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Private Cord Blood Banking: Current Use and Clinical Future

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Abstract International private umbilical cord blood banking has expanded rapidly in recent years since the first cord blood transplant which was 20 years ago. Private companies offer parents the opportunity to store umbilical cord blood for the possible future use by their child or other family members. The private cord blood industry has been criticised by a number of professional bodies including the EU Ethics Committee, the Royal College of Obstetrics and Gynaecology, the Royal College of Midwives and the US College of Paediatrics. This review presents the arguments from the opponents of private cord blood banking, and then makes the case for private cord banking based on the latest scientific and clinical evidence.

Keywords Stem cells · Umbilical cord · Private banking

Introduction

Most of the criticism of private cord blood banking comes from professionals in the fields of obstetrics, haematology and to some extent paediatrics [35]. These objections are based on current issues relating to autologous haematological transplantation. The issues surrounding the allogeneic use of private cord blood units and the wider debate relating to regenerative medicine have not been taken into account in the debate. Research and development in cord blood stem cell technology will also be discussed as these areas are rarely considered in this debate and have a major impact on the validity of private cord blood banking.

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Haemopoietic Stem Cell Transplants

Haemopoietic stem cell transplants using bone marrow have been carried out since 1968 [6] and represent the most widespread clinical use of stem cells. In recent years there has been a major increase in the numbers undergoing transplant using cord blood or peripheral blood stem cells [7]

Haemopoietic stem cell transplants (using either bone marrow, mobilised peripheral blood stem cells or cord blood) are used for treating haematological pathologies such as leukaemias, Hodgkins Disease, multiple myeloma and non-Hodgkins lymphoma, haemoglobinopathies, immunodeficiencies and inherited metabolic diseases [18]

In the USA approximately 30% of haemopoietic transplant patients find a suitable match from HLA matched siblings. Alternatively, by searching international public bone marrow banks an unrelated unit can be matched which accounts for about 50–80% of patients depending on the ethnic group. Nevertheless, only 30% of Caucasians and a smaller percentage of other ethnic groups ultimately get a marrow transplant from an unrelated donor. This is due to deterioration of the patients' condition or death during the search [30]. Umbilical cord blood has emerged in recent years as an attractive alternative to bone marrow [31].

Umbilical Cord Blood Transplants–The Advantages

Cord blood is widely used in transplant medicine as an alternative source of the haemopoietic stem cells found in bone marrow. According to December 2008 figures from Netcord (the international database for cord blood transplants from public banks) there have been 9020 cord blood units released for transplant to children and adults worldwide from a total inventory of 207981 units. In the USA approximately half of all haemopoietic stem cell transplants now use cord blood.

Gluckman [9, 10] has reviewed the cord blood transplant literature several times including her paper in 2000 carried out a large scale analysis of 527 cord blood transplants from 121 centres and 29 countries showing that survival following umbilical cord blood transplants was comparable to that with related or unrelated bone marrow transplants. Although engraftment with cord blood was delayed, the incidence of acute and chronic graft-versus-host Disease (GVHD) was reduced and the overall event-free survival with umbilical cord blood was not statistically different compared to bone marrow transplants. It has also been reported that despite HLA disparity in umbilical cord blood transplants, they generate comparable results in terms of engraftment, GVHD and survival with HLA matched bone marrow [39].

The advantages of using umbilical cord blood are particularly evident in the matter of related transplants. Rocha et al. [24] showed that recipients of cord blood from HLA identical siblings had a lower risk of acute or chronic GVHD than recipients of marrow from HLA identical siblings. Children with acute leukaemia who received HLA mismatched cord blood from an unrelated donor also had a lower risk of GVHD than recipients of HLA mismatched marrow from an unrelated donor [25].

Cohen and Nagler [5] reviewed 2500 umbilical cord blood transplants and concluded that cord blood transplants are accompanied by a high probability of engraftment and donor type reconstitution, but that time to engraftment represents a yet unresolved problem. The major advantage of cord blood transplants is that they allow for a greater degree of HLA mismatch (up to 50%) and there is a lower death rate from GVHD.

The use of cord blood stem cell transplantation in adults is in accepted source of stem cells for transplantation where an HLA matched adult donor is unavailable [19, 26]. The clinical use of cord blood has come to the point where it may become the front-line treatment for treatment of children suffering from leukaemia [32].

