

# Perception and Knowledge About Stem Cell and Tissue Engineering Research: A Survey Amongst Researchers and Medical Practitioners in Perinatology

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## Abstract

**Introduction** Stem cell and tissue engineering (SC&TE) research remain controversial. Polemics are potential hurdles for raising public funds for research and clinical implementation. In view of future applications of SC&TE in perinatal conditions, we aimed to measure the background knowledge, perceptions or beliefs on SC&TE research among clinicians and academic researchers with perinatal applications on the department's research agenda.

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**Material and Methods** We polled three professional categories: general obstetrician gynecologists, perinatologists and basic or translational researchers in development and regeneration. The survey included questions on demographics, work environment, educational background, general knowledge, expectations, opinions and ethical reflections of the respondent about SC&TE.

**Results** The response rate was 39 %. Respondents were mainly female (54 %) and under 40 years (63 %). The general background knowledge about SC&TE is low. Respondents confirm that remaining controversies still arise from the confusion that stem cell research coincides with embryo manipulation. Clinicians assume that stem cell research has reached the level of clinical implementation, and accept the risks associated of purposely harvesting fetal amniotic cells. Researchers in contrast are more cautious about both implementation and risks.

**Conclusion** Professionals in the field of perinatology may benefit of a better background knowledge and information on current SC & TE research. Though clinicians may be less aware of the current state of knowledge, they are open to clinical implementation, whereas dedicated researchers remain cautious. In view of the clinical introduction of SC & TE, purposed designed informative action should be taken and safety studies executed, hence avoid sustaining needless polemics.

**Keywords** Stem cell · Tissue engineering · Embryonic · Fetus · Amniotic fluid · Perinatology

## Introduction

Stem cell and tissue engineering (SC&TE) are modern technologies that have been controversial from their initial reporting. Today they still are, despite years of successful

research. This controversy lives among the general public and law makers, as well as some medical care givers, researchers, scientists and eventually among public decision makers [1]. The controversy may initially have found its start in the confusion between stem cell research and human embryo manipulation and the debate consists in a merely re-iteration of arguments for or against giving moral status to embryos [2, 3]. In vitro fertilization is a major progress for patients suffering from infertility problems, but a side effect is the generation of redundant embryos, from which embryonic stem cells (ESC) can indeed be isolated. Destruction of human embryos to create ESC lines is considered as immoral by pro-life movement members because they see the embryo as an early-age human life [2]. This issue was technically solved by the development of new ESC isolation techniques avoiding embryo destruction [4, 5]. Next to that, there is also a more generic opposition to the use of postembryonic stem cells, whether they are isolated from redundant fetal [6] and placental material, amniotic fluid [7] or from adult tissues [8, 9]. Confusion is a major hurdle for research. False beliefs can lead to needless negative opinions with subsequent impact on care providers, patients and decision makers.

With a continuous flow of headlines about new developments in stem cell and tissue engineering applications, it seems that we come increasingly closer to clinical implementation. This also applies to the field of fetal medicine, including the management of surgically correctable congenital birth defects as well as neonatal acquired diseases [10–12]. Fetal or postnatal surgical intervention often falls short, for which prenatal stem cell and gene therapy have a therapeutic potential [13]. Herein we embarked on a survey to explore if and how much the perinatal professional community is ready to embrace this novel technology. We aimed to analyse the relation between perceptions and background knowledge on stem cells and tissue engineering (SC&TE) research and considerations about human SC & TE experiments, among practicing general obstetricians and gynaecologists, academic specialists in perinatal care as well as their researchers. This will help us to assess the need for appropriate information and education about SC&TE research to build an adequate image and to forge an opinion.

## Materials and Methods

We aimed to interview 50 subjects within each of three empirically chosen different professional categories: (A) general obstetrician gynecologist (OB/GYN) practitioners, without formal subspecialty, (B) perinatologists (i.e. fetal medicine specialists, neonatologists, pediatric surgeons and obstetricians working in tertiary units; PERINAT) and (C) academic basic or translational researchers in the field of development

and regeneration, who are not necessarily medical doctors (RESEARCH).

