Research Paper

Time to Revise the Medical Students' Educational Curriculum: Focus on New Therapeutic Strategies as Regenerative Medicine in Neurological Disorders

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ABSTRACT

Background and Aim: Healthcare students highly affect the general public regarding transferring knowledge about novel therapeutic approaches. Therefore, assessing and updating their knowledge about the application of new strategies in the treatment of different diseases is very important. The present study was designed to evaluate the level of the students' knowledge about stem cells and their application in neurological disorders at the Guilan University of Medical Sciences (GUMS).

Methods and Materials/Patients: In this cross-sectional study, a questionnaire was designed in three sections. Exclusion criteria were reluctance to participate in the project or answer to less than 20% of the questions. Inclusion criteria included studying at GUMS and willingness to participate in the project and answer the questionnaire. The questionnaire was distributed in all GUMS faculties, including medicine, paramedicine, nursing and midwifery, dentistry, health, and pharmacy. The data were analyzed by SPSS v. 16 through Pearson correlation coefficient, independent t-test, one-way analysis of variance (ANOVA), and Cronbach's alpha.

Results: According to the total awareness score, 51.2% of students showed very poor and 39.7% showed poor knowledge about stem cells and their application in neurological diseases. The knowledge score of the students in the medical faculty was higher than non-medical and was dependent on their educational year. In addition, medical students showed no significant difference in neither knowledge (F=1.406, P=0.221) nor attitude (F=0.603, P=0.697) scores. Fortunately, 72.2% of students had moderate and 20.6% had a strong attitude toward stem cell applications. A moderate correlation was observed between attitude toward stem cells and knowledge about the application of stem cells (r=0.325, P=0.000).

Conclusion: GUMS students' knowledge level was poor toward stem cells and their application in neurological diseases. It is suggested to include some courses about stem cells in the educational curriculum. However, the student's attitude toward the use of stem cells was encouraging.

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Highlights

• Knowledge and awareness of students at the Guilan University of Medical Sciences (GUMS) towards stem cells and their applications are poor.

• Students of the Guilan University of Medical Sciences (GUMS) have a good attitude towards stem cells and their applications

• No efficient program or course was found in the university's curriculum.

Plain Language Summary

Medical universities' students have an important role in educating general public in terms of transferring knowledge about novel therapeutic approaches. Therefore, in this study we evaluated the level of students' knowledge about stem cells and their application in nervous system diseases at Guilan University of Medical Sciences (GUMS). To achieve this goal, a questionnaire was designed in three sections and was distributed among all GUMS faculties, including medicine, paramedicine, nursing and midwifery, dentistry, health, and pharmacy. Furthermore, the students were asked to fill them out. Most of the students showed strong attitude towards stem cells' applications especially medical students. However, most of the students had insufficient knowledge about stem cells and their application in neurological diseases. It seems that the students did not have enough awareness of new therapeutic approaches such as cell therapy. Therefore, allocating some topics about stem cells in their educational curriculum is highly recommended.

1. Introduction

Stem cells are non-specific cells, which are able to differentiate into specialized cells that make up different tissues in the body. This strong ability to proliferate and differentiate into a wide range of specialized cell types has made them candidates for growth, healing, and repair of the brain, bones, muscles, nerves, blood, skin, and other organs. Stem cells have two key characteristics of self-renewal and differentiation that distinguish them from other cells. Self-regeneration means that the stem cell is able to regenerate itself for long periods of time and these cells have the ability to multiply and divide continuously and are not limited in this regard. Differentiation properties in stem cells enable them to differentiate into cells with specific functions under special conditions in the body or laboratory environment [1].

Stem cells' clinical application to repair tissue damage and defects has been growing in recent decades. One of the methods of using these cells is injecting them into the affected area. Today, stem cells have been considered one of the branches of new technology in the study of basic sciences and clinical sciences. The most important applications of stem cells are the development of medicine, treatment of incurable diseases, the discovery of drugs, study of gene function, biological development, embryology, and genetics [2].

Autologous hematopoietic stem cell transplantation has shown positive results and feasibility in the treatment of progressive multiple sclerosis. Autologous hematopoietic stem cell transplantation can slow the progression of the disease in patients with progressive and severe multiple sclerosis. However, the safety and possibility of performing this process are significantly related to the correct choice of patients and medication regimen [3]. Regarding ischemic stroke, stem cell transplantation has been shown to reduce neurological defects [4]. There are many experimental studies based on the use of stem cells in stroke patients with the aim of improving patient performance. Producing specific neurons to repair damaged ones during a stroke is a big challenge. To achieve this goal, neuronal stem cells need different sources [5].

