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KNOWLEDGE AND PERCEPTIONS OF REGENERATIVE MEDICINE AMONG PHYSICIANS FROM JOHOR BAHARU MALAYSIA

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ABSTRACT

Regenerative medicine holds an immense promise in addressing health challenges in an effective mean, albeit its clinical practice is still limited. This study aims to determine the level of knowledge and perception of regenerative medicine among Malaysian physicians and also to measure its association to demographic factors. A self-administered questionnaire was designed to collect responses on demographic characteristics, knowledge and perception by randomly distributed to 100 physicians in Johor Baharu Malaysia. Total scores on selected questions were used to assess the level of knowledge. The highest possible score was 18. Statistical analysis was conducted using SPSS software. The survey had a 100% response rate. Participants were in age range of 25 to 55 years from 11 different specialities with 1 to 33 years in practice. The total scores ranged from 4 to 14 (Mean = 7.76 ± 2.46). Physicians in age group 25-35 have significantly higher level of knowledge (p = 0.033). Specialty (p = 0.00), gender (p = 0.003) and place of graduation (p = 0.009) also significantly determined the level of knowledge. All the participants had a high level of perception on regenerative medicine. In conclusion, a poor to moderate level of knowledge but high level of perception was observed amongst participants. Therefore, educational initiatives such as conferences and seminars should be organized to increase the knowledge and awareness of Malaysian doctors on regenerative medicine and its application.

1.0 Introduction

The medical field is fast growing and ever evolving. It is vital that medical doctors are regularly trained to advance their knowledge. Attending Continuing Medical Education (CME) programs is part of a life-long learning process for clinicians and the nature of their work makes it mandatory for them to be up-to-date with the current advances pertaining medical field to maintain their professional competence [1]. However, there is an obvious gap between the time the research is published and the time that the clinicians are aware of it, and adopt it in their

daily practice [2]. Furthermore, current trends show that contemporary medicine brings exciting and innovative new diagnostic and treatment opportunities which had not been taught in medical schools previously. It has been reported that CMEs too have faced challenges recently in terms of theoretical bases, methodology and even expected outcomes [3]. However, the continuous education for awareness, acceptance and willingness to apply and adhere to new innovative methods of treatments has not been properly practiced. Moreover, it has been confirmed that knowledge, attitude and perception of clinicians are important determinants in the management of diseases [4].

Regenerative medicine as a multidisciplinary field is a promising area of research and therapy in healthcare [5]. Regenerative medicine, tissue engineering, stem cell therapy and its related fields are relatively at their infancy stage, but rapidly advancing in Malaysia, garnering significant interest from medical doctors, medical researchers, as well as the public [6]. However, challenges lie in keeping clinicians abreast of the latest information on approved treatments in Malaysia and other countries. Acceptance that such challenges do exist may be the first step in improving healthcare services. Meanwhile, the extent of knowledge and perception of the healthcare providers' on new medicinal products, application, practice, treatment and medical device has a direct impact on the development and improvement of healthcare services. A higher level of knowledge in scientific disciplines including regenerative medicine may increase the number of medical doctors and their level of involvement in research activities thereby advancing the science, therapeutic potential and application of regenerative medicine amongst the medical community. Since there are no published findings available on the level of knowledge and perception on regenerative medicine among Malaysian medical doctors, this study aimed to provide pilot data on a group of doctors in Johor Baharu (JB) and also to detect any association between demographic factors and the level of knowledge and perception in the study population.

2.0 Materials and methods

a. Participants

This was a cross sectional study utilizing a self-administrated questionnaire which was designed by the study team to assess information on regenerative medicine. The sampling method used was a non-probability convenience sampling. Johor Baharu (JB) which is one of 13 states in Malaysia was selected as the site of study due to the residency of the main researcher. The participants were medical doctors practicing in JB which were identified and invited to participate in the study through professional networking. Inclusion criteria for this study were: (i) being a medical doctor either a general practitioner (GP) or a medical specialist; (ii) practicing in JB in either private or government segments; (iii) consented volunteers.