Physicians with a general profile were recruited by e-mailing the membership of regional societies of obstetricians and gynaecologist ( $n=127$ ) as well as neonatologists ( $n=79$ ) and fetal medicine specialists ( $n=91$ ) (PERINAT). The RESEARCH group was recruited among stem cell researchers from the laboratories working in the field of stem cell applications in human development and regeneration of the Katholieke Universiteit Leuven and the Université Libre de Bruxelles ( $n=118$ ). The numbers above indicate the number required to obtain around 50 responses per group.

The questions (Appendix 1) included questions on demographics, work environment and educational background of the respondent, followed by questions about:

1. The respondent's general knowledge on stem cell applications and tissue engineering;
2. The respondent's expectations, opinions and ethical reflections on stem cell applications and tissue engineering in the field of perinatology.

Respondents could answer anonymously, and return their questionnaires to one central address by prepaid envelope. Descriptive statistics was made for demographic variables, and further analysis was done by educational background, working environment and age. Ordinal questions were tested using the Pearson's chi-squared test. A P value below 0.05 was considered as significant; values being displayed in the tables (R version 3.0.1, <http://www.r-project.org/>).

## Results

The overall response rate was 39.0 % ( $n=162/415$ ) and different among the three professional groups. The characteristics of respondents categorized by group are summarized in Table 1. Though 17 nationalities were represented in the survey, the majority of participants was Belgian (50.6 %,  $n=82$ ). We first analysed the answers by professional groups. The age profile among respondents was different for each professional group, e.g. we obtained more response from senior (>50) perinatologists than early career (30–50 years) general obstetricians.

### Questions About Background Knowledge on Stem Cell Applications and Tissue Engineering

The average knowledge (Q6 & Q7) on and interest (Q8 & Q9) in stem cell applications and tissue engineering was limited for general OB/GYN (84 %) as well as for perinatologists (74 %), with a mirror image for researchers (Table 2). This was even more marked for knowledge on *amniotic fluid-derived* stem

**Table 1** Demographical characteristics of the participants with difference according to the background education

		All respondents		General OB/GYN		Perinatologists		Researchers		<i>p</i> value
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Total		162	100	51	31.5	50	30.9	55	34	
Gender (Q1)	Male	71	44.7	22	44.0	23	46.0	22	44.0	0.802
	Female	90	53.8	27	54.0	27	54.0	33	66.0	
Age (Q2)	<30y	47	29.0	13	26.0	1	2.0	16	32.0	<0.001
	<40	53	32.7	16	32.0	19	38.0	13	26.0	
	<50	33	20.4	13	26.0	12	24.0	8	16.0	
	≥ 50	28	17.3	8	16.0	18	36.0	0	0.0	
Place of work (Q3)	Private practice	6	3.7	3	6.0	1	2.0	1	1.8	<0.001
	District general hospital	11	6.8	7	14.0	3	6.0	0	0.0	
	Academic hospital	87	53.7	40	80.0	46	92.0	0	0.0	
	Research laboratory	56	34.6	0	0.0	0	0.0	53	96.4	

cells research (Q13) with over 75 % of clinicians, and 42 % of researchers reporting to be unfamiliar with it. Surprisingly, two out of three respondents were convinced that the current

level of development of stem cell research (Q12) has reached the level of moving from the bench to the bedside, and 70 % were convinced that this type of research is, or is about, to be