In summary, existing clinical practice as well as a range of studies supports the value of umbilical cord blood transplantation [28]. The issue is whether there is additional merit in privately storing a child's umbilical cord blood at birth, unless there is need for directed storage.

The Case Against Private Banking

A number of professional and academic bodies are unconvinced by or opposed to private cord blood banking (except for directed cord blood banking) although they do not call for a ban. These views are presented mainly in the UK by the Royal College of Obstetrics and Gynaecology (RCOG) and in the USA by the American College of Paediatrics. These policy documents include references to the odds against a child requiring an autologous transplant as being between 1 in 1,000 and 1 in 200,000 [16].

The Society of Obstetrics and Gynaecology in Canada also produced a detailed paper on cord blood banking in support of altruistic donation but against private banking for autologous use [1].

The arguments against private cord blood banking focus on the limited role for autologous haematopoietic stem cell transplant [34]. The critics make several points:

- Firstly, they claim most patients will succeed in getting a suitable HLA match from a public source
- Secondly, they claim that autologous cord blood should not be used in cases of leukaemia since cancerous changes may be present in the stem cells used [4]
- Additionally it is claimed that the autologous transplantation does not have the beneficial graft-versus-leukaemia effect that is present in allogeneic transplantation [36].

These authors also dismiss possible future uses for cord blood non-haemopoietic stem cells in regenerative medicine as "speculative". The American College of Pediatrics Policy Statement says in regard to regenerative medicine research, "the results of such research will be necessary to formulate future recommendations regarding autologous cord blood banking".

The opposition to private cord banking however is not limited to scientific evidence, but extends into the difficult terrain of public policy, bioethics, societal organisation of medicine and access to medicine. Thus, while not explicitly condemning private cord blood banking as contrary to the common interest, such bodies make it clear that their preference and policy recommendation is that donation to public banks should be encouraged. Private banking is thereby seen as being in competition for limited biological resources with public banking [29].

The European Group on Ethics [13] published opinion paper No 19 entitled 'Ethical Aspects Of Umbilical Cord Blood Banking' and came to the following conclusions:

- Private cord blood banks sell a service 'no real use regarding therapeutic options' and unrealistically raise clients' hopes. Private cord blood banking raises 'serious ethical criticisms'

- Private cord blood banks should be discouraged and where allowed operate under strict conditions. They should not banned as this would restrict freedom of choice.
- Informed consent is essential in private cord blood banking to ensure that clients fully understand the current and future clinical utility of the cord blood unit.
- Advertising by private cord blood banks must be controlled by public authorities
- European private cord blood banks must operate within the European Union Tissues and Cells Directives (EUTCD). In the UK these Directives formed the basis of the Human Tissue Act 2004 which in turn resulted in the development of the regulatory body the Human Tissue Authority (HTA). The HTA issues a license to operate to all public and private cord blood banks in the UK using both desk audit and formal inspection.
- Information should be given to private cord blood bank clients regarding the storage and safety of their cord blood units in the event of termination of business or bankruptcy
- Public cord blood banks should receive support to ensure long-term functioning

It may also be argued that private cord blood banking could result in social injustice where the rich could afford the service (at approximately £1,300 in the UK) and the poor could not. In addition, private cord blood units may never be used whereas had they been placed into a public bank they may well have been used to treat other HLA-matching patients [29].

A recent estimate on the clinically useful size of a public cord blood bank to provide a suitable match for the UK population of 61 million people was 50,000 cord blood units [23]. There is still a long way to go and with restricted financial resources such a target for the public banks may take a long time to achieve.

The Case for Private Banking

Are these authors and organisations correct in their perceptions of the value of cord blood to an individual? We believe this is not the case and that the scientific evidence shows that private banking is a reasonable and rational choice. Our view is that the critics have misunderstood the value of private cord banking, and have construed it as being identical to banking for autologous use (admittedly because many private banks themselves have been confused on this point).

We show below that the main benefit (for haemopoietic stem cell transplantation), is in the area of related allogeneic transplantation (i.e. siblings or parents) which is generally the most desired clinical option facing a transplant physician. We also outline briefly the novel types of non-haemopoietic cells present in cord blood and the potential for these in regenerative medicine.

Our view is that the professional bodies mentioned have paid insufficient attention to developments in stem cell science and regenerative medicine and to the prospect that autologous regenerative medicine technology may be used in the future. The matter of how stem cell therapies will make it to market also has a bearing on the issue in that in some cases these are likely to be autologous applications.