Many scientists believe that investigation of stem cells provides a special opportunity to learn more about the cytopathology of diseases, how diseases occur at the cellular level, and how they can be prevented at that level. Stem cells are the body's repair units that play a key role in maintaining and regenerating organs and tissues throughout the life of an organism. Their main function is to replace dead cells and regenerate damaged tissues. Based on extensive research on stem cells, scientists have claimed that these cells may be "capable of treating various diseases, such as cancer and cardio-

vascular disease, and hope for treatments based on stem cell replacement" [6].

The first step of stem cell application in treatment in Iran has been taken in 1991 when the first Hematopoietic Stem Cell Transplantation (HSCT) was done. Later on, in 2009, the first registration center for stem cell donation was established under the name "Iranian Stem Cell Donor Registry (ISCDR)". The number of these centers has grown since, and we have multiple stem cell registration centers in Tehran (the capital of Iran) and other provinces as part of the plan of the Iranian Blood Transfusion Organization (IBTO), all 31 provinces of Iran are going to have donor centers of their own [7, 8].

Although stem cell research and treatment have been controversial among the public and researchers, the question always arises as to whether sufficient information about the use of these cells is available to healthcare providers and medical graduates [9]. The lack of scientific information and principles of science in the process and application of biotechnology, such as stem cell therapy is a concern for the general public. More information in this field will help increase the knowledge about key issues and awareness will cause a more positive attitude in people, while lack of information and awareness will cause anxiety and worry [10].

Having a good understanding of the importance of stem cells is crucial to make advances and broader studies in this field and also to find their significant applications in medicine, significantly in medical students. These students play a key role in expanding these studies and finding new scientific results, as well as in creating a culture and informing other health workers and the general public. Awareness of the knowledge level of this group of students and planning to raise their awareness to raise the hope that if in the near future, stem cell-based therapies in various areas of prevention and treatment are introduced, there will be educated individuals with sufficient knowledge in order to apply new sciences and inform the people in the society [11].

We intend to use this strategy by providing a questionnaire to medical students to assess their familiarity with stem cells and their applications in treatment, such as donation in neurological diseases. By determining their level of knowledge and attitude towards stem cells and assessing their strengths and weaknesses in this area, the results of this study can be used for curriculum planners at the national and even global levels to include such topics in medical school curriculums. This may help construct the main infrastructure of this sci-

ence in universities, which is the training of specialized and efficient staff. On the other hand, by answering the questionnaire, some students will gain interest in the field of stem cells and will be encouraged to increase their knowledge and may even contribute to research in this field.

2. Methods and Materials/Patients

This project was performed to assess the knowledge and attitude about the use of stem cells in the treatment of neurological diseases among the students of all Guilan University of Medical Sciences (GUMS) faculties in 2020-21. All processes of the present study were approved by the ethics committee of Guilan University of Medical Sciences (GUMS) (IR.GUMS.REC.1399.658). The convenience sampling method was used in this study and the sample size was assessed considering a previous study [12]. Totally, 471 students participated in this study, of whom 82 students were from the medical faculty and the remaining 389 students belonged to other GUMS faculties. Inclusion criteria were being a Guilan University of Medical Sciences (GUMS) student, willingness to participate, and answer to all questions. Exclusion criteria were reluctance to participate and less than 20% answered the questions.

The demographic characteristics of students included sex, academic grade (year), type of high school (National Organization for Development of Exceptional Talents [NODET] or regular high schools), being an exchange student or not, being a citizen of Guilan province or not, having another academic degree in other fields, a history of neurological diseases in the first- and second-degree family.

Questionnaire

The used questionnaire included questions to assess students' awareness, knowledge, and attitudes toward stem cells and their therapeutic applications in neurological diseases. Its Content Validation Index and Ratio (CVI and CVR) have been evaluated previously [12].

Section A with six multi-choice questions (16 choices) assessed the students' awareness of the types of stem cells. In this section, a 16-point scoring system was used and the obtained score ranged from 0 to 98: very low (0-24), low (25-49), moderate (50-73), and good (74-98).

Section B had 11 questions in order to evaluate the student's knowledge about the application of stem cells in neurological diseases. The answer had three options:

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Yes, No, and I do not know, which a score of two allocated to the correct answer, a score of one to "I do not know", and zero to a wrong answer. The scoring ranged from 0 to 22: very low (0-5), low (6-11), moderate (12-15), and good (16-22).

Section C of the questionnaire was the sum of sections A and B that highlights a better picture and understanding of students' awareness. The overall scoring range for awareness total score was from 0 to 120: very low (0-30), low (31-60), moderate (61-91), and good (92-120).