**Table 2** Participant knowledge about SC&TE research according to the professional background

		All respondents		General OB/GYN		Perinatologists		Researchers		<i>p</i> value
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Knowledge on stem cell applications (Q6)	Non existing	12	7.4	7	14.0	4	8.0	1	1.8	<0.001
	Limited	88	54.3	35	70.0	34	68.0	15	27.3	
	Familiar	38	23.5	6	12.0	10	20.0	22	40.0	
	Expert	22	13.6	2	4.0	2	4.0	17	30.9	
Knowledge on tissue engineering (Q7)	Non existing	27	16.7	14	28.0	10	20.0	2	3.6	<0.001
	Limited	94	58.0	30	60.0	34	68.0	27	49.1	
	Familiar	34	21.0	5	10.0	3	6.0	24	43.6	
	Expert	6	3.7	1	2.0	3	6.0	2	3.6	
Interest in stem cell applications (Q8)	None	3	1.9	2	4.0	0	0.0	1	1.8	<0.001
	Minimal	67	41.4	31	62.0	19	38.0	15	27.3	
	Important	90	55.6	17	34.0	30	60.0	39	70.9	
Interest in tissue engineering (Q9)	None	14	8.6	6	12.0	4	8.0	4	7.3	0.131
	Minimal	75	46.3	29	58.0	20	40.0	22	40.0	
	Important	72	44.4	15	30.0	26	52.0	29	52.7	
SC program (Q10)	Yes	91	56.2	23	46.0	23	46.0	41	74.5	0.006
	No	33	20.4	13	26.0	15	30.0	4	7.3	
	I don't know	37	22.8	14	28.0	12	24.0	10	18.2	
TE program (Q11)	Yes	55	34.0	10	20.0	13	26.0	28	50.9	0.007
	No	42	25.9	13	26.0	17	34.0	11	20.0	
	I don't know	64	39.5	27	54.0	20	40.0	16	29.1	
Level of development (Q12)	In vitro	8	4.9	4	8.0	2	4.0	2	3.6	0.383
	In vivo animal	33	20.4	11	22.0	7	14.0	14	25.5	
	Human experiment	97	59.9	26	52.0	33	66.0	35	63.6	
	Routine clinical	17	10.5	6	12.0	7	14.0	2	3.6	
	I don't know	6	3.7	3	6.0	1	2.0	2	3.6	
AF-SC knowledge (Q13)	Not interested	13	8.0	4	8.0	3	6.0	6	10.9	<0.001
	Aware	38	23.5	3	6.0	8	16.0	24	43.6	
	Unfamiliar	108	66.7	43	86.0	39	78.0	23	41.8	

clinically effective for patients (Q17). Respondents with a clinical background are in general more optimistic about safety and the point in time that it will be clinically introduced than researchers.

At least 20 % of the academic respondents (PERINAT and RESEARCHERS) were unaware of a specific operational (pre)clinical perinatal stem cell (Q10) research program. Being asked the same question about a tissue engineering research program (Q11), more than 30 % replied not to be aware of an in house (pre)clinical research programme ( $p=0.007$ ).

#### Questions About Expectations for, Opinions and Ethical Thoughts on Stem Cell Applications and Tissue Engineering

Table 3 displays these results. Q15 polled about reasons why non-embryonic stem cell research might be controversial. Over two thirds indicated that this was due to a lack of information, and one respondent out of two that there might be confusion on embryonic and non-embryonic stem cell research or that commercial abuse would be possible. RESEARCHERS were particularly cautious about potential harm (51 %), which was much less the case for clinicians (<33 %). One third of respondents worried about the impossibility of the fetus to consent for stem cell research. When clinical applications become possible, most respondents think that the medical community would still worry about safety (Q20; 69 %), and the general public would not embrace it because of lack of knowledge (Q21; 51 %). Respondents with a clinical background are in general more optimistic than researchers about safety and the exact point in time that this will be introduced clinically.

Participants were asked about the source of SC, and the majority indicated this should be on redundant material (Q16, 63 %,  $n=102$ ). No differences in answers were observed among the three professional categories ( $p=0.426$ ). Conversely, at the same time over 70 % of respondents thought that on purpose amniotic fluid sampling was acceptable (Q18) or that they would feel comfortable to ask their patient to do so (Q19). Basic researchers were more reluctant on this matter (Q18).

#### Subgroup Analysis

We also looked at differences according to other demographic variables than professional background, i.e. gender and age (Tables 4 and 5). Gender distribution was not equal within the different professional groups, e.g. 54 % females for general OB/GYN and 66 % in the RESEARCH group. The response rate among males and females was however equal. There were more women reporting a lack of knowledge on TE but not on SC-research (Q7).