Private Banking–Autologous Use or Family Use?

Sullivan et al. [33] critique the private cord banking industry and refer to a private cord bank in North America which says that 34 of its units have been used and comments "*but ironically most have been for allogeneic transplant of siblings*". Nevertheless, more recent reports describe the successful use of autologous cord blood transplantation [12].

We believe that private cord blood banks have largely failed to explain the value of their service by presenting private cord blood banking as being exclusively or primarily for autologous use. In the USA in particular, private cord blood banks now focus on the real value to the family rather than to autologous use although the professional bodies in the UK such as the RCOG and RCM are still focusing exclusively on the autologous argument.

A presentation at a conference in Wurzburg in 2006 summarised data collected from private cord bank transplants [14]. An analysis of 52 transplantation cases from cord blood units stored in private cord blood banks in the period 1994 to 2004 showed that of these 46 cases were actually allogeneic transplantation to siblings. Allogeneic transplantation is clearly the most common use of privately stored cord blood units.

There is little doubt that cord blood transplants from related sources are much superior to unrelated transplants in terms of clinical outcome. Gluckman et al. [8] analysed outcomes between cases of related and unrelated umbilical cord blood transplant. It showed that survival at one year in the related transplant group was 63% versus only 29% in the unrelated transplant.

There is a 25% probability of a perfect HLA match with siblings, and there is also a higher tolerance of HLA mismatches which increase the probability of usefulness if required. It would seem that the use of private cord blood banking to provide an immediate source of transplant within the family is valuable and is one which has not been taken into account by critics of private cord blood banking. An additional benefit here is that privately stored cord blood is available immediately which is an important consideration in terms of morbidity and mortality.

The use of related umbilical cord blood transplants extends beyond use in malignant disease. For instance, hundreds of patients with thalassemia have been cured of their disorder by allogeneic transplant, in most cases using cells from HLA identical donors [20].

These data on the beneficial effects of related cord blood transplants and the benefits of cord blood transplants themselves strongly indicate that cord blood transplantation to siblings is highly advantageous and is the preferred option over searching for matched allogeneic units. Such availability for immediate use by siblings (assuming HLA matching) is provided by private cord blood banking.

Clinical Investigations of Double Transplant

The number of total nucleated cells (TNC) transplanted is strongly correlated with positive clinical outcomes. Generally a minimum of 2×10^7 total nucleated cells per kg of recipient patient is required and most physicians will seek higher levels if it is possible (up to 4×10^7). The average cord blood unit contains around 1×10^9 TNC. In some cases units contains less either through natural variation or else because only a smaller volume of blood has been collected.

There is significant current interest in the use of two units for transplantation in order to reduce engraftment time and to treat adults as well as children. A range of such transplants have been reviewed and the conclusion was made that patient outcome in adults treated with two units was improved [38].

Other possibilities include the use of one or more cord blood units combined with CD34+ cells obtained from another suitable donor and the use of such transplants in adults. While ex-vivo expansion of HSC would be the ideal solution as discussed below, the use of multiple units may be a valuable intermediary stage for overcoming the main limitation of cord blood which is the relatively low total stem cell count.

The main obstacle to the use of cord blood transplants in adults has been the risk of graft failure and delayed haemopoietic recovery both primarily due to the imbalances between the adult body size and the number of haemopoietic stem cells. If such an approach becomes more established in clinical practice, then it will prove challenging to obtain two matched units from public banks. Thus having a source of cord blood which is either already matched for autologous use or closely matched for use in a sibling would be very valuable.

Issue of Use in Leukaemias and Genetic Diseases

The World Marrow programme has indicated that autologous use of cells in cases of leukaemia is counter-indicated if such cells contain cancerous or pre-cancerous mutations [4]. That is a valid concern for autologous transplantation but in the cases of high need such transplants have been used successfully. However, the use of molecular diagnostics has the potential to allay such concerns. Recently there has been a case reported in the US in which a three year old girl with relapsed leukaemia was successfully treated with an autologous transplant. To test for the absence of cancer clones in the cord blood it was screened using PCR to search for a particular immunoglobulin receptor gene loci rearrangements. The child survived and was aged 6 at the time of publication [12].