Ethical approval was obtained from the research and ethics committee in the Faculty of Medicine and Health Science, UCSI.

b. Questionnaire Design

The questionnaire consisted of three sections: 1) demographics, 2) knowledge on Regenerative Medicine and 3) perception of Regenerative Medicine. The first part of the questionnaire established the respondents' demographic variants including age, gender, religion, race, marital status, year and place of graduation from medical school and medical discipline. Part two of the questionnaire was designed to determine the level of knowledge of the participants using 18 items in seven questions, all of which had three optional answers (yes, no and not sure). These questions were designed to assess the knowledge of participants both on basic (3 questions with 9 items) and also clinical applications of regenerative medicine (4 questions with 9 items). Score '1' was given to each correct answer and score '0' was given for each wrong answer as well as the answer of "not sure". Thus the highest possible score for each participant was 18. Part three of the questionnaire was set out with 5 items to evaluate the perception of the respondents towards regenerative medicine. Surveys were completed in front of one of the authors and approximate completion time was 10 to 15 minutes. Prior to attempting the survey, the author briefed the respondents on the objective of the study and a written informed consent was obtained from each participant.

c. Data Analysis

The data collected from the questionnaire was analysed using Statistical Package for Social Science (SPSS) version 20.0 system. The data cleaning process was carried out before proceeding with data analysis. Continuous variables were described with mean ± standard deviation, and qualitative variables were expressed as percentage value. The distribution and association, means, median, mode, percentage, standard deviation of all demographic variables, knowledge and perception of regenerative medicine among physicians were analysed by computing descriptive statistical analysis. In this study we perform ANOVA for further analysis that tell us whether three or more means are the same so it tests the null hypothesis that all group means are equal toward knowledge and perception of regenerative medicine. The F-ratio was reported to control the type I error. Due to the low number of participants in some of the sub-specialist groups, participants were grouped into two distinct groups of GP and specialist for the ANOVA analysis. The level of significance (with 95% confidence) was set at 0.05.

Table 1 Demographic, practice characteristics and mean score of100 doctors who responded to a questionnaire about regenerative medicine

Characteristic		*Number (%)*	*Mean Score (±SD)*
Age group	25-35 years	41 (41%)	8.37 ± 2.53
	36-45 years	36 (36%)	7.92 ± 2.56
	46-55 years	18 (18%)	6.50 ± 1.51
	46-55	5 (5%)	6.20 ± 2.17
Gender	Male	47 (47%)	8.26 ± 2.76
	Female	53 (53%)	7.32 ± 2.08
Religious	Islam	34 (34%)	7.53 ± 2.64
	Buddhist	33 (33%)	8.15 ± 2.56
	Hindu	23 (23%)	7.30 ± 2.06
	Other.	10 (10%)	8.30 ± 2.36
Marital status	Married	83 (83%)	7.73 ± 2.41
	Single	17 (17%)	7.88 ± 2.76
Ethnicity	Malay	34 (34%)	7.79 ± 2.67
	Chinese	37 (37%)	7.69 ± 2.44
	Indian	27 (27%)	7.82 ± 2.36
	Others	2 (2%)	7.50 ± 2.12
Working Disciplines	1.General Practice	36 (36%)	7.31 ± 1.88
	i. Medical Officer	32 (32%)	6.66 ± 1.62
	ii. General Surgeon	5 (5%)	9.80 ± 2.78
	2. Specialists:		
	i. Gynaecology	6 (6%)	7.00 ± 2.28
	ii. Orthopaedics	4 (4%)	9.25 ± 2.22
	iii. ENT	4 (4%)	10.75 ± 3.95
	iv. Ophthalmology	3 (3%)	10.00 ± 3.00
	v. Neurology	3 (3%)	6.67 ± 2.89
	vi. Psychiatry	3 (3%)	10.00 ± 1.73
	vii. Cardiology	2 (2%)	13.00 ± 1.41
	viii. Paediatrician	2 (2%)	11.50 ± 0.71
Place of Graduation	Malaysia	34 (34%)	8.00 ± 2.34
	United Kingdom	6 (6%)	10.50 ± 3.08
	Russia	21 (21%)	7.76 ± 2.70
	India	21 (21%)	6.81 ± 2.23
	Indonesia	18 (18%)	7.50 ± 1.86
Year of Graduation	1980-1989	8 (8%)	7.36 ± 2.00
	1990-1994	26 (26%)	7.15 ± 2.31
	1995-1999	31 (31%)	8.19 ± 2.45
	2000-2013	35 (35%)	8.67 ± 3.18