The same goes for trends according to the age of respondent, categorized as age under or above 40 years. First, we

obtained more answers from younger people (<40 years). Answers from respondents  $\geq 40$  were more polarized i.e. more respondents reporting no previous knowledge on, or considering themselves experts in tissue engineering. Younger respondents considered their knowledge more often as limited. Respondents <40 years-old were also more reluctant to harvest fetal cells purposely (respectively 67.0 %, and 57.4 %) rather than work with redundant material only. This difference was not observed when analysing the data for professional background. Again, at the same time, 68 % of the younger respondents thought that on purpose amniotic fluid sampling was acceptable (Q18) or that they would feel comfortable to ask their patient to do so (Q19). Another striking difference was that Belgian respondents were more likely not to ask their patients to donate material compared with respondents with another nationality (respectively 65.9 % vs 82.9 %,  $p=0.006$ ).

#### Discussion

We polled the professional community on the imminent applications of stem cells and tissue engineering in perinatology. These “future” users are apparently confident that SC & TE are about to be implemented, though they identified some hurdles, such as a lack of information and concerns about safety.

We selected on purpose different subgroups among the stakeholders and they indeed responded differently. Among the majority of clinicians, the average knowledge on SC&TE research is limited, whether respondents were more subspecialized perinatologists or general obstetricians gynaecologists. The knowledge on specific cell types or fetal sources, such as amniotic fluid derived cells, was even less, which for us was surprising given their professional background. Despite a rather low overall knowledge, the interest of clinicians in SC&TE applications was high, particularly among perinatologists. Also they seemed to be aware of local research programs, more so for stem cell research (46 %) than for tissue engineering (26 %), again with a difference according to the degree of sub-specialization. Though we did not further poll about the reasons for the difference between “generalists” and subspecialists, we assume that perinatologists feel more the need for, and appreciate the potential benefit of SC&TE applications, as caregivers of the fetal patient. This coincides with the statement from subspecialists that they would be willing to harvest on purpose amniotic cells by amniocentesis, which after all is indeed a procedure with a (very low) risk [14]. However, the general attitude of all respondents was that ideally the research should be done with redundant cells. Of interest is that perinatologists also perceive the potential risks of SC&TE applications as a lesser problem. Conversely, researchers in SC&TE laboratories answered differently to all the above. Obviously, by the

**Table 3** Expectations, opinions and ethical reflections on SC&TE research

		All respondents		General OB/GYN		Perinatologists		Researchers		<i>p</i> value
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
ESC experiment(Q14)	Unacceptable	11	6.8	1	2.0	7	14.0	3	5.5	0.258
	Animal only	17	10.5	4	8.0	5	10.0	8	14.5	
	Acceptable	124	76.5	42	84.0	34	68.0	42	76.4	
	I don't know	9	5.6	3	6.0	4	8.0	2	3.6	
Cause of controversy (Q15)	Lack of infos	104	64.2	29	58.0	31	62.0	38	69.1	0.551
	Confusion with ESC	76	46.9	21	42.0	24	48.0	28	50.9	
	Commercial abuse	88	54.3	29	58.0	27	54.0	28	50.9	
	Potential arm	60	37.0	14	28.0	16	32.0	28	50.9	
	Foetus does not consent	44	27.2	14	28.0	11	22.0	16	29.1	
SC source acceptable(Q16)	redundant material	102	63.0	25	50.0	31	62.0	41	74.5	0.426
	specific material	37	22.8	13	26.0	12	24.0	11	20.0	
When will it be applicable(Q17)	Today	36	22.2	15	30.0	14	28.0	5	9.1	0.026
	About to happen	77	47.5	23	46.0	24	48.0	26	47.3	
	Next generation	37	22.8	10	20.0	11	22.0	16	29.1	
	Distant future	11	6.8	2	4.0	1	2.0	8	14.5	
Amniocentesis for SC/TE purpose (Q18)	Not acceptable	2	1.2	0	0.0	2	4.0	0	0.0	0.006
	Yes if done for another reason	31	19.1	5	10.0	4	8.0	19	34.5	
	Acceptable whatever	118	72.8	43	86.0	43	86.0	30	54.5	
	No opinion	8	4.9	1	2.0	1	2.0	6	10.9	
Would you ask you patient to donate (Q19)	Yes	118	72.8	49	98.0	45	90.0	21	38.2	<0.001
	No	6	3.7	1	2.0	3	6.0	2	3.6	
	I don't see patient	37	22.8	0	0.0	2	4.0	32	58.2	
Medical community (Q20)	Would embrace it	9	5.6	3	6.0	3	6.0	2	3.6	0.260
	Resist because of knowledge	33	20.4	12	24.0	15	30.0	6	10.9	
	Resist because of safety	112	69.1	34	68.0	30	60.0	43	78.2	
	Reject it	1	0.6	0	0.0	0	0.0	1	1.8	
	I don't know	6	3.7	1	2.0	2	4.0	3	5.5	
General public (Q21)	Would embrace it	16	9.9	4	8.0	6	12.0	6	10.9	0.544
	Resist because of knowledge	82	50.6	26	52.0	26	52.0	27	49.1	
	Resist because of safety	42	25.9	14	28.0	11	22.0	14	25.5	
	Reject it	4	2.5	0	0.0	0	0.0	4	7.3	
	I don't know	16	9.9	6	12.0	6	12.0	4	7.3	