Autologous transplantation clearly cannot be used in genetic disease. Nevertheless, private cord blood banking is not equivalent to simply autologous transplants and the use of related allogeneic transplants for a number of genetic diseases is a valuable option. Autologous transplantation utilising gene therapy technology may be useful in the future for genetic diseases.

The Development of Ex-Vivo Expansion Technologies

The current situation in relation to umbilical cord transplants is that it would be desirable to be able to routinely treat larger patients (adults), without the necessity for double transplants. This could be achieved if ex-vivo expansion technologies permitted self replication of the stem cells. This presents a range of technical difficulties; isolation of true haemopoietic stem cells presents a major challenge and the signalling pathways responsible for maintaining these cells as such while undergoing self renewal are not fully understood.

A significant amount of basic research is underway in this field and there a small number of such programmes that are currently in clinical trials. It was reported recently that Viacell's programme in this field has been terminated but good progress is apparently being made by the company Gamida Cell in Israel. This company has a proprietary system for sequestering copper ions which results in the haemopoietic stem cells being kept in a un-differentiated state during expansion. It is impossible at this stage to speculate when such technology will receive regulatory approval and move into routine clinical practice.

Adult Haemopoietic Stem Cells Versus Umbilical Cord Cells

The question of whether or not haemopoietic stem cells from adult bone marrow have similar proliferative capacity as cord blood derived cells is uncertain at this time. However one study has shown that human CD34+ cells derived from cord blood showed greater proliferative capacity in a mouse model which was genetically engineered to tolerate human cells [17].

The Development of Regenerative Medicine

Regenerative medicine refers to the various research programmes aimed at treating disease through the use of stem cells, not necessarily through tissue replacement. There is a wide range of such research underway in universities and in stem cell focused biotechnology companies. Early therapeutic targets include orthopaedic applications such as cartilage repair or spinal fusion, cardiac applications such as treatments for myocardial infarction and other areas including diabetes and Central Nervous System (CNS) applications [40].

Most of the companies in this area are using bone marrow derived or cord blood derived mesenchymal stem cells (MSC), or closely derived cell types. MSC are found in bone marrow, in umbilical cord blood and in other sources such as adipose tissue. These cells differentiate in-vitro into bone, cartilage and tendon but can also be manipulated to differentiate into a wider range of cells types. MSC are defined by the presence of a number of surface antigens and a recent study suggests that these cell arise in the neural crest [22]. In addition it has been demonstrated that there is a lineage negative CD45+ cell population in cord blood which may also have multi-potential capabilities [27].

All Mesenchymal Stem Cells are not Created Equal

Critics of private cord blood banking say that if it is possible to obtain MSC from the bone marrow of a child or adult then what is the value of storing cord blood? There are compelling reasons why the MSC obtained later would not be as good. Studies have shown that these early MSC have a much greater degree of engraftment potential than later cells. These younger MSC also have different gene expression patterns. It is evident that these are in fact different cells although related [3].

Whether or not stem cells mobilised from the adult can substitute for the engraftment potential and plasticity of cells obtained from cord blood in clinical trials remains to be seen. However, if cord blood mesenchymal cells prove superior to adult mesenchymal cells as proposed by Harris and Rogers [11] then it will be too late for an individual to do anything about that unless the cord blood and the early mesenchymal stem cells have been preserved at birth.

Autologous Versus Allogeneic Business Models

Stem cell therapies are in development by specialist biotechnology companies and divisions within large medical device companies. In order to fully appreciate the potential value of private cord blood banking, the manner in which these companies advance products to the market and the stem cell company business models must be considered.

Stem cell therapy occurs within the context of current medical practise. The development of stem cell therapeutic products may be more than “minimally manipulated” and hence will be regulated by the MHRA and other comparable regulatory authorities such as the FDA as medicinal products. There are a range of biotech companies and many public companies that have stem cell therapeutics in development. In addition, some of the largest biotech companies such as Amgen have an interest in this field as do medical device companies such as Smith & Nephew and Medtronic. There are currently two main commercial approaches under development in the biotech stem cell companies; these can be called the ‘allogeneic business model’ and the ‘autologous business model’. The absence of a clear business model is one of the main reasons why pharmaceutical companies have held back from investing in this area to date.

