospital visit. The decrease in ED admissions during the pandemic period has had a positive effect on the emergency professionals' response to real emergencies. However, it is important to provide the necessary warnings and medical referrals in order to prevent the delay in the admission of patients who need critical intervention to the hospital for the aforementioned reasons.

Declaration

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This study has been approved by Gazi University Ethics Committee (Approval Date: 23.07.2020, Approval Number: E.78134)

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ORIGINAL ARTICLE

The effectiveness of anterior cruciate ligament reconstruction on the patellofemoral stability and patellar height

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Abstract

Background: Considering the critical role the anterior cruciate ligament (ACL) plays in knee biomechanics, it is a logical hypothesis that ACL reconstruction (ACLR) will have positive effects on knee kinematics and stability. Our objective was to investigate radiologically and clinically the effect of single-bundle ACLR on patellar height and patellofemoral balance.

Methods: In this prospective study, 87 patients operated on with hamstring autograft-used single-bundle ACLR were analyzed. History of dislocation, stability-related physical examination findings, Tegner-Lysholm Knee Scoring Scale, and Kujala Anterior Knee Pain Scale were used for functional assessment. All patients underwent pre-and post-operative magnetic resonance imaging and Insall-Salvati (IS) Index, Caton Deschamps Index, Blackburne-Peel Index, and Patella-patellar tendon (P-PT) angles were measured on T1-weighted sagittal section images.

Results: A total of 79 patients (90.8%) achieved an excellent or good result, according to the Tegner-Lysholm Knee Scoring Scale, and the patients' postoperative 1st year mean Kujala Anterior Knee Pain Score was calculated as 90.4 (Range: 79.1 – 96.4). On physical examination, increased passive patellar translation was observed in 2 patients (2.3%), but the J sign appeared to be negative in all the patients. While all patellar height indices decreased after reconstruction, only the decrease in IS index was statistically significant ($p=0.007$). Moreover, the P-PT angle was found to be significantly lower after ACLR ($p<0.001$).

Conclusions: Our study is an essential step in demonstrating the relationship between anterior cruciate ligament reconstruction and patellar height. With single-bundle ACLR, sagittal balance improves, patellar height indices decrease, and patients' susceptibility to patellofemoral instability may reduce.

Keywords: Anterior Cruciate Ligament; Knee Joint; Patella; Patellar Ligament; Patellofemoral Joint.

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INTRODUCTION

While patellar height plays a crucial role in the extensor mechanism and contributes significantly to knee stability, patellar height disorders are associated with cartilage degeneration, instability, and deterioration in knee functions (1). More specifically, increased patellar height (patella alta) is associated with trochlear dysplasia and increased susceptibility to patellofemoral instability whereas decreased patellar height (patella baja) is associated with decreased range of motion and joint stiffness (2). The relationship between patellar height disorders and many knee-related clinical conditions such as total knee replacement, high tibial osteotomy, meniscal tear, and patellofemoral instability has been studied exclusively in the literature, considering their effects on clinical outcomes (3-5).

With an incidence of 25-78/100,000, the anterior cruciate ligament (ACL) rupture is one of the most common and most commonly treated knee injuries in the younger population (6,7). Furthermore, considering the critical role the ACL plays in knee biomechanics, it is inevitable that ACL reconstruction will have positive effects on knee kinematics, stability, and related pathologies (8,9). Although the relationship between ACL reconstructions and many different conditions such as meniscal tears, cartilage degeneration, and trochlear dysplasia has been investigated in the literature, the relationship between ACL reconstruction and patellar height disorders has been studied only in a limited number of studies, to the best of our knowledge (10-13). On the other hand, considering the important role of the anterior cruciate ligament in the balance of the knee and the effects of autografts used in ACL reconstruction on patellar or quadriceps tendon lengths, it is a reasonable hypothesis that there is a relationship between ACL reconstruction and patellar height (14,15).

The specific purpose of this study was to investigate radiologically and clinically the effect of ACL reconstruction on patellar height, knee stability, and patellofemoral balance by comparing the pre-and postoperative patellar height and analyzing post-operative knee functions of patients who underwent single-bundle ACL reconstruction using hamstring autograft. We hypothesize that knee stability will change positively in patients who have undergone ACL reconstruction, and the susceptibility to patellar height disorders will reduce.

MATERIALS AND METHODS

Following the ethics committee approval, patients who underwent single-bundle ACL reconstruction using hamstring autograft in our clinic between 2019-2022 were followed-up prospectively. To examine the effect of ACL reconstruction on patellar height, only isolated ACL ruptures were included in the study, while patients with medial and/or lateral meniscal tears were excluded. In addition, patients with known patellofemoral instability or a history of patella dislocation, patients who were treated with allograft or other autografts (bone-patellar tendon or quadriceps), patients who were operated via double-bundle technique, patients who did not comply with the recommended rehabilitation process, and patients who refused to participate in the study were also excluded. According to the inclusion and exclusion criteria, 22 patients were excluded and 87 prospectively followed-up patients were included in the study. Informed consent was obtained from all the patients. This study was approved by the clinical research Ethics Committee of the Ankara City Training and Research Hospital (Date: 17.03.2021, Number: E1-21-1636).

After a clinical diagnosis of ACL rupture with anterior drawer, Lachman and pivot shift tests, and radiological diagnosis through the examination of magnetic resonance imaging (MRI) images by orthopedic surgeons (ÖD and BG), single-bundle anatomical ACL reconstruction was performed using a quadrupled graft of semitendinosus and gracilis tendons (each doubled) as described in the literature (6,7). While endobutton-continuous loop was used for femoral fixation of the graft, bioabsorbable interference screws and staples were used for tibial fixation. All surgeries were performed by the same surgeon (ÖD). After the surgery, all the patients started closed chain exercises and weight-bearing as tolerated while open-chain exercises started at the postoperative 6th week. The same rehabilitation program was recommended and applied to all the patients in the same rehabilitation center, between the postoperative 6th week and 3rd month. Return to sports was not approved for any of the patients before six months. Following the rehabilitation process, MRI was performed, and functional measurements were made for all the patients during their first-year follow-up.