nature of their job they have a broader knowledge on SC&TE, yet they were similarly convinced that we have (nearly) reached the level of first clinical trials. At the same time they are a little bit more cautious. For instance they perceive the harvesting of cells as risky, are more concerned about potential harm and the inability of the fetus to consent.

The fetus is nowadays considered as a patient with its own rights. Prenatal imaging techniques are continuously contributing to improve antenatal fetal diseases potential diagnosis and treatment. Despite an overall progress, fetal malformations remain major contributors for postnatal mortality and significant morbidity [15]. Stem cell and tissue engineering research could lead to new ways of repairing or replacing injured organs. For perinatal applications, the

availability and strong potential of placental, membrane and amniotic fluid-derived stem cells is a unique situation [16]. Again, the safety of harvesting amniotic fluid on purpose is medically spoken not truly a hurdle. These cells could be harvested at the moment the anomaly is diagnosed hence an amniocentesis is done, and processed during the remainder of pregnancy to build biomaterials for postnatal use when treating the defect [17].

Our survey identified different perceived worries among scientists and the general public. For the public, it seems that any polemic around SC&TE research is the consequence of a lack of information (Q21) [1] and concern about commercial abuse (Q15). These are generic issues, not unique to perinatal applications. In this respect, lessons could be learnt from the