The allogeneic business model is predicated on the hypo or non-immunogenicity of bone marrow derived stem cells (MSC) and hence the objective is to develop a universally compatible stem cell ‘product’ for various diseases in a manner analogous to existing drugs or biologically active molecules. This would obviously have major benefits in terms of profitability and also compatibility with ‘Big Pharma’ business models and hence provide licensing opportunities. Companies here include Osiris Therapeutics Inc, and Mesoblast (Australia). Products from these companies are now in early clinical trials.

The autologous business model by contrast is based around developing commercial systems which would allow widespread use of autologous stem cell therapy. The leading company in this area is probably Aastrom Biosciences Inc which is developing therapies for orthopaedic, cardiac and other uses. Aastrom uses bone marrow derived stem cells taken from the patient and expanded in their proprietary cell culture system. These cells, which will be regulated in the US and EU as biologics, are then returned to the patient for therapy.

This review cannot analyse the scientific and business merits of each approach in detail, but it is quite possible if not probable that the future stem cell market will be divided into those diseases which are treated according to the allogeneic business model (assuming the products can get regulatory approval) and those that are treated according to the autologous business model. It is unlikely that one cell type will solve all of the various therapeutic needs.

Given the above picture of the future of regenerative medicine it is reasonable to suppose that private processing and storage of early MSC and related cell types could prove extremely valuable in the future. Nevertheless, at this time it is impossible to specify precisely how such cells would be used.

New Primitive Cell Types in Cord Blood?

The possibility that there are embryonic like cells in the adult (or in cord blood) is very exciting, although in some respects, a controversial area. Jiang et al. [15] reported that they had identified a cell termed the 'Multipotent Adult Progenitor Cell' (MAPC) from murine bone marrow that had the capability to differentiate into most if not all of the cells of the embryo when injected into blastocysts. These results have not been repeated in full by other groups and are controversial.

However, McGuckin and Forraz [21] describe the discovery of "cord blood derived embryonic like stem cells" (CBE) from human cord blood. Using sequential immunomagnetic separation they obtained a cell population that represents only 0.16% of the total mononuclear cells. The similarity to hESC was confirmed by testing immunoreactivity to a selection of hESC markers. Significantly, CBEs also expressed pluripotency transcription factor Oct-4 involved in differentiation inhibition and hESC self renewal. The authors make the important point that if cells with this degree of plasticity can be obtained from cord blood there is less need for the controversial human embryonic stem cell.

A group at the University of Minnesota along with scientists from the company BioE Inc have described and patented a new type of primitive cell termed MLPC or multi lineage progenitor cells from umbilical cord blood [2].

Clinical and Commercial Potential

What of the clinical or commercial potential of such new primitive stem cells? While a few companies have moved early to capture these discoveries, the commercial significance of these cells cannot be fully evaluated at this time but the commercial arena in which these types of discoveries can be put in context. As in pharmaceuticals or other areas of biotechnology, competition is driven by the objective of creating and commercialising innovative products addressing unmet clinical need which can be protected by patents. The competitive position of companies and return on research and development expenditures rests on patent protection. In the stem cell industry, the identification and protection of proprietary cells and cell sub-types is a primary driver of competition (as well as being possibly an inhibitory factor in innovation).

Since many of these cell types currently used do not provide a homogenous population of cells, competition is being directed into better characterisation and definition of cells types as defined by unique patterns of cell surface antigens (including absence of other antigens). Thus, while it is likely that cord blood stem cells and bone marrow derived cells will be very important, it is by no means clear that 'mesenchymal stem cells' as defined today will emerge as the most useful or dominant cell type which is employed either in an allogeneic or autologous setting for regenerative medicine.

Some of the 'newer' cells above may prove more versatile or be found to be better for therapy for reasons relating to long term toxicology, engraftment, time to engraftment and cell-host interactions. The point here is that companies are commercially motivated to pursue the identification, isolation and patenting of different cell sub-types and progenitors. In addition, given recent discoveries above, it is reasonable to suppose that additional types or sub-types of these cells will be found in umbilical cord blood in the future. This is clearly a fast moving and confusing field but our view here is that some at least of these reported cell types are possible future candidates for therapeutic purposes irrespective of whether or not they prove to be fully pluripotent.