Tegner-Lysholm Knee Scoring Scale and Kujala Anterior Knee Pain Scale were used to evaluate the postoperative functional results of the patients (16). While evaluating the Tegner-Lysholm Knee Scoring Scale, the result was accepted

as "excellent" if the patient scored 90 points and above, "good" if the score was between 84-90 points, "fair" if the score was between 65-83 points, and "poor" if the patient was scored below 65 points, as described in the literature (15). While evaluating the Kujala Anterior Knee Pain Scale, patients were asked 13 questions according to the Turkish validated version (16) and scored between 0 to 100, in which higher scores were associated with better patellofemoral function and knee stability (3,19-22). Apart from these two scorings, in order to evaluate patellar stability and patellofemoral balance in all patients in their postoperative 1st year outpatient clinic controls, patients were questioned whether they had any patellar dislocations in the last year, whether they experience anterior knee pain, and whether they have increased passive patellar translation or positive J sign associated with patella alta in physical examination (23). In addition to the functional evaluation, patients' age, gender, side, trauma mechanisms, and complications were recorded. All functional clinical scoring and all physical examinations were performed by the same author (BG) at the same control (po 1st year) after patients started active exercise and adhered to a regular follow-up protocol.

To evaluate the change in patellar height before and after surgery, pre-and post-operative MRI images of all the patients, which were taken in a semi-flexed position, were examined. Although patellar height indices could also be evaluated with direct radiographs, to obtain images with similar qualities in the same flexion degree, all measurements were conducted in the first T1-weighted sagittal cross-section image where the patella is seen completely in MRIs taken at 30 degrees semiflexion. Insall-Salvati, Caton Deschamps, Blackburne-Peel indices, and patella-patellar tendon angle were measured pre-and post-operatively. All measurements were conducted by the same author, who is a radiologist with 10 years of experience (ISD) by using the software IC Measure® (The Imaging Source, Germany).

Insall-Salvati (IS) index is defined as the ratio of the length of the patellar tendon to the length of the patella. The length of the patellar tendon is the distance between the lower patellar pole and the tuberositas tibia whereas the length of the patella is the distance between the upper and lower patellar poles as shown in the figure (Figure 1). The normal range for IS index is between 0.8 and 1.2; ratios lower than 0.8 are described as patella baja whereas ratios higher than 1.2 are described as patella alta (24,25). Caton Deschamps (CD) index is delineated as the ratio of the distance between the inferior edge of the patellar cartilage and the anterosuperior point of the tibial plateau to the length of the cartilage-covered articular surface of the patella (Figure 1). The normal range for the CD index is between 0.6 and 1.3; ratios lower than 0.6 are described as patella baja whereas ratios higher than 1.3 are described as patella alta (24,25). Blackburne-Peel (BP) index is defined as the ratio of the perpendicular distance between the inferior edge of the patellar articular cartilage to the articular surface of the tibial plateau and the length of the cartilage-covered articular surface of the patella (Figure 2). The normal range for the BP index is between 0.5 and 1.0; ratios lower than 0.5 are described as patella baja whereas ratios higher than 1.0 are described as patella alta (24,25). Patella-patellar tendon angle (P-PT angle) is used to analyze the sagittal alignment of the knee (26,27). It is reported in the literature that the P-PT angle is used to evaluate the sagittal patellar tilt, patellar tendon pathologies, and sagittal plane patellofemoral alignment (26,27). Accordingly, the P-PT angle is defined as the angle between the line connecting the upper and lower patellar poles and the line drawn from the lower patellar pole to the tuberositas tibia (26,27) (Figure 3).

Figure 1. Sagittal section image of the T1-weighted magnetic resonance imaging of a 26 years-old male patient. Insall-Salvati index (LT/LP) is defined as the ratio of the length of the patellar tendon (LT) to the length of the patella (LP). Caton Deschamps index (PTG/PG) is defined as the ratio of the distance between the inferior edge of the patellar cartilage and the anterosuperior point of the tibial plateau (PTG) to the length of the cartilage-covered articular surface of the patella (PG).

Figure 2. Sagittal section image of the T1-weighted magnetic resonance imaging of a 26 years-old male patient. Blackburne-Peel index (PP/PG) is defined as the ratio of the perpendicular distance between the inferior edge of the patellar articular cartilage to the articular surface of the tibial plateau (PP) and the length of the cartilage-covered articular surface of the patella (PG).

Figure 3. Sagittal section image of the T1-weighted magnetic resonance imaging of a 26 years-old male patient. Patella-patellar tendon angle (P-PT angle) is defined as the angle between the line connecting the upper and lower patellar poles and the line drawn from the lower patellar pole to the tuberositas tibia.

Statistical analysis was performed through SPSS version 26.0. The conformity of data to normal distribution was determined by using visual (histogram, probability plots) and analytical methods (Kolmogorov-Smirnov test). Mean and standard deviation were used as descriptive statistics for normally distributed variables whereas median and interquartile range values were used for skewed distributed variables. Paired Samples T-Test was used to determine the difference between the means for normally distributed data sets, and the Wilcoxon Signed-Ranks test was used for data sets which do not comply with the normal distribution. While the Chi-square test was used to compare categorical data, Fischer's Exact Test was adopted in cases where the Chi-square assumption was not met. A p value below 0.05 was considered significant. With measurements of 87 patients, the power of the study was found to be 81.7% by using the G power® version 3.1.9.4.

RESULTS

With a mean age of 33.6 years (Range: 18 – 47 years), 75 patients (84.3%) were male and 12 patients (13.8%) were female. A total of 79 patients (90.8%) achieved an excellent or good result according to Tegner-Lysholm Knee Scoring Scale, and the patients' postoperative 1st year mean Kujala Anterior Knee Pain Score was calculated as 90.4 (Range: 79.1 – 96.4). In the first-year evaluation of the patients, while none of the patients had a patellar dislocation, 9 patients (10.3%) had anterior knee pain during the postoperative one-year follow-up. On physical examination, increased passive patellar translation was observed in 2 patients (2.3%), but the J sign appeared to be negative in all patients. Detailed distribution of demographic data is presented in Table 1.

Table 1. Demographic profile of the patients

		Number of Patients (N=87 patients*)	Rate (%)
Age (years)		33.6 years (Range: 18 – 47)	
Gender	Male	75	86.2%
	Female	12	13.8%
Side	Right	51	58.6%
	Left	36	41.4%
Injury Mechanism	Sports Injury	67	77%
	Vehicle Accident	4	4.6%
	Industrial Injury	16	18.4%
Patellar Instability-Related Findings	Patellar Dislocation	0	0
	Anterior Knee Pain	9	10.3%
	Increased Passive Patellar Translation	2	2.3%
	J Sign	0	0
Tegner-Lysholm Knee Score	Excellent	64	73.6%
	Good	15	17.2%
	Fair	6	6.9%
	Poor	2	2.3%
Kujala Anterior Knee Pain Scale		90.4 points (Range: 79.1 – 96.4)	

N: number of patients

While all patellar height indices decreased postoperatively, only the decrease in IS index was statistically significant (P=0.007). Moreover, the P-PT angle was found to be significantly lower after ACL reconstruction (P<0.001). Detailed analysis of patellar height indices before and after ACL reconstruction is shown in Table 2.