Section D of the questionnaire was about students' attitude toward the use of stem cells in neurological diseases, using the 5-point Likert scale. On this scale, according to the participant's answer, a score from one to five was given. The answer "I totally agree" had a score of five and "strongly disagree" had a score of one. The total score in this section was 8 to 40. A lower score illustrated a more negative attitude towards the use of stem cells in the field of neurological diseases. In addition, the scores were divided into four groups very poor attitudes (8-16), poor (17-24), moderate (25-32), and strong (33-40).

Statistical analysis

The data of this study were analyzed using SPSS version 16. Pearson correlation coefficient, independent t-test, one-way analysis of variance (ANOVA), and Cronbach's alpha were used to analyze the data. A $P<0.05$ was considered significant.

3. Results

In this study, 471 GUMS students in the age range of 18 to 40 years participated, of whom 64.8% were female (n=305), 34.2% were male (n=161), and 1.1% did not mention gender. Also, 0.8% of the participants (n=4) were postgraduate students, 61.4% (n=289) were undergraduate students, 2.5% (n=12) were master's degree students, 33.3% (n=157) were studying in professional doctor programs (medical, dentistry, and pharmacy), of whom 17.4% (n=82) were medical students and 15.9% (n=75) were dentistry and pharmacy students.

In addition, 67.5% (n=318) of the participants had studied at regular high schools and 68.6% (n=323) were local students of Guilan province. Also, 6.8% (n=32) were transferred students to the GUMS and 7.9% (n=37) had a previous academic degree. Furthermore, 1.7% (n=8) had first-degree relatives suffering from neurological

disorders and 14.4% (n=68) declared second-degree relatives with other diseases.

Cronbach alpha index for questionnaire sections was calculated as 0.929 for awareness (section A), 0.247 for knowledge (section B), 0.979 for total awareness (section C), and 0.097 for attitude (section D). The questionnaire's internal consistency reliability was poor according to the Cronbach alpha index for sections B and D; however, it had appropriate content validity. Descriptive indices of questionnaire sections are shown in Table 1.

There was no significant correlation between age and each section's score of the questionnaire using the Pearson correlation coefficient (Table 2). Also, no significant difference was observed between male and female participants' scores in all questionnaire sections.

Furthermore, there were significant differences in sections A and D scores of the questionnaire between medical and non-medical students that indicates more knowledge and attitude of medical students about stem cells' applications in neurological diseases. However, there was no significant difference in sections A and C of the questionnaire between the two groups (Table 3).

Our results showed a significant difference in students' grade and their attitudes about the application of stem cells in neurological disorders so that the higher academic grade resulted in a higher and better attitude toward stem cell application (Figure 1).

However, it is noteworthy that there was no difference between medical students' scores and their study phase in basic, physiopathology, stager, and intern stages and they acquired approximately the same scores: section A: F=1.393, P=0.226 for, section B: F=0.991, P=0.423, section C: F=1.406, P=0.221, and section D: F=0.603, P=0.697 that highlights the absence of an educational syllabus in medical students curriculum.

Regarding high school type, individuals who studied at NODET high schools had better scores in all sections compared to those with regular high school backgrounds (P<0.05).

Students with another previous academic degree had the same score compared to students without a previous academic degree in sections A (P=0.285), C (P=0.142), and D (P=0.077) of the questionnaire. However, in section B, they showed a significantly higher score (P=0.003).

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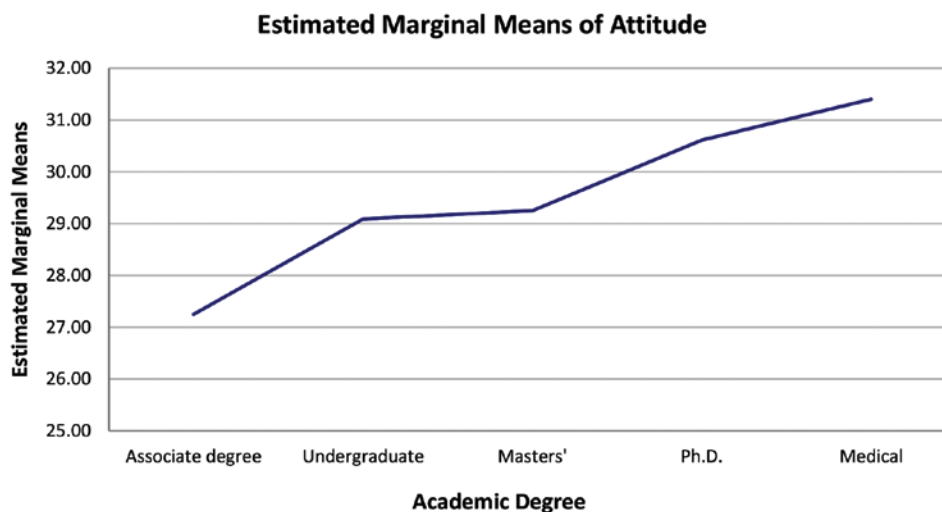
Figure 1. The correlation between students' academic degree and their attitude toward stem cell applications