**Table 4** Knowledge related to gender distribution and age groups

		Male		Female		<i>p</i> value	<40y		≥40y		<i>p</i> value
		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%	
Knowledge on stem cell applications (Q6)	Non existing	4	5.6	9	10.0	0.459	6	6.1	6	9.8	0.064
	Limited	42	59.2	52	57.8		48	48.5	40	65.6	
	Familiar	15	21.1	32	35.6		29	29.3	9	14.7	
	Expert	9	12.7	13	14.4		16	16.2	6	98.4	
Knowledge in tissue engineering (Q7)	Non existing	9	12.7	18	20.0	0.015	13	13.0	14	22.9	0.015
	Limited	43	60.6	50	55.6		59	59.0	35	57.4	
	Familiar	12	16.9	22	24.4		27	27.0	7	11.5	
	Expert	6	8.5	0	0.0		1	1.0	5	8.2	
Interest in stem cell applications (Q8)	None	1	1.4	2	2.2	0.845	3	3.0	0	0.0	0.362
	Minimal	28	39.4	39	43.3		39	39.0	28	46.7	
	Important	41	57.7	48	53.3		58	58.0	32	53.3	
Interest in tissue engineering (Q9)	None	5	7.0	9	10.0	0.305	9	9.0	5	8.2	0.913
	Minimal	29	40.8	46	51.1		45	45.0	30	49.2	
	Important	36	50.7	35	38.9		46	46.0	26	42.6	
SC program(Q10)	Yes	42	59.2	48	53.3	0.048	63	63.0	28	45.9	0.011
	No	18	25.4	15	16.7		13	13.0	20	32.8	
	I don't know	10	14.1	27	30.0		24	24.0	13	21.3	
TE program (Q11)	Yes	24	33.8	31	34.4	0.011	40	40.0	15	24.6	0.021
	No	26	36.6	16	17.8		19	19.0	23	37.7	
	I don't know	20	28.2	43	47.8		41	41.0	23	37.7	
Level of development (Q12)	In vitro	5	7.0	13	14.4	0.561	6	6.0	2	3.3	0.588
	In vivo animal	17	23.9	40	44.4		22	22.0	11	18.0	
	Human experiment	38	53.5	30	33.3		61	61.0	36	59.0	
	Routine clinical	8	11.3	6	6.7		8	8.0	9	14.7	
	I don't know	2	2.8	1	1.1		3	3.0	3	4.9	
AF-SC knowledge (Q13)	Not interested	8	11.3	5	5.6	0.313	9	9.0	4	6.7	0.542
	Aware	18	25.4	19	21.1		26	26.0	12	20.0	
	Unfamiliar	44	62.0	64	71.1		64	64.0	44	73.3	

introduction of umbilical cord blood banking [18]. In Belgium and France public banking is widely embraced, meaning that the use of stem cells per se is no longer questioned [19]. Also for this matter, very controversial issues needed to be cleared and these countries did choose to go for public rather than private cord blood banking. The next step is to address more the specifics of perinatal applications, such as the debate on embryonic stem cells, patient consent, and potential fetal harm. Obviously the latter was not a concern with umbilical cord blood donation, as it is considered as a 'redundant' material.

Purpose designed action needs to be taken to remove obstacles for research and development. Opinions identified through surveys like ours could help to build research promotion campaigns with both medical and political decision-makers as principal targets. SC&TE research could also benefit from a better visibility in general communication media using new tools like debates initiated on internet forums and social networks. Marketing techniques are very effective to

identify potential users needs and build a positive image of a new product that is promoted through advertising campaigns. Integration of such interesting techniques could create and improve perceptions and opinions about SC&TE research and applications.

Our poll further revealed other ambivalences within the clinical and scientific communities. Most of the participants considered redundant material as the only acceptable SC source for research (Q14). On the other hand, participants were less restrictive when specific situations closer to clinical practice were proposed. 72.8 % of respondents considered on purpose amniotic fluid sampling as acceptable (Q18). These discrepancies may be due to combining questions on using SC for research rather than treatment [18]. Similarly, the "Human Embryonic Stem Cell COordinators" group showed that when questions about research were approached in the context of treatment, the boundaries between treatment and research tended to become blurred [20] creating confusion which may be expressed through discrepant perceptions.

**Table 5** Expectations, opinions and ethical reflections on SC&TE research related to gender distribution and age groups