Table 2. Pre-operative and post-operative patellar height values of ACL-reconstructed patients, based on pre-and post-operative T1-weighted sagittal section MRI images

	Pre-operative Values	Postoperative Values	P
Insall-Salvati Index*	1.08 (IR: 0.19) Range: 0.78 – 1.57	1.02 (IR: 0.17) Range: 0.65 – 1.66	**0.007**
Caton Deschamps Index*	1.05 (IR: 0.17) Range: 0.79 – 1.34	1.02 (IR: 0.21) Range: 0.09 – 1.54	0.067
Blackburne-Peel Index†	0.89 (SD: 0.117) Range: 0.69 – 1.18	0.87 (SD: 0.139) Range: 0.59 – 1.26	0.073
Patella-Patellar Tendon Angle*	141.3 (IR: 5.6) Range: 132 – 151.5	138.2 (IR: 7.2) Range: 128.9 – 156.3	**<0.001**

P: statistical significance value; IR: interquartile range; SD: standard deviation.

*: Median, interquartile range and minimum – maximum values were used as descriptive statistics for skewed distributed variables.

†: Mean, standard deviation and minimum – maximum range were used as descriptive statistics for normally distributed variables.

No tunnel malposition and impingement were observed in any patients clinically and during radiological examinations of MRI images. In four patients (4.6%), there were complaints of hypoesthesia in the anterolateral area of the knee, related to the injury of the infrapatellar branch of the saphenous nerve. In two patients (2.3%), swelling and erythema were detected in the knee after surgery, and patients were diagnosed with a superficial infection. Both patients responded to systemic antibiotic therapy. None of the patients needed a second operation.

DISCUSSION

This study is one of the first studies investigating the relationship between single-bundle hamstring autograft-used ACL reconstruction and patellofemoral balance (10-15,28). The strength and most important finding of our study is the low incidence of patellofemoral problems in the one-year follow-up of patients after single-bundle ACL reconstruction using a hamstring autograft. Patellar dislocation and J sign positivity were not detected in any of the patients. The increased passive patellar translation was observed in only two patients (2.3%). Although statistically significant (P=0.007 and P<0.001) decreases were detected radiologically in the Insall-Salvati index and P-PT angle, these decreases did not lead to a clinically significant difference.

Patella alta, upward slippage of the patella, is an important risk factor for patellofemoral instability (1,2). Although it has been defined with different values in different patellar height indices, increased index values are generally interpreted as patella alta (24,25). In our study, we hypothesized that in patients who have undergone ACL reconstruction, a more stable knee would be obtained, thus the susceptibility to patellar height disorders would decrease. In other words, we hypothesized that patellar height index values would decrease significantly in patients who underwent ACL reconstruction. Indeed, when the sagittal section images of the pre-and post-operative MRIs of our patients who had single-bundle ACL reconstruction using hamstring autograft were examined, we found that all patellar height index values decreased and the Insall-Salvati index showed a significant decrease (P=0.007). Considering the association of patella alta with patellofemoral instability, our finding can be interpreted as indicating that ACL reconstruction reduces the susceptibility to patella alta and possibly-related patellofemoral instability. Although it is an assertive statement that patellofemoral instability will decrease with ACL reconstruction, with the increased stability of the knee and patellar height changes after reconstruction, we believe that the patellar height-related patellofemoral instability may decrease. Interpretation of our finding is supported by the literature. Hao *et al.* (29) reported that the thinness of the ACL increases the susceptibility to patellofemoral instability. Cai *et al.* (30) reported that ACL reconstruction reduces patellofemoral dysfunction. On the other hand, the very low rate of the decrease in IS index (from 1.08 to 1.02) raises doubts about whether our finding, although statistically significant, will be clinically effective. Fortunately, clinically, the patients did not show any patellofemoral balance-related symptoms (positive J sign, history of dislocation) at one-year postoperative follow-up, and the Kujala Anterior Knee Pain Score associated with patellofemoral problems was calculated as 90.4 (range 79.1 – 96.4) in our study. These results show that patients do not experience patellofemoral balance problems clinically after ACL reconstruction and are not prone to problems related to patellar height. When we examine the reasons for this finding, the first point to be emphasized is that we should discuss whether our patellar height index values are the cause or the result. There is no consensus in the literature regarding the effectiveness of patellar height in the initial ACL rupture. Güven et al. (31) reported that the IS index was higher in patients with ACL rupture than in the healthy population. On the other hand, Gobbi et al. (32) stated that patellar height disorders were risky in terms of patellofemoral instability, but not in ACL tears. With larger studies comparing the patellar height index values of patients with ACL rupture and the normal population, the relationship between patellar height and ACL could be demonstrated clearly. Another important reason behind the decrease in patellar height index values after ACL reconstruction is that, as we mentioned before, the ACL plays a regulatory role in many key mechanisms of the knee. For this reason, it is an expected result to obtain a more stable knee with its reconstruction. Another point to be emphasized is that, although clinically supported, only one of the patellar height indices (IS) has a significant decrease in our study. This can be an important point of contention but, in this study, we did not aim to investigate the superiority of patellar height indices to each other, and IS index has been defined as more reliable than its alternatives in the literature (24). It should be noted that anatomical variations of the patella or the patellar joint surface may also affect all patellar height index measurements.

Strength and balance of the quadriceps and hamstring muscles play a critical role in both the occurrence and post-reconstruction rehabilitation of ACL ruptures. Ahmad et al. (33) emphasized the effectiveness of reducing quadriceps dominance and increasing hamstring muscle strength in the occurrence of ACL rupture in female athletes. Cai et

al. (12) reported that quadriceps muscle strength after ACL reconstruction was associated with postoperative functional outcomes of the patients. All patients included in our study underwent the same physical therapy protocol and went through the same rehabilitation process. In this way, we aimed to achieve similar muscle strength and better function. In our study, a total of 79 patients (90.8%) achieved an excellent or good result, according to Tegner-Lysholm Knee Scoring Scale. On the other hand, it should be kept in mind that quadriceps atrophy is not uncommon after ACL reconstruction, may continue after rehabilitation, is directly related to patellar height, and play a crucial role in maintaining the normal anatomical relationship of the patellofemoral joint (12,34). Although we aimed to achieve a standard muscle strength by applying the same rehabilitation process for to patients in our study, more comprehensive results can be obtained with studies in which quadriceps muscle strength is measured objectively and compared with patellar height index values.