3. Results

A hundred physicians were invited to participate in the survey and we had a full response from them. All questionnaires were completed. Most respondents were either general practitioner (GP) (36%) or medical officer (32%) (Table 1). The socio-demographic characteristics of participants are tabulated in Table 1. About 78% of the participants were in the range of 25 to 45 years old. Ninety four percent (94%) of participants had graduated either from Malaysian or other Asian medical

schools. The experience of the participants as physician varied from 1 to 33 years with majority of them (35%) having been in practice for less than 15 years.

To assess the level of knowledge of participants in the basics of regenerative medicine, they were asked about the definition and source of stem cells.

Table 2 Questions in part 2 of questionnaire for assessment of knowledge on Regenerative medicine among medical doctors in Johor Baharu

	Knowledge Questions	*Yes*	*No*	*Not Sure*
1	Stem cells can be defined as:			
	a) Normal cell can be found only in bone marrow	65	17	18
	b) Specialized cells used in cancer treatment	76	17	7
	c) Stem cells can be found in platelet rich plasma (PRP)	72	20	8
	d) Unspecialized cells with potential to differentiate into variety type of cells	76	24	-
2	In your opinion, stem cell can drive from:			
	a) Adipose tissue	25	69	6
	b) Bone marrow	77	23	-
	c) Cord blood	18	64	18
	d) Embryo	73	24	3
3	Do you believe that oral consumption of stem cell is efficient to treat a disease?	21	79	-
4	Definition of Regenerative Medicine (RM) is			
	a) A branch of medicine which involves repair, replace and regeneration of cells and tissue.	100	-	-
	b) A branch of medicine which treat diabetes.	58	23	19
	c) A branch of medicine involving neuroscience.	57	28	15
5	Is this application part of regenerative medicine?			
	a) Cloning	25	67	8
	b) Organ Transplantation via autograft	50	40	10
	c) Stem Cell therapy	83	17	-
	d) Tissue engineering	68	32	-
6	Is drug delivery part of regenerative medicine?	19	69	12
7	Can stem cell therapy cause cancer in certain conditions?	54	40	6

About 45% of the answers were correct. In such, when asked about the source of stem cells, the most common response was for bone marrow (77%) and embryo (73%). The majority of participants did not know that adipose tissue and cord blood are the some other source of stem cells. Only a small number of participants, 25% and 18% respectively were able to correctly identify these other sources. The majority of respondents (79%) knew that oral consumption of stem cell is not an efficient mean to treat a disease. The questions the highest number of incorrect answers were those on the cord blood as not being a source of stem cell (82%), drug delivery is not being a treatment modalities of regenerative medicine (81%), defining stem cells as specialized cells used in cancer treatment (76%) and PRP as a source of stem cell (72%). The response to questions and finally tally scores to all questions answered by the participants is summarized in Table 2. Mean knowledge scores were calculated based on the number of correctly answered questions in part two of the questionnaire. "Not sure" responses were made about 7% of the total responses and were considered as incorrect answers to be scored as zero. The total scores ranged from 4 to 14 (Mean = 7.76 ± 2.46). A significant difference was observed in the level of knowledge about the basics of regenerative medicine between physicians in the age group of 25-35 and 46-55 years ($p = 0.033$). Female participants had a significantly higher level of knowledge in comparison to the males ($p=0.003$, F-ratio= 9.067). Since the number of participants in each medical specialty was small, to ensure a more accurate analysis, all the participants were grouped in either GP or specialist. Analysis stratified according to specialty showed that the GPs have significantly lower level