		Male		Female		<i>p</i> value	<40y		≥40y		<i>p</i> value		
		<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%			
ESC experiment (Q14)	Unacceptable	7	9.9	4	4.4	0.619	5	5.0	6	9.8	0.499		
	Animal only	7	9.9	10	11.1		9	9.0	8	13.1			
	Acceptable	52	73.2	71	78.9		80	80.0	44	72.1			
	I don't know	4	5.6	5	5.6		6	6.0	3	4.9			
Cause of controversy (Q15)	Lack of infos	44	62.0	60	66.7	0.738	70	70.0	34	55.7	0.062		
	Confusion with ESC	34	47.9	41	45.6		45	45.0	31	50.8		0.519	
	Commercial abuse	42	59.2	45	50.0		0.200	52	52.0	36		59.0	0.505
	Potential arm	21	29.6	39	43.3		0.102	36	36.0	24		39.4	0.039
	Fetus does not consent	22	31.0	22	24.4		0.371	24	24.0	20		32.8	0.852
	SC source acceptable (Q16)	redundant material	40	56.3	62		68.9	0.218	67	67.0		35	57.4
specific material	20	28.2	16	17.8	19	19.0	18		29.5				
When will it be applicable (Q17)	Today	15	21.1	21	23.3	0.092	20	20.0	16	26.2	0.633		
	About to happen	32	45.1	44	48.9		47	47.0	30	49.2			
	Next generation	18	25.4	19	21.1		26	26.0	11	18.0			
	Distant future	5	7.0	6	6.7		7	7.0	4	6.6			
Amniocentesis for SC/TE purpose (Q18)	Not acceptable	2	2.8	0	0.0	0.095	0	0.0	2	3.3	0.037		
	Yes if done for another reason	9	12.7	21	23.3		23	23.0	8	13.1			
	Acceptable whatever	53	74.6	65	72.2		68	68.0	50	82.0			
	No opinion	5	7.0	3	3.3		7	7.0	1	1.6			
Would you ask your patient to donate (Q19)	Yes	52	73.2	65	72.2	0.983	69	69.0	49	80.3	0.123		
	No	5	7.0	1	1.1		3	3.0	3	4.9			
	I don't see patient	13	18.3	24	26.7		28	28.0	9	14.7			
Medical community (Q20)	Would embrace it	3	4.2	6	6.7	0.472	3	3.0	6	9.8	0.245		
	Resist because of knowledge	14	19.7	19	21.1		19	19.0	14	22.9			
	Resist because of safety	51	71.8	60	66.7		72	72.0	40	65.6			
	Reject it	1	1.4	4	4.4		1	1.0	0	0.0			
	I don't know	1	1.4	1	1.1		5	5.0	1	1.6			
General public (Q21)	Would embrace it	9	12.7	7	7.8	0.821	11	11.0	5	8.2	0.078		
	Resist because of knowledge	34	47.9	47	52.2		55	55.0	27	44.3			
	Resist because of safety	18	25.4	24	26.7		23	23.0	19	31.2			
	Reject it	1	1.4	3	3.3		4	4.0	0	0.0			
	I don't know	7	9.9	9	10.0		6	6.0	10	16.4			

The ranking of the different items as potential causes for the controversy about stem cell experimentation in perinatology was very instructive. The top 3 causes were the lack of information, commercial abuse and confusion of “stem cells” with “embryonic stem cells”. The perceived obstacles for SC use in perinatal medicine were mainly safety concerns for the medical professionals whereas it was the lack of knowledge among the general public. To overcome this, targeted actions will have to be taken.

The reluctance of Belgian respondents to ask their patients to donate material for SC&TE research compared to participants from other countries is another interesting observation (Q19). It is actually surprising as Belgium has a very liberal legislation in terms of stem cell sources, which would suggest

that a public debate has been held based on appropriate information. Also, Belgium has widely embraced cord blood donation and its public banking, which is a sign of public approval. This could be an exception to our hypothetical link between background knowledge and acceptability of SC&TE research.

There was an apparent effect of gender and age on the answers to the survey. There were more female respondents (53.8 %), especially under 40 years (64.0 %). This illustrates the feminization of the medical profession, including in Obstetrics & Gynaecology [21, 22]. The answers of male respondents on their self-perceived knowledge about SC & TE were more discrepant than that of females, and they were also more frequently aware about local SC&TE research programs.

Because age and gender were statistically not independent (Fischer's exact test  $p=0,01$ ) we must be cautious with conclusions on these relationships however.

Our study has some limitations. First it is using an unvalidated questionnaire. Second we targeted a very specific population, omitting the lay public or law makers, which would certainly have been very interesting, hence should be included in future similar surveys. Third, we were rather unpleasantly surprised by the overall low response rate (39 %). Apparently this rate is what one can expect: a recent survey on the use of umbilical cord blood stem cell applications had a comparable 42 % response rate [18]. This observation should make us worry about the interest of, or position taken by the 60 % non-responding colleagues, and the impact of any future action taken because addressing issues that may not be relevant to this silent majority.

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