In our study, we found a significant decrease in the P-PT angle postoperatively ($P<0.001$). The most important point to emphasize is, although statistically significant, how clinically effective a mere 3-degree decrease on average in the P-PT angle (from 141.3 to 138.2) can be. Studies conducted with the P-PT angle in the literature have shown that even 2-degree decreases in this angle value can be evaluated as clinically significant (26,27). The P-PT angle is used to interpret patellar sagittal balance, and higher P-PT angle values are often associated with patellar tendon strain, tendinopathy, and anterior knee pain (26,27,35). In the stabilized knee after ACL reconstruction, the decrease in the postoperative P-PT angle can be interpreted as a decrease in the loads on the anterior knee and patellar tendon. Indeed, only 9 (%10.3) of our patients reported anterior knee pain during their follow-ups. On the other hand, the biological causation of the relationship between ACL reconstruction and decrease of the P-PT angle is not clear, and this relationship can be clarified with cadaver and clinical studies. It should be noted that the exclusion of reconstructions using bone-patellar tendon autografts also affects this finding. It is also an important question whether this small decrease can be explained by the measurement error. In our study, it is aimed to prevent measurement error by performing all radiological measurements by an experienced radiologist.

Our study has several limitations. First, although the changes in IS index and P-PT angles are statistically significant, the distribution of the data is skewed, and the postoperative ranges seem to be widened. In addition, the sample size may also affect these variables. Further clinical and biomechanical studies investigating the relationship between ACL reconstruction and patellar height may obtain more objective results. Secondly, only patellar height indices of the sagittal plane were examined. More comprehensive results can be obtained with studies in which trochlear dysplasia and axial instability indices are also investigated. Another important limitation is that, as we mentioned before, the quadriceps muscle strength is not measured and evaluated. In addition, the evaluation of functional measurements (Tegner-Lysholm Knee Scoring and Kujala Anterior Knee Pain Scales) only postoperatively and the inability to compare the scores before and after surgery can be considered as a limitation. Finally, the fact that all the reconstructions included in the study are single-bundle reconstructions using hamstring autografts is a limitation. Although we have achieved standardization in this way, the effectiveness of different graft types and surgical techniques on patellar height and associated patellofemoral instability can be searched with larger cohorts and randomized trials.

Our study is an essential step in demonstrating the relationship between anterior cruciate ligament reconstruction and patellar height. With single-bundle anterior cruciate ligament reconstruction using hamstring autograft, sagittal balance improves, patellar height indices decrease, and patients' susceptibility to patellofemoral instability may reduce.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the clinical research Ethics Committee of the Ankara City Training and Research Hospital (Date: 17.03.2021, Number: E1-21-1636).

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ORIGINAL ARTICLE

Determining the risk of development of cranial pathology in patients with minor head injury using antiagregan-anticoagulants

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Abstract

Background: The use of antiplatelet/anticoagulant drugs, which increases bleeding tendency, among patients has been increasing by age. Such patients can be admitted to the emergency department with minor head trauma, and some ambiguities might occur in the management of emergency departments. This study is conducted to determine the factor of intracranial haemorrhage in anticoagulated patients and the patients on antiplatelet therapy and its effect on clinical management, identifying predictors of positive imaging findings and their outcomes.

Methods: Via a prospective analysis, patients who all had minor head trauma between June 1st, 2014 and May 1st 2015 have been included in this study. For this study, there are several inclusion criteria such as being evaluated by doctors in the Emergency Department (ED) and not being interfered during the diagnosis and the treatment. Through the study, the medications, the mechanism of injury, and Cranial Computed Tomography (CT) results have been reviewed. In addition, the demographic data, symptoms, and clinical examinations of the patients have also been recorded.

Results: 606 patients, who were admitted to the emergency department between the above-mentioned dates, with minor head trauma have been included in the study. When the data of the patients is examined, it can be seen that the average age of the patients is 48.6 ± 22.6. In addition, 57% (n = 345) of the patients are men and 43% (n = 261) are female. Also, 30% of them (n:182) were taking antiplatelet/anticoagulant. Patients who use antiplatelet/anticoagulant are older than the patients who didn't use antiplatelet/anticoagulant therapy. According to the CT results, there has been a pathological finding in 14,6% of them. However, this is not statistically significant (p=0,762). Similarly, there is no statistically significant difference between 68 users of antiplatelet and anticoagulant therapy (p = 0.865). Nausea seems to be statistically significant in patients with pathology in the Cranial CT (p=0,045).

Conclusions: Patients with minor head trauma who used Acetyl Salicylic Acid (ASA) might end in mortality or might have intracranial haemorrhage. However, the symptoms of the patient, the physical examination and the laboratory data are insufficient to predict the risk of intracranial pathology.

Keywords: Minor Head Trauma, Antiplatelet/Anticoagulant Therapy, Intracranial Pathology.

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INTRODUCTION

Traumatic brain injury (TBI) is one of the most common conditions in emergency departments with 200 new cases in per 100,000 people. (1). It is the primary cause of trauma-related fatalities in all age groups and the leading cause of death in patients aged 65 and above. (2)

As individuals age, the use of antiplatelet and anticoagulant medications increases due to several conditions such as atrial fibrillation, coronary artery disease, cerebrovascular diseases, and deep vein thrombosis (3). Moreover, elderly patients are at an elevated risk of falls or other injuries (4). Various studies have reported an increased risk of both spontaneous and traumatic bleeding, especially with warfarin use (5). In addition, elderly patients using ASA or clopidogrel have demonstrated a heightened risk of mortality associated with head trauma. However, studies indicate that the initial Glasgow Coma Scale (GCS) score and the extent of haemorrhage on brain seen in computed tomography (CT) can predict the mortality in these patients (6).

Minor head injury is typically defined as patients with a Glasgow Coma Scale (GCS) score of 15 upon hospital admission, with or without post-traumatic amnesia or loss of consciousness (7). It is among the most common reasons for emergency department admissions (3). Although the use of CT has increased the diagnosis rates of head traumas, the removal of CT scans for minor head traumas remains an issue of debate (6). Also, the indications for CT scans in patients with minor head trauma who are using anticoagulants or antiplatelet medications are not entirely clear. In a prospective study, clinical findings and brain CT results have been found to be compatible, but in another study, it is determined that a CT scan is unnecessary for patients with minor head trauma (6,7).

The purpose of this study is to examine the relationship between a patient's symptoms, physical signs, and diagnostic tests, as well as the risk of complications in patients with minor head trauma who are using antiplatelet or anticoagulant medications. It is aimed to identify various factors such as age, medical history, concurrent medications, and symptoms that might predict mortality and morbidity in these patients. By identifying the factors that indicate the risk of developing cranial pathology in patients with minor head trauma using anticoagulants or antiplatelets, we hope to shorten the duration of hospital stays in the emergency department, prevent unnecessary testing, and reduce malpractice.

