

Unrelated haematopoietic stem cell transplantation in Taiwan and beyond

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Since its inception in October 1993, the world-renowned Buddhist Tzu Chi Marrow Donor Registry has facilitated more than 1800 cases of stem cell donations for patients in 27 countries to date. Under the auspices of the Buddhist Tzu Chi Stem Cells Center (BTCSCC), the Registry (>310 000 donors) offers, on average, one case of stem cell donation every day to national or international transplantation community. The accomplishment of the Registry stems from the philosophy and spirit of giving without reward that was inspired by its founder Dharma Master Cheng Yen, the Samaritan devotions of selfless voluntary stem cell donors and the efforts from a dedicated network of volunteer workers. Demographically speaking, slightly less than one third of the donations are provided to domestic patients and the rest to mainland China and countries in Asia, North America, Europe, Middle East, Oceania, and South Africa. While most of the patients belong to the Oriental ethnic group, a few of the patients are non-Oriental. In addition to the Registry, a non-profit umbilical cord blood (UCB) bank is operating since 2002 to provide a complimentary role for patients unable to identify appropriate bone marrow stem cell donors in the Registry in time. To date, with an inventory of over 12 000 units of UCB cryopreserved in the Tzu Chi Cord Blood Bank, 47 units have been employed in 37 cases of transplantation for both paediatric and adult patients domestically and internationally. The fact that Buddhist Tzu Chi Marrow Donor Registry and Cord Blood Bank are established and operating without governmental financial support is unique and special. To facilitate haematopoietic stem cells to its domestic patients experiencing financial burdens, the BTCSCC offers financial aids to the underprivileged for their medical relief. This humanitarian approach and compassion is definitely a role model for many countries in the world.

Introduction

The Buddhist Tzu Chi Marrow Donor Registry (BTCMDR) and Tzu Chi Cord Blood Bank (TCCBB) are non-government organisations (NGO) operating under the auspices of the Buddhist Tzu Chi Stem Cells Center (BTCSCC), Buddhist Tzu Chi Medical Centre in Hualien, Taiwan. Both divisions offer haematopoietic stem cells (HSC) to patients for transplantation purposes domestically and internationally. Since its inception in October 1993, the world-renowned BTCMDR has facilitated more than 1800 cases of stem cell donations for patients in 27 countries to date. It is also self-reliant in terms of human leukocyte antigen (HLA) typing and all stages of stem cell procurement, preservation, transport and utilisation. In fact, our laboratory has made several unique contributions to delineating the HLA makeup in the Chinese population.¹⁻⁶ The Registry, with more than 319 000 volunteer donors in its database,³ now offers, on average, one case of stem cell donation every day to national or international transplantation community on the mission of saving lives. The accomplishment of the Registry stems from the philosophy and spirit of giving without reward that was inspired by its founder Dharma Master Cheng Yen, the Samaritan devotions of selfless voluntary stem cell donors and the efforts from a dedicated network of volunteer workers.

Key words

Hematopoietic stem cell transplantation;
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Declaration

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Local and overseas stem cell donation

Demographically speaking, slightly less than one third of the life-saving stem cell donations are provided to domestic patients and a little more than two thirds are delivered to patients in China and the rest to countries in Asia, North America, Europe, Middle East, Oceania, and South Africa. While most of the patients received the HSC donations from BTCSCC were of the Oriental ethnic group, a few of the patients were non-Oriental. Until the end of 2008, a total of 1801 HSC donations were provided by BTCSCC to 27 countries and regions in all five continents over the world. These included transplantation centres in Asia (n=1642), North America (n=81), Europe (n=54), Oceania (n=24), and Africa (n=1)