of knowledge compared to specialists (p=0.00, F-ratio is 25.297). However, a separate analysis was also done for each sub-specialty. Accordingly, Cardiologists had the highest level of knowledge about the basics of regenerative medicine among all the participants (Mean= 13±1.414) followed by Pediatricians (Mean: 11.5± 0.707) and ENT specialists (Mean: 10.75±3.948). Significant differences were observed between cardiologists and GPs (p=0.009), Medical officers (p=0.002), Gynecologists (p= 0.020) and Neurologists (p=0.036). Also, ENT specialists showed significant differences with Medical officers (p=0.011). A non-significant difference between Pediatricians and Medical Officers (p=0.054) was observed.

Moreover, countries where the participants graduated from showed a significant association with level of knowledge, as such graduates from United Kingdom have a higher score compared to those who graduated from India (p= 0.009).

There was no association between race, religion, marital status, year of practicing with level of knowledge about the basics of regenerative medicine amongst doctors in JB.

A high level of perception toward regenerative medicine applications was observed among the study participants. Moreover, results from part three of the questionnaire (Table 3) showed that the majority of respondents (more than 80%) have an interest to participate in related educational programs to improve their knowledge and practical skills and to be involved in therapeutic applications of regenerative medicine if it were approved by authorized bodies. A majority of respondents (77%) agreed with this statement that regenerative medicine would be the next era of preventive and therapeutic medicine. There was no association between any of the demographic factors and perception of regenerative medicine among participants.

4. Discussion

The significance of the survey data collection is to design clinical guidelines, improving patients' safety, physicians' learning needs and regulatory policy-making which has been highlighted in a number of studies [7-11]. On the other hand, data from several surveys have shown an association between some of the socio-demographic variables and the level of knowledge in different areas of medical science [12-14] but there is no such study in regard to the field of regenerative medicine. Accordingly, our results show that medical speciality and age were the key determinants of the level of knowledge in regenerative medicine among study participants. We believe that specialists were more knowledgeable and had positive perception on regenerative medicine because they are faced with more challenging medical problems, or had patients who probably needed cell therapy and other regenerative medicine applications when compared to a general practitioner. Such belief is also in line with previous observations which found a higher level of knowledge on specific conditions among physicians caring for affected persons [15-16]. Furthermore, the significant difference between the two age groups in regard to knowledge on regenerative medicine may be explained by younger doctors were more up-to-date on clinical developments and current standards of care. This observation is in agreement with other studies which reported age as a predictor of beliefs or special practice among physicians [17-18]. However, this result contradicts a study by Martinez et al. [19] which found there was no effect of age on a clinician's knowledge on a specific disease.

In this study, significant gender differences were observed in regard to knowledge on regenerative medicine, favouring female physicians. Previous findings have found gender to influence attitude, knowledge, perception and interest towards different medical practices among physicians [20-23]. However, effects of ggender differences are not limited to medical practices and have been reported in different fields [24-27]. For instance, a study by Simon [28] has revealed that more knowledge of biotechnology in males and females increases the probability of being negative about science. In addition, a gender–education interaction was observed which shows the independent effects of education and knowledge of biotechnology on attitudes in male but not female.

The high response rate from participants of this study may have been due to the selection of participants from a medical community with a strong network between physicians practicing within a small city. This is consistent with a study by Nicholas and his group [29]. However, a high response rate to a survey does not guarantee the validity of the results since the other origin of inaccuracy should be taken into account [30].