It should be noted that having first-degree relatives with neurological disorders not only did not show an impact on the level of awareness and attitude but also the score in the knowledge section (Mean=13.25) was even lower than the students without first-degree relatives with neurological disorders (Mean=14.62), (P=0.001). Interestingly, the level of scores was higher in all sections of the questionnaire except section A in the stu-

dents that had second-degree relatives with neurological disorders (P<0.05).

Our findings indicated that 327 participants (69.4%) had very low awareness in section A, which shows the weak knowledge of the students about the types of stem cells. It is noteworthy to mention that only one student showed good awareness. Also, 267 students (56.7%) represented moderate knowledge about stem

Table 1. Descriptive indices of questionnaire sections

Questionnaire Sections	Minimum	Maximum	Mean±SD	Skewness	Kurtosis
A	0.00	75.00	19.23±15.13	0.955	0.174
B	10.00	22.00	14.59±2.24	0.262	-0.026
C	11.00	91.00	33.83±15.60	0.935	0.294
D	22.00	40.00	29.68±3.34	0.236	-0.397

Table 2. The correlation between age and questionnaire sections

		1	2	3	4	5
Age		-				
Section	A	-0.032	-			
	B	-0.045	0.143	-		
	C	-0.037	0.990	0.283	-	
	D	-0.016	0.052	0.325	0.097	-

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Table 3. Medical and Non-medical students' scores in different sections of the questionnaire using an independent t-test

Sections	Study Field	Frequency	Mean±SD	T	P
A	Medical	82	20.31±16.07	-0.709	0.479
	Non-medical	389	19.01±14.92		
B	Medical	82	15.42±2.44	-3.737	0.0001
	Non-medical	389	14.42±2.15		
C	Medical	82	35.74±16.63	-1.217	0.224
	Non-medical	389	33.43±15.36		
D	Medical	82	31.4±3.08	-5.249	0.0001
	Non-medical	389	29.32±3.29		

Table 4. Awareness, knowledge and attitude of students about stem cells and their applications

	Score Level	No. (%)
Awareness about the types of stem cells	Very low (0-24)	327(69.4)
	Low (25-49)	131(27.8)
	Moderate (50-73)	12(2.5)
	Good (74-98)	1(0.2)
Knowledge about the application of stem cells	Very low (0-5)	0(0.0)
	Low (6-11)	46(9.8)
	Moderate (12-15)	267(56.7)
	Good (16-22)	158(33.5)
Awareness total score	Very low (0-30)	241(51.2)
	Low (31-60)	187(39.7)
	Moderate (61-91)	43(9.1)
	Good (92-120)	0(0.0)
Attitude towards the use of stem cells	Very poor (8-16)	0(0.0)
	Poor (17-24)	34(7.2)
	Moderate (25-32)	340(72.2)
	Strong (33-40)	97(20.6)

cells and their applications in section B. More than half of the students had very weak knowledge about stem cell types and their applications. Fortunately, 437 students (92.8%) showed moderate and strong attitudes toward stem cell applications and no participant had a very low score, which indicates the positive attitude of students toward stem cell applications (Table 4). Furthermore, the Pearson correlation analysis showed a strong correlation between awareness about the use of stem cells and the awareness total score (r=0.990, P=0.0001). A weak correlation was observed between the total score of stem cell awareness and knowledge

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Table 5. The correlation between questionnaire sections

	1	2	3	4
Awareness about the types of stem cells	-			
Knowledge about the application of stem cells	0.143	-		
Awareness total score	0.990	0.283	-	
Attitude towards the use of stem cells	0.052	0.325	0.097	-

about stem cell applications (r=0.283, P=0.000) and also between stem cell awareness and knowledge about stem cell applications (r=0.143, P=0.002). No correlation was found between attitude toward stem cell and total stem cell awareness (r=0.097, P=0.035) as well as stem cell attitude and stem cell awareness (r=0.052, P=0.258). There was a moderate correlation between attitude toward stem cells and knowledge about the use of stem cells (r=0.325, P=0.0001) (Table 5).