MATERIALS AND METHODS

This study is designed as a prospective observational clinical study and conducted in the Adult Emergency Department of a University Medical Faculty with an annual adult patient number of 55,000 between June 1st 2014 and May 31st 2015.

This study was approved by the clinical research Ethics Committee of Gazi University Faculty of Medicine (Date: 23.06.2014, Number: 337).

Inclusion and Exclusion Criteria:

All minor head trauma patients who agreed to participate in the study and aged 18 and over with a GCS score of 15 have been included in the study. Patients with a GCS score of ≤14, polytrauma patients, pregnant patients, patients with known intracranial masses, bleeding disorders, and thrombocytopenia have been excluded from the study.

Data Collection:

The patients who applied to a university hospital adult emergency department for minor head trauma have been included in the study. The contact information, the demographic data, medications used, the medical history, vital signs, physical examination findings, existing symptoms, diagnostic tests, pathological laboratory and radiological findings, and the trauma mechanism of the included patients have been recorded on the study form.

One month after the patient's initial ED visit, the responsible research assistant for the study scanned the hospital registration system or contacted the patient/patient's relatives via phone to inquire if the patient had developed any additional trauma-related complaints, whether there was a re-visit to the hospital or not, and if there were any morbidity and mortality-related information. All the acquired data were recorded on the study form.

Statistical Analysis:

The normality of the variables is examined by using the Kolmogorov-Smirnov and Histogram methods. For continuous variables, arithmetic mean ± standard

deviation or median and minimum/maximum values are used depending on the distribution structure. Post-hoc statistics are used to determine from which group the difference has been originated and if there is a difference between groups. Chi-square tests, Fisher, Kruskal Wallis, and Bonferroni tests are used in statistical analyses. SPSS for Windows 20 (SPSS Inc. ®, Chicago, USA) program is used to analyse the data. The results with $p<0.05$ are considered to be statistically significant.

RESULTS

Between June 1st 2014 and May 31st 2015, a total of 52,096 patients applied to the University Hospital Adult AS. Of these patients, 1,000 (1.91%) of them had head trauma. There were 619 minor head trauma patients who met the study criteria, but 13 patients who did not want to participate in the study and met the exclusion criteria were removed, leaving 606 patients for the study. Of these patients, 182 (30.02%) were using an antiplatelet and/or anticoagulant drug (Figure 1).

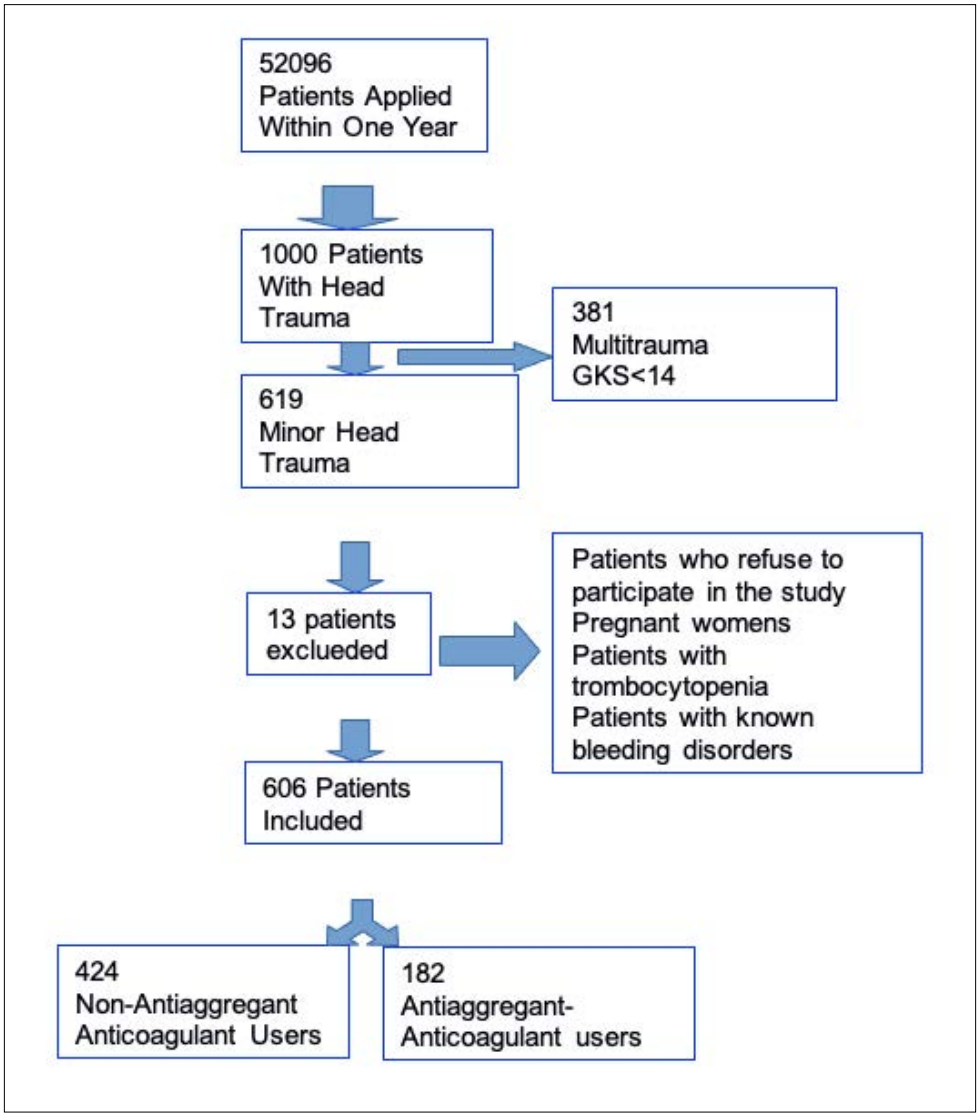

Figure 1. Flow Chart

The mean age of the 606 patients who presented with minor head trauma is 48.6±22.6 (min:18 max:101), with 57% (n:345) male and 43% (n:261) female rates. The rate of the patients using antiplatelet and anticoagulant drugs is found to be 30.0% (n:82). The average age of these patients is 71.98±12.4 (min:41 max:101), and 47% (n:86) are male. Patients who used antiplatelet and anticoagulant drugs are mostly elderly and female, and there is a statistically significant difference between those who did and did not use antiplatelet and anticoagulant drugs (p=0.000, p=0.002).