Overall, our results indicate that randomly selected doctors from JB in general have a poor to moderate level of knowledge about regenerative medicine and its applications. Whilst this may lead to poor management of diseases in a number of patients, the effect may not be significant at this stage, due to the infancy stage of regenerative medicine clinical applications. Furthermore, most of regenerative medicine practices and stem cell therapies are yet to be approved for human diseases [31]. However, it is expected that medical doctors should have a broad knowledge of available and approved therapies and be able to counsel these treatment options to patients. Over time, there are a number therapies being established and an increasing number of clinical trials being launched [32-34], medical doctors' knowledge and perception on regenerative medicine may be directed to better disease management. Recently, it has been reported that clinical applications of new methods and therapies, which have been translated from biomedical research, rely on specialist knowledge [35].

Table 3 Questions in part 3 of questionnaire on perception of regenerative medicine among physicians in JB

	Question	*Yes*	*No*	*Not Sure*
1	Does practicing regenerative medicine harmful?	13	87	0
2	If any of the regenerative medicine applications are approved by authorized bodies, do you have interest to participate in any educational program?	84	13	2
3	If any of the regenerative medicine applications are approved by authorized bodies, do you have interest to apply it in your practice?	86	14	0
4	In view of your religion, is there any restriction for you on practicing regenerative medicine?	7	93	0
5	Do you agree with this statement that regenerative medicine would be the next era of preventive and therapeutic medicine?	77	23	0

On the other hand, even stem-cell-based therapies are the only available care for a few diseases, such as leukemia, the extraordinary promise of regenerative medicine has raised the expectations of both clinicians and the public [36]. Nevertheless, lack of knowledge is one of the barriers to use the approved treatment and screening test for the patient. Thus by the rapid advancement in all areas of regenerative medicine, the need for translational medicine to translate basic research to clinical practice by increasing the clinicians' knowledge and perception is obvious. The exceptional attention to translational medicine for many new biomedical sciences in recent decades from both clinicians and scientists gives hope toward patient-centered treatment. However, the field of translational regenerative medicine is in its infancy [37] and many of clinicians show a substantial lack of knowledge regarding the basics of regenerative medicine. The main purpose of knowledge translation is to ensure that there is adequate awareness, access and application of products of from evident-based research among all levels of healthcare providers and consumers [38].

Interestingly, a high level of perception of regenerative medicine was observed among doctors in JB. Our results also suggest that doctors in JB are favorable to educational training in regenerative medicine. At first glance, this may also imply that they are willing to improve their knowledge and probably apply it in their patients care either directly by daily practice or referring them to more established centers in this field. Advanced understanding of stem cell therapy and regenerative medicine will assist health care professionals to carry out their roles, and the continuing educational program may be one of the potential approaches in achieving this goal. Consequently, general practitioners are an important target group for the educational program. Although many have inadequate knowledge on the topic, they are often considered as the principle source of health information for their patients as well as public. The satisfactory response rate suggests that demographic factors are not a determinant among Malaysian doctors in JB regarding their perception for acquiring new knowledge.

5.0 Conclusion

Our results point out a substantial lack of knowledge regarding even the basics of regenerative medicine among medical doctors in Johor Baharu (JB). However, among socio-demographic factors, in being a medical doctor by specialty, younger age and female were determinants of having a higher level of knowledge in regenerative medicine in the study population. Although the knowledge of regenerative medicine was poor to moderate among medical doctors in JB, the high level of perception indicates the need for authorized bodies to plan continuing educational programs to develop and improve a clinicians' knowledge on regenerative medicine and its related fields. Such programmes will not just benefit the doctors but also the entire community of academicians and industry experts in the long term. However, this study was conducted in one city and a multi-location study with a larger

sample size is needed to justify designing appropriate educational program for all medical doctors in Malaysia.

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