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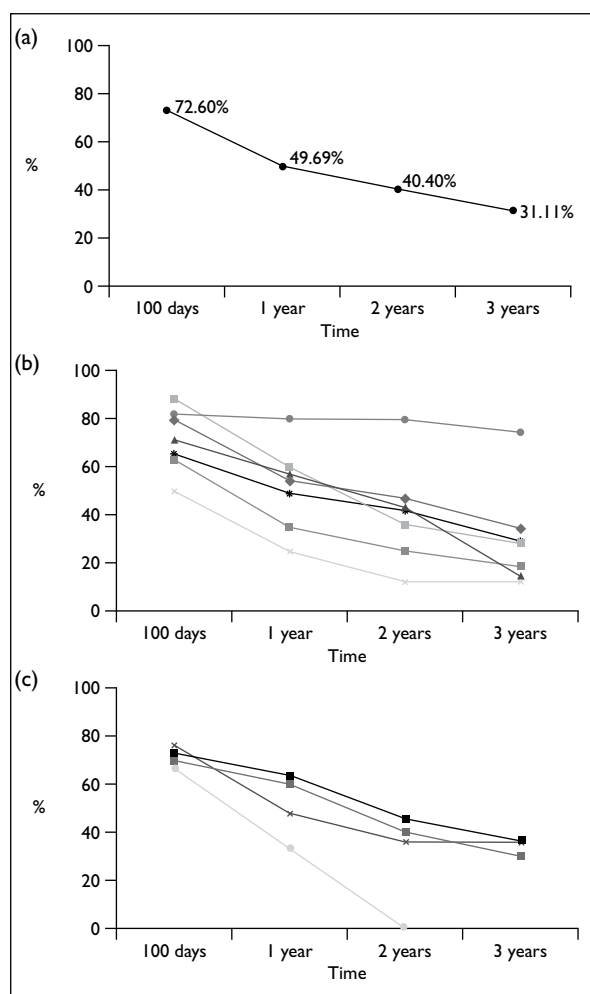


FIG. Overall survival of (a) patients worldwide receiving the haematopoietic stem cells (HSC) donations from the Buddhist Tzu Chi Stem Cells Center (BTCSCC), (b) patients in Asia receiving the HSC donations from BTCSCC [each line represents average number of patients survived in transplantation centres in each country], and (c) patients in countries outside of Asia receiving the HSC donations from BTCSCC [each line represents average number of patients survived in transplantation centres in each country]

[Box]. In Asia countries, the three leading recipient areas were China (42%), Taiwan (29.4%), and Korea (8.7%). For the rest of the world, the five leading recipient countries were the United States (US, $n=65$), Germany ($n=24$), Australia ($n=22$), Canada ($n=16$), and the United Kingdom (UK, $n=9$). This probably reflects the size of the Oriental ethnic populations in these countries, and also the relative ease, or otherwise, of obtaining such ethnic stem cells from their regional and other registries.

In Taiwan, a total of 12 transplantation hospitals received 531 HSC donations from BTCSCC. Among them, Taipei Veteran Hospital (32%) and National Taiwan University Hospital (26%) led the rest. In addition, 20 to 48 cases (4-9% each) of haematopoietic stem cell transplantation (HSCT)

非親屬造血幹細胞移植在台灣及台灣之外

國際聞名的慈濟骨髓資料庫，從1993年10月成立至今，已經提供了全世界27個國家總共超越1800例的造血幹細胞捐贈給血液疾病患者。慈濟骨髓資料庫，在慈濟骨髓幹細胞中心之管轄下，目前已擁有超過31萬筆志願造血幹細胞捐獻者，平均每天提供一例造血幹細胞服務給台灣國內或國際造血幹細胞移植的共同體。慈濟骨髓資料庫的成就歸功於其創始人證嚴法師所倡導與薰陶，和無所求而付出的精神與哲學、來自於義不容辭的志願捐獻者，和一團隊積極投入的人間志工菩薩。以人口統計學來說，略少於三分之一的造血幹細胞是獻給台灣病友，有三分之一以上是捐贈給中國，其餘則是供給在亞洲、北美洲、歐洲、中東、大洋洲及南非的國家。大部分的受贈病友是亞裔，但也有少部分病友是非亞裔。除了骨髓資料庫，從2002年起，非營利的慈濟帶血庫與骨髓資料庫能相輔相成，提供造血幹細胞捐獻給在骨髓資料庫找不到適宜捐贈者的病友，或是當病友在緊急狀況而沒有多餘的時間等候時。慈濟帶血庫至今已庫存一萬兩千袋帶血，並已使用47袋為37位病友提供含兒童或成人的幹細胞移植了。慈濟骨髓資料庫與慈濟帶血庫在無任何政府的經費支持下成立並運作成效，是相當不容易也是很令人讚揚的，為要協助弱勢清寒病友完成幹細胞移植，慈濟骨髓幹細胞中心亦提供經費援助，這種人道行為的確是世界上的典範。