4. Discussion

The present study investigated the knowledge and attitude of GUMS students about stem cell applications in neurological disorders. Our findings revealed that a large number of students had little knowledge about stem cells and their applications, more precisely about their use for neurological disorders. Although the students' knowledge was disappointed, their strong attitude toward stem cell applications was encouraging.

Although, in general, higher grade students (medical and non-medical) showed better scores in knowledge and awareness sections, medical students' scores did not differ by their educational year rendering the lack or absence of educational programs and courses in their curriculum during their study in medicine.

Zühre Kaya et al. in Turkey investigated the impact of a brief targeted educational program about hematopoietic stem cell transplantation and donation on the knowledge level of 301 first-year students. They showed that this program significantly increased the knowledge of the students as well as their willingness to participate in stem cell donation [13]. In another study, a total number of 85 nursing students (43 in the experimental group and 42 in the control group) took a pre-test. Then, the experiment group attended an educational program about hematopoietic stem cell donation (HSCD). Afterward, all participants took part in a post-test. Knowledge, attitude, and willingness for HSCD significantly increased in the experiment group compared to the control group. Interestingly, this result was persistent even after 14 weeks when a second post-test was held. Also, the experiment group's registration ratio for HSCD increased after program [14]. This study firmly highlights the impact of education on the students' knowledge and attitude about HSCD.

In addition, Altemani et al. in Saudi Arabia designed a questionnaire to evaluate the knowledge and attitude of 75 doctors and 45 medical students about stem cell therapy in diabetes mellitus. They found that only 2.5% of participants had good knowledge about stem cells. Also, their attitude toward stem cell therapy was not strong and only 10% of them had a good and excellent attitude. This study indicates that lack of education about stem cells in universities leads to the lack of providing the optimal view and knowledge of doctors about stem cells, which causes the misleading transfer of knowledge and views about stem cells to the general public [15]. Unfortunately, there is no official educational curriculum in the field of stem cells and their applications in the treatment of diseases in Iranian medical universities of medical sciences. Considering such a program in students' educational curriculum creates a new horizon for healthcare society to increase their awareness and knowledge about stem cells and motivate them to use these new therapeutic strategies and encourage the public to donate their stem cells.

Registration of medical students at stem cell donor centers shows their knowledge and high attitude about their applications. Therefore, increasing the students' awareness about regenerative medicine and its impact on the future of medicine encourages them to find more information and participate in stem cell donor centers. More importantly, this behavior could be transferred to the public as well. Our findings revealed that students with a stem cell donor registry had better

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results regarding stem cell knowledge and attitude. In concurrent with our study, Almaeen et al. evaluated the knowledge and attitude of 217 medical and dental students about stem cells. Their findings showed that 72.4% of participants had medium knowledge and 70% of them represented a strong attitude toward stem cell research and applications. More interestingly, there was a strong correlation between the level of knowledge of students and their awareness about the Saudi Stem Cell Donor Registry [16].

In a study conducted by Narayanan et al. in the USA, the students registered for bone marrow donation had better scores in the field of stem cell awareness and knowledge. It should be noted that the high scores of these students probably contributed to their educational experience about stem cells and the necessity of donating them at the time of university admission or before [11].

Taken together, the lack of a program regarding stem cell biology in universities and educational institutes is the main reason that justifies students' low knowledge. However, the good point is that most students have a strong attitude toward stem cells and their applications.

In Iran, despite significant progress in the establishment of stem cell donation centers in recent years, not much has been done in the field of education, especially for medical students.

5. Conclusion

The students who are studying at GUMS showed low levels of awareness and knowledge about stem cells and their clinical applications in neurological disorders. However, their attitude toward stem cells was good and heartwarming.

Our findings remind us of the necessity of medical students' curriculum revision and considering new concepts and therapeutic strategies in their training because the medical sciences progress rapidly and our procrastination will take us away from the science caravan. The positive attitude of our students toward stem cell applications is an invaluable advantage that shows their passion and readiness for new therapeutic technologies.

Finally, healthcare students are reliable sources that act as knowledge transmitters to the general population, especially about novel therapeutic approaches, such as stem cells. A higher level of knowledge and attitude of the first line of health in society, including

students and doctors, is a fundamental factor to motivate and join the general population to participate in stem cell donation programs. Hopefully, educational programs for medical students regarding stem cells and their applications would increase the desire of people and clinicians to use new therapeutic strategies in the treatment of incurable diseases, such as neurological disorders.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the Ethics Committee of Guilan University of Medical Sciences (GUMS) (Ethics code: IR.GUMS.REC.1399.658).

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Authors' contributions

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Conflict of interest

There is no conflict of interests.

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