When the medical histories of all patients are examined, hypertension is most frequently detected at a rate of 24.2% (n:147), while diabetes mellitus (DM) and coronary artery disease (CAD) are detected at frequencies of 10.5% (n:64) and 9.7% (n:59), respectively. In patients using antiplatelet and anticoagulant drugs, hypertension is observed at a rate of 65.4%, CAD at a rate of 31.0%, and DM at a rate of 29.7% (Table 1).

Table 1. The Demographic Data of the Patients

	Antiaggregant-Anticoagulant users n=182	Non- antiaggregant-anticoagulant users n=424	p=+
	mean ±SD	mean ± SD	
Age	71.98±12.4	38.55±17.5	
Gender	n (%)	n (%)	<0.001
Female	96 (52.7)	165 (38.9)	0,002
Male	86 (47.3)	259 (61.1)	
Comorbid Factors	n (%)	n (%)	
DM*	54 (29.7)	10 (2.4)	<0.001
HT**	119 (65.4)	28 (6.6)	<0.001
CAD***	57 (31.0)	2 (0.5)	<0.001
CVO****	14 (7.0)	1 (0.2)	<0.001
AF*****	12 (6.6)	0	<0.001
Other	39 (21.4)	11 (2.6)	<0.001

*DM: Diabetes Mellitus, **HT: Hypertension, *** CAD: Cornerary Artery Disease, **** CVO: Cerebrovascular Event, *****AF: Atrial Fibrillation, +: Pearson Chi-Square

The primary mechanism of injury in patients with minor head trauma is determined to be falls, at a rate of 46% (n:281). When ED admission symptoms are examined, the most commonly observed symptoms are nausea,10% and headache, 33%.

When the admission symptoms of patients using and not using antiplatelet and anticoagulant drugs are compared, it is seen that there has been no statistically significant relationship for symptoms other than dizziness (Table 2).

Table 2. The comparison of admission symptoms of the patients using and not using antiaggregant-anticoagulant drugs

Symptoms n (%)		Antiaggregant-Anticoagulant Users	Non-Antiaggregant-Anticoagulant Users	Total	p=+
		n (%)	n (%)		
Nausea	yes	167 (91.8)	44 (10.4)	201 (33.7)	0.257
	no	15 (8.2)	380 (89.6)	395 (66.3)	
Headache	yes	54 (29.7)	149 (35.1)	203 (33.4)	0.112
	no	128 (70.3)	275 (64.9)	403 (66.5)	
Concussion	yes	3 (1.6)	4 (0.9)	7(1.1)	0.353
	no	179 (98.4)	420 (99.1)	599 (98.8)	
Amnesia	yes	6 (3.3)	14 (3.3)	20 (3.3)	0.984
	no	176 (96.7)	410 (96.7)	586 (96.6)	
Consciousness	yes	2 (1.1)	5 (1.2)	7 (1.1)	0.647
	no	180 (98.9)	419 (98.8)	599 (98.8)	
Seizure	yes	2 (1.1)	1 (0.2)	3 (0.4)	0.216
	no	180 (98.9)	423 (99.8)	603 (99.5)	
Dizziness	yes	18 (9.9)	17 (4)	35 (5.7)	**0.05**
	no	164 (90)	407 (96)	571 (94.2)	
Visual impairment	yes	3 (1.6)	10 (2.4)	13 (2.1)	0.418
	no	179 (98.4)	414 (97.6)	593 (97.8)	
Syncope	yes	2 (1.1)	7 (1.7)	9 (1.4)	0.461
	no	180 (98.9)	417 (98.3)	597 (98.5)	
+: Pearson Chi-Square					

Of the 606 patients included in the study, 58% (n:349) underwent a Cranial CT based on the decision of the clinician. 47.8% (n:167) of these patients were using antiplatelet or anticoagulant drugs. Among the 182 minor head trauma patients who were using antiplatelet/anticoagulant drugs, Cranial CT was performed for 91.6% (n:167) of the patients, while among the 424 patients who were not using these drugs, only 42.9% (n:182) of them underwent Cranial CT based on the decision of the clinician, which seems to be significantly lower (p=0.000). The rate of Cranial CT performed by clinicians has increased significantly as the number of patients with symptoms increased (p=0.000).

Moreover, pathological findings are detected in 14.6% (n:51) of the patients who underwent Cranial CT. 23 of these patients were using antiplatelet and/or anticoagulant drugs. The most common pathological finding has been subarachnoid haemorrhage (SAH), which has been observed in 28% (14) of the patients. Only one patient had SAH, subdural haemorrhage, and skull fracture together. In addition, two patients had both SAH and subdural haemorrhage, two patients had both SAH and skull fracture, and one patient had both subdural haemorrhage and skull fracture. It is determined that there has been no statistically significant difference in the incidence of pathology on Cranial CT between the patients using and not using antiplatelet-anticoagulant drugs (p=0.762). However, when pathological findings are examined individually, the incidence of SAH seems to be significantly higher in patients not using these drugs than in those who were using them (p=0.038).

When the use of antiplatelet and anticoagulant medications among patients is examined, it is found that 134 patients used ASA, 31 patients used clopidogrel, 15 patients used warfarin, 1 patient used DMAH, and 7 patients

used dabigatran. However, when the analysis is done individually, it seen that there is no statistically significant difference in the pathology detected in the Cranial CTs of the patients using ASA, clopidogrel, and warfarin (as determined by the Pearson Chi-square and Fisher tests). Due to the small number of patients using dabigatran (7 patients) and DMAH (1 patient), the detection of pathology in Cranial CT could not be statistically evaluated (Table 3).

Table 3. Pathology status in cranial CT according to the drugs used

Drugs		with pathology in Cranial CT n (%)	without pathology in Cranial CT n (%)	p=+
ASA	Using	14 (11.6)	107 (88.4)	0.241
	Not	37 (16.2)	191(83.8)	
Clopidogrel	Using	7 (24)	22(76)	0.164
	Not	44 (13.8)	276 (86.2)	
Warfarin	Using	2 (14.3)	12 (85.7)	0.972
	Not	49 (14.6)	286 (85.4)	
Dabigatran	Using	1 (16.6)	5 (83.4)	0.615
	Not	50 (14.6)	293 (85.4)	
+: Pearson Chi-Square				

Besides, cranial pathology is detected in 10% of the patients using ASA (n:14), 22.5% of the patients using clopidogrel (n:7), and 14% of the patients using dabigatran (n:1). Only one patient using ASA had both subdural hematoma and SAH. The mean INR value for the patients who were using warfarin is 2.2 (min:0.9, max:4.69), and three patients had an INR value greater than 3. Although two patients using warfarin had ischemia detected in their Cranial CT, none of the patients had intracranial bleeding (Table 4).