The Significance of this Uncertainty

The discovery of new cell types in cord blood and the uncertainty over their value (both clinically and commercially) along with the reasonable assumption that there are other undiscovered cell types in cord blood, means that there is a reasonable degree of uncertainty over what will eventually be commercialised or prove useful in any particular disease in the long term. This uncertainty is a very strong reason for processing and storing umbilical cord blood and specifically for private processing and storage of umbilical cord blood. No one knows exactly what is being destroyed today when a placenta and cord blood is incinerated. No one knows if adult allogeneic or autologous cells will be a substitute for cord blood cells in the future. In the absence of such information the individual is faced with the choice of dismissing all of this current and ongoing as 'speculative' i.e. betting against the longer term potential of the science and rejecting cord blood storage or else preserving the cord blood and thereby accepting the odds on possible future use, even if that use cannot be fully foreseen at this time.

Our view is that it is both prudent and entirely in keeping with current scientific knowledge to assume that umbilical cord blood represents a potentially valuable resource of particular value to the individual and his/her siblings and immediate family for purposes of regenerative medicine and that therefore it should be preserved.

Public Versus Private Banking and Innovation in Cell Expansion

While this is primarily a scientific review, the broader non-scientific issues underpinning criticism of private cord

blood banking also need to be addressed. The criticisms of private cord blood banking from professional bodies and bio- ethicists need to be set in context of the values that underpin organ donation. Organ donation, including blood donation, has historically been seen as a gift relationship between the donor and society and the desirability of such a relationship still underpins most national policies in this field [37].

Critics of the industry maintain that the donation to a private bank deprives the public domain of cells which could otherwise be useful for public banking. Since public banks are in many places less well developed than private banks, the argument is that this is against the public interest and undermines social solidarity (a view especially favoured in France but also in other Western European countries). While public cord blood banks are undoubtedly good for society, the choices facing the individual in this situation are complex. If she is motivated to donate the cord blood unit to a public bank, that means that there is no guarantee that if it is needed by her child it will be available i.e. it may be matched to another individual first. Thus, this is not like gifting blood to a blood bank. We would argue that there is no ethical obligation for an individual to donate her child's cord blood for public use in that such donation may not be retrieved and may not be available when needed by her family.

However, we would further argue that the attacks on the private cord blood industry by its critics represent opposition to the principle of patient autonomy, a key pillar of bioethics today. Under this principle, patients are seen as rational agents with the rights to be informed and to make choices which affect themselves and their offspring. There have been societal trends in recent decades towards greater degree of patient knowledge, private healthcare, private healthcare insurance, more autonomy and responsibility for wellness and less medical paternalism combined with enhanced expectations of parental responsibility. The recent Cord Blood Education and Awareness Bill in the American Senate proposes public and professional education in cord blood stem cell technology and the requirement for physicians to provide cord blood information to all pregnant women. Such legislation will enable fully informed consent on the fate of cord blood.

We regard these as positive developments and, in keeping with the principle of patient autonomy, those who support such developments strongly may also support private cord banking. Conversely, we reject physicians refusing to give their patients a choice on this matter, even if they are unconvinced themselves. Many such physicians, according to our own unpublished research, have in fact privately stored cord blood for their own family!

Moreover, we believe that the arguments of the professional bodies are erroneous because they have not carefully weighed all the evidence as presented here before judging the service to be of little value and appear in some cases to be ill informed of advances in adult stem cell research. There are in fact compelling reasons for private cord blood banking which can be supported scientifically as described above.

Furthermore, conflict of interest between the public and private cord blood banking sectors is not inevitable. It may be possible, even at present, to meet both objectives and very likely even more easily once ex-vivo expansion becomes a reality. It may be that a small cord blood unit could be retained from a private cord bank for future use when ex-vivo expansion is well developed and similarly a woman donating to a public bank could in principle retain a small amount for the use of her family–again predicated on the future availability and regulatory approval of ex-vivo expansion. The matter of standards would need to be agreed between public and private banks and be in accordance with regulatory requirements which will regulate expanded cells as biologicals.

Conclusion

The case against private cord blood banking is focused almost entirely on the matter of autologous haemopoietic stem cell transplants. It rarely considers the value of related allogeneic transplant and it is not well informed on regenerative medicine and its future prospects. The reasons for supporting private cord banking can be summarised as follows:

- In haemopoietic stem cell transplants the cord blood unit is useful for either autologous or sibling/parent transplants and may also be valuable as a double unit transplant or in co-transplantation with bone marrow or peripheral blood stem cells
- There is strong evidence in particular to support the value of related versus unrelated transplants.
- There is therefore a good case