had been performed with our HSC units in seven other hospitals, including our own Tzu Chi hospital in Hualien. The first stem cell supply across the straits from Taiwan to China was completed on 18 April 1997. Since then, due to its population size, the demand for Chinese HSC donations from China has rapidly outnumbered that of Taiwan itself. In fact, more than two thirds ($n=748$) of the HSC donations from BTCSCC were supplied to China, involving 41 hospitals in all. Among them, the First Affiliated Hospital of Zhejiang University (26%), Guangzhou Nanfong Hospital (14%), Guangzhou Jinan Hospital (7.3%), Peking University People's Hospital and Beijing Dao Pei Hospital (6.7% each) and Shanghai Ruijin Hospital (5.7%) were the leading recipient hospitals. It is not uncommon to have two or even three units of stem cells couriered to China to the same hospital on the same day. Geographically, the provinces receiving most stem cell units were Guangdong ($n=206$), Zhejiang ($n=197$), Beijing ($n=130$), and Shanghai ($n=92$). In addition, large numbers of donations were made to other Asian and western countries and regions. In Asia region, leading recipients of the rest of HSC ($n=363$) included Korea (43%), Hong Kong and Thailand (17% each), Singapore and Japan (10% each), and Malaysia (3%). In all these countries except Japan, one or two hospitals are responsible for over two thirds of the unrelated HSCT from BTCSCC (Korea: St. Mary Hospital $n=65$, Asan Medical Centre $n=34$; Hong Kong: Queen Mary Hospital $n=51$; Thailand: Ramathibodi hospital $n=35$; Singapore: Singapore General Hospital $n=19$ and National University of

BOX. Worldwide destination of the Buddhist Tzu Chi Stem Cells Center stem cells (numbers are shown in brackets)

Mainland China				
浙江附一 (196)	廣州南方 (105)	廣州濟南 (55)	北京道培 (50)	北京人民 (50)
上海瑞金 (43)	四川華西 (26)	蘇州附一 (25)	武漢協和 (22)	廣州珠江 (19)
上海長海 (16)	北京307 (15)	廣西附一 (13)	上海交通 (12)	上海兒童 (11)
北京301 (9)	廣東人民 (8)	西安西京 (6)	天津血研 (6)	福建協和 (6)
上海新華 (5)	廣州婦嬰 (5)	廣州人民 (5)	上海道培 (5)	湖南湘雅 (4)
徐州附一 (4)	北京第三 (4)	廣州軍醫 (3)	哈爾濱 (2)	山東濟南 (2)
南京鼓樓 (2)	武漢同濟 (2)	北京深圳 (2)	宣武醫院 (1)	海口人民 (1)
北京304 (1)	廣東汕頭 (1)	海南人民 (1)	浙江附二 (1)	重慶新橋 (1)
Taiwan				
北榮 (171)	台大 (138)	林口長庚 (48)	成大 (35)	中國 (32)
高醫 (28)	三總 (22)	慈濟 (21)	和信 (20)	奇美 (8)
中榮 (5)	高榮 (3)			
Korea				
St. Mary's (65)	Asan (34)	Samsung (11)	Seoul (7)	Inje (7)
Chonnam (6)	Pusan (5)	Severance (4)	National Cancer Center (4)	INHA (3)
Kyungpook (2)	Dong A (1)	Ewha (1)	Han Yang (1)	Kun-Kuk (1)
St. Vincent's (1)	Catholic Korea (1)	Ucsan College (1)	Yon-Sei (1)	
Hong Kong				
Queen Mary (51)	Tuen Mun (3)	Princess Margaret (2)	Prince of Wales (2)	Queen Elizabeth (2)
Marrow Match Foundation (2)				
Singapore				
Singapore General (19)	National University (12)	Mount Elizabeth (4)	KK Women Children (1)	St. Jude (1)
Thailand				
Ramathibodi (35)	King Chulalongkom (9)	Siriraj (8)	Chulalongkom (2)	Phramong Kutklao (2)
Natl. Blood Center (1)				
Malaysia				
Subang Jaya (9)	Ampang (2)			
Canada				
Vancouver General (6)	Canadian Blood Services (3)	Princess Margaret (3)	Foothills Calgary (1)	Montreal Children (1)
Toronto General (1)	Winnipeg (1)			
Japan				
Kyoto U of Tokyo (4)	Keio (2)	Meitetsu (2)	Tokai (2)	Yokohama (2)
National Kyshu (2)	Tokyo Metropolitan (2)	Univ. of Tokyo (2)	Yokohama City U. (2)	Chiba (1)
Ehime (1)	Hamahomachi (1)	JRCNFH (1)	Kurashiki (1)	Nagano (1)
National Cancer (1)	Niigata (1)	Osaka (1)	Institute of Tokyo (1)	Tohoku (1)
United States				
NMDP 514 (8)	NMDP 501 (4)	NMDP 527 (4)	NMDP 528 (4)	NMDP (3)
New York (3)	NMDP 524 (3)	NMDP 525 (3)	NMDP 535 (3)	Arlin Cancer (2)
NMDP 506 (2)	NMDP 511 (2)	NMDP 530 (2)	NMDP 579 (2)	NMDP 579 (2)
Fred Hutchinson (2)	Dallas (1)	NMDP 305 (1)	NMDP 321 (1)	NMDP 402 (1)
NMDP 405 (1)	NMDP 443 (1)	NMDP 504 (1)	NMDP 512 (1)	NMDP 518 (1)
NMDP 557 (1)	NMDP 578 (1)	NMDP 589 (1)	St. Francis (1)	Tufts (1)
Germany				
ZKRD TC Essen (3)	U Hamburg-Eppendorf (3)	Klinik fur Knochenmark (2)	Univ. of Essen (2)	ZKRD CCVKB (2)
ZKRD TC Frankfurt (2)	ZKRD Uni. Hamburg (2)	ZKRD U of Berlin (2)	DKD Wiesbaden (1)	ZKRD (1)
ZKRD LMU (1)	TC Hamburg St. George (1)	ZKRD TC Nuemberg (1)	ZKRD TC Leipzig (1)	
United Kingdom				
Anthony Nolan (3)	Bristol Royal (1)	Glasgow (1)	GOSH (1)	Newcastle General (1)
The Royal Free (1)	UCH (1)			
Australia				
Prince Alfred (4)	Perth (3)	Sydney Children's (3)	Alfred (3)	St. Vincent's (2)
Westmead (2)	Wealth (1)	Melbourne (1)	Brisbane and Women (1)	
Other countries				
Sweden (4)	France (4)	Holland (3)	Italy (3)	Israel (2)
New Zealand (2)	Philippines (2)	Belgium (2)	South Africa (1)	Switzerland (1)
Norway (1)	Denmark (1)	Spain (1)	Spain (1)	