Table 4. The distribution of pathological CCT findings of the patients using antiaggregant-anticoagulant

	ASA	Clopidogrel	Warfarin	Dabigatran	DMAH
SAH	2	1	0	0	0
Subdural Hematoma	5	1	0	0	0
Parenchymal Hematoma	2	2	0	1	0
Skull Bone Fracture	2	0	0	0	0
Facial Bone Fracture	2	3	0	0	0
Other	2	0	2	0	0
Total	15	7	2	1	0

Out of the 606 patients included in the study, 19 (3.1%) were hospitalized, 11 of them in services and 8 of them in intensive care units (Table 5). Furthermore, no statistically significant difference is found in the discharge patterns of the patients from the emergency department based on the use of antiplatelet and anticoagulant medications (p=0.47).

Table 5. Exiting the patients from the emergency department

	Antiaggregant-Anticoagulant Users n (%)	Non-Antiaggregant-Anticoagulant Users n (%)	Total
Discharge	174 (95.6)	413 (98.5)	587 (96.9)
Service	5 (2.7)	6 (1.4)	11 (1.8)
Intensive Care	3 (1.6)	5 (1.1)	8 (1.3)
Total	182 (100.0)	424 (100)	606 (100.0)

90% of the patients were diagnosed with only minor head trauma, while in 6.6% of the patients, other body injuries were also present in addition to minor head trauma (Table 6).

Table 6. Using and not using antiaggregant/anticoagulant Distribution of Patients' Diagnoses

Diagnoses	Antiaggregant-Anticoagulant Users n(%)	Non-Antiaggregant-Anticoagulant Users n(%)	Total
Intracranial pathology	12 (6.5)	20 (4.7)	32 (5.2)
Other cranial pathologies	11 (6.0)	8 (1.8)	19 (3.1)
Other body area injury	19 (10.4)	21 (4.9)	40 (6.6)
Total	182 (100)	424 (100)	606 (100)

Also, the frequency of other body and intracranial pathology is seen to be statistically significantly increased in patients using anticoagulant-antiplatelet drugs (p=0.024). Of the patients using antiplatelet-anticoagulant drugs, 84% (n:153) was diagnosed with only minor head trauma, 10.4% (n:19) had other body injuries in addition to minor head trauma, and 6% (n:12) was diagnosed with intracranial pathology.

It has been observed that the patients with intracranial or other pathology detected in Cranial CT had an increase in related complaints and outpatient clinic visits. These visits were generally due to the need for follow-up examinations in line with their current diagnoses.

When the final statuses of patients using antiplatelet-anticoagulant agents are examined one month later, it is seen that 82% (n:149) of them had no recurring complaints, 10% (n:19) of them visited the outpatient clinic with the same and/or related complaints, 3% (n:5) of them visited the emergency department for the same and/or related reasons, and one of them died in the intensive care unit before being discharged from the hospital (Table 7). Also, eight patients could not be reached as they did not respond to the follow-up call.

Table 7. The status of the patients using antiaggregant/anticoagulant, one month after trauma

Type of discharge from the emergency department	Latest Status After 1 Month				Total⁺ n (%)
	No Re-application n (%)	Outpatient Clinic Applications n (%)	emergency department Applications n(%)	Deceased n (%)	
Discharge	146 (87.4)	16 (9.6)	5 (3.0)	0 (0)	167 (100)
Service	3 (60)	2 (40)	0 (0)	0 (0)	5 (100)
Intensive Care	0 (0)	1 (50)	0 (0)	1 (50)	2 (100)
Total⁺	149 (85.6)	19 (10.9)	5 (0.9)	1 (0.6)	174 (100)
+: Row percentages					

Three out of 606 patients with minor head trauma (0.5%) died within one month after the trauma. Two of the three patients did not have any pathology detected in their Cranial CT. The other patient who died and had pathology detected in their Cranial CT was a 46-year-old individual who was using antiplatelet-anticoagulant drugs (ASA + clopidogrel). The other two patients who died and did not have any detectable intracranial pathology were in their 80s and were not using any antiplatelet-anticoagulant drugs. When comparing the mortality rates between patients who were using the drugs and those who were not, statistically significant higher rates have been observed in patients who were using the drugs ($p=0.000$) (Pearson Chi-square test, post hoc test).

DISCUSSION

The world is experiencing an increase in the elderly population due to the advancements in medicine and technology, which leads to a longer life expectancy and more improved living standards (8). As a result, the population of Turkey is expected to have a 17% proportion of people over the age of 65 by 2050, compared to 6% in 2000. With the rise of the elderly population, the use of antiplatelet and anticoagulant drugs has also increased (9). Therefore, identifying risk factors for intracranial events in patients who use these drugs is thought to be crucial, especially considering the prevalence of head trauma cases in emergency departments (10).

It is important to note that the accumulation of atheromatous plaques in cerebral vessels and cortical atrophy in elderly individuals make the brain a sensitive area (11). Studies have shown that the risk of intracranial bleeding increases in patients using anticoagulants who have suffered head trauma, with the most common cause being a simple fall at their own level. This increased risk is associated with the growing elderly population and the corresponding rise in anticoagulant use (12).

In this study, it has been found that patients who used antiplatelet and anticoagulant drugs accounted for 30% of those with minor head trauma, with an average age of 72. Other studies have also reported similar age distributions (13). Simple falls are found to be the most common cause of head trauma, which is consistent with the previous research (6).

In another retrospective study that was conducted between 1999 and 2004, patients who used ASA and clopidogrel were examined. When looking at their current diseases, it was found that CAD was 40%, cerebrovascular accident (CVA) was 29%, and atrial fibrillation (AF) was 6%. In our study, when the current diseases of those using antiplatelet-anticoagulant are examined, the rates are; CAD is 31%, CVA is 7%, and AF is 6.6% (6).

In a study that investigated the indications to perform a brain computed tomography (Cranial CT) in minor head trauma based on symptoms such as nausea, amnesia, and headache were found to have a statistically significant relationship with the pathology detected on Cranial CT (14). In our study, it is seen that there has been a significant relationship between nausea, vomiting, amnesia, and the pathology detected on Cranial CT. Additionally, there has been a relationship between the absence of amnesia and the absence of pathology on Cranial CT. There has also been a significant relationship between patients without any symptoms and the absence of pathology on Cranial CT.

In a study conducted in 2011, no relationship was found between the use of medication and the pathology detected on Cranial CT in minor head trauma patients using antiplatelet-anticoagulant drugs. However, a significant relationship was found between amnesia and the pathology detected on Cranial CT (13). In Viola et al.'s study, no significant relationship was found between amnesia, nausea, headache, and Cranial CT in minor head trauma patients (15). In another study, minor head trauma patients using warfarin were examined, and a significant relationship was found between headache, nausea, amnesia, and confusion and pathology detected on Cranial CT, while a significant relationship was found between disorientation and pathology (16).

In our study, it is determined that there has been no significant relationship between the use of medication and Cranial CT, as well as between symptoms and the pathology detection in Cranial CT among those using antiplatelet-anticoagulant drugs. Saboori et al. investigated the indications for Cranial CT in minor head trauma and examined the relationship between headache, nausea, amnesia, loss of consciousness, confusion, and seizure and pathology development in Cranial CT in patients over 6 years of age. They found a significant relationship

between nausea and confusion and Cranial CT, but did not find a significant relationship between amnesia, dizziness, headache, and Cranial CT. They also found that as the number of symptoms increased, the frequency of pathology development in Cranial CT also increased (17). In our study, overall, it is seen that there is no increase in the frequency of pathology detection in Cranial CT as the number of symptoms has increased, but in the group of patients using medication, there is an increase in the frequency of pathology development in Cranial CT as the number of symptoms has increased.

When various studies in the literature are reviewed, it is seen that Sacco et al. reported a significant relationship between coagulopathy and Cranial CT in studies of moderate head trauma patients with a GCS score of 13-14. In contrast, Gomez et al. did not find a significant relationship between coagulopathy and Cranial CT in a study of moderate head trauma patients (18-19). Mina et al. performed a retrospective study of anticoagulant-treated head trauma patients and found no significant relationship between drug use and pathology in Cranial CT, although there was a significant difference in INR levels (4). Another retrospective study of patients with a GCS score of 15 and no neurological deficits who were using anticoagulants recommended against routine Cranial CT imaging. A study of minor head trauma patients using ASA and clopidogrel found a significant relationship between drug use and pathology in Cranial CT (21).

Miller reported a 6.1% incidence of intracranial injury in 1382 cases of minor head trauma evaluated via CT (22). Boran reported a 9.2% incidence of pathology in Cranial CT in 371 patients with a GCS score of 15 (23). In this study, 3% of minor head trauma patients have been diagnosed with intracranial pathology, and 5.4% of patients using antiplatelet and anticoagulant agents have been diagnosed with intracranial pathology, which is statistically significant ($p < 0.05$). There is also a statistically significant difference between the use of SAK medication and non-use ($p < 0.05$). Another study of intracranial haemorrhage patients using ASA and clopidogrel did not find a significant difference in drug use regarding intracranial pathology (24).

In a study examining the lengths of hospital stays and complications of minor head injury patients using antiplatelet-anticoagulant agents, it was found that patients using antiplatelet agents stayed in the hospital less frequently, but there was no statistically significant difference between patients using warfarin. Considering mortality rates, it was observed that patients using antiplatelet agents had a higher mortality rate. However, this study has been retrospective and there have been uncertainties in the data of some of the patients included in the study (25).

In Brewer et al.'s study, it was found that the mortality rate of minor head injury patients using antiplatelet-anticoagulant agents increased after an intracranial haemorrhage, but their study was also retrospective and the study group consisted of only 140 patients. Besides, they were unable to access some of the patients' data (13). In our study, it has been determined that the use of antiplatelet-anticoagulant agents increases mortality. 19 patients have been included in our study and they were followed up with the brain surgery clinic and their recommendations were followed. No surgical intervention was required for any of the patients.

In a study examining minor head injury patients using warfarin, it was found that the use of warfarin increased mortality (16). In our study, only one of the three deceased patients was using ASA, and the other patients were not using antiplatelet-anticoagulant agents. Another study suggests that patients with an INR>3 are at high risk for mortality. In another study, it was found that the average INR value of patients using warfarin was 2.4 and the mortality rate was high in patients with an INR>4. Similarly, Karni et al. found that mortality increased in elderly patients with minor head injury using warfarin, but their GCS was between 11 and 13 (27). In a level 3 systematic review, it was suggested that the INR value cannot be a determinant for delayed bleeding risk (28). In our study, there are 15 patients using warfarin, and only one of the three patients with an INR value greater than 3 had ischemia detected in their Cranial CT, while no pathology was found in the other patients. This result might be due to the small number of patients.

There are not many studies conducted with dabigatran, and the number of studies evaluating patients with minor head trauma is also limited. In a study that examined

patients with trauma using dabigatran and warfarin, no significant differences were found in terms of patient survival and intracranial pathology (29, 30). In another study, it was found that the risk of bleeding associated with dabigatran was lower than that of warfarin (31). In another study with an average GCS of 14.6, five patients using dabigatran were compared to 25 patients using warfarin and 25 patients not using any medication, consequently, it was found that the mortality rate was higher with dabigatran (32). All of these studies are retrospective and have a small number of patients. In our study, there is no significant difference between dabigatran and warfarin in terms of mortality and the incidence of intracranial pathology.

Several studies have followed patients who were using antiplatelet-anticoagulant medication and had negative CT results by performing intermittent control CT scans, and the new pathology detection rate was found to be between 0.6% and 6%. However, this did not lead to any changes in the patients' vital functions, clinical status, or treatment (33, 34, 35). In another study, risk factors for delayed intracranial haemorrhage were examined in patients using antiplatelet-anticoagulant medication, and in a series of 500 patients who underwent two CT scans six hours apart, the incidence of delayed bleeding was found to be 1%. They concluded that patients with a normal initial CT scan could be discharged if there was no neurological deterioration during follow-up (36). In our study, the need to revisit the emergency department or outpatient clinic within one month of follow-up is lower in patients with no intracranial pathology detected than in those with intracranial pathology.

Although the study has been conducted in a tertiary university hospital, the number of patients included in the study is limited and could not cover all patients. Some of the patients had to be excluded because their symptoms and physical examination findings were not recorded. We were not able to obtain the final status of 8 patients using antiplatelet and anticoagulant medications because we could not reach them by phone. The final status data of these patients might have changed the possible patient outcome analyses.

In cases of head trauma, cranial CT is recommended in all the criteria of the American College of Emergency Physicians (ACEP), Canada, New Orleans, and Nexus II criteria, even if the patient has a GCS score of 15, in the presence of recurrent vomiting, age ≥ 65 years, clinical findings of skull base fracture, coagulopathy, dangerous mechanism, and presence of focal neurological deficit (4,31).

The results obtained in this study contribute to the existing literature on the relationship between anticoagulant use, symptoms, and the presence of pathology in brain computed tomography scans in patients with minor head trauma. It is crucial to take into account these factors in order to make informed decisions regarding the treatment and further evaluation, and ultimately improving patient outcomes.

Declarations

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