Singapore n=12; Malaysia: Subang Jaya Medical and cities receiving HSC from BTCSCC in the West Centre n=9). In comparison, the range of institutions and Japan is scattered throughout the country

(number of centres: Japan 20; US 30; Germany 12; Australia 9; UK 7) with only two hospitals receiving more than four units.

Cord blood banking in Taiwan

In addition to the BTCMDR, the non-profit TCCBB is operating since 2002 to play a complimentary role for patients unable to identify appropriate bone marrow stem cell donors in the Registry or when time is not favourable in the location of suitable marrow donors.⁷ The first delivery of cord blood was to Johns Hopkins Hospital in July 2004 to a 2-year-old Chinese girl. To date, with an inventory of over 12 000 units of umbilical cord blood cryopreserved in the TCCBB, 47 units have been employed in 37 cases of transplantation for both paediatric and adult patients domestically and internationally. In Taiwan, a total of eight hospitals received 21 cord blood donations from TCCBB as of December 2008. In addition, cord blood units have been supplied to Hong Kong (n=6), Malaysia (n=4), US (n=3), and Singapore, Germany and UK (n=1 each).

Survival of patients after haematopoietic stem cell transplantation with stem cells from the Buddhist Tzu Chi Marrow Donor Registry

To follow-up patients who received the HSC donations from BTCMDR, follow-up reports were collected from transplantation centres. The survey asked for survival information of each patient at 100 days, 1 year, 2

years, and 3 years after the HSC transplantation. This current update used 31 December 2007 as the cut-off date for this survival rate survey. The overall rate of the follow-up return was 82.9%. The overall rate of survival of 100 day, 1 year, 2 years, and 3 years after the HSC transplantation was 72.6%, 49.7%, 40.4% and 31.1% respectively (Fig a).

Comparison of the 3-year survival rates between patients in Asia and patients in countries outside Asia is depicted in Figures b and c. Both groups had similar rate of success in HSC transplantation, suggesting that the HSC harvested worked equally well irrespective of distance between BTCSCC harvest centre and the countries of the HSC recipients.

Conclusions

The fact that BTCMDR and TCCBB are established and operating without governmental financial support is both extraordinary and exemplary. To facilitate HSCT to domestic patients experiencing financial burdens, the BTCSCC offers financial aids to the underprivileged for their medical relief. Its work is facilitated by a huge network of unpaid volunteers, and command huge public trust due to its religious and NGO background. This humanitarian approach and compassion is definitely a role model for many countries in the world. The worldwide contribution of our work is substantial in that 2.8% of all registered marrow donor in the world come from Taiwan, which make up only 0.34% of world population. The BTCSCC continues its mission set forth 15 years ago to help save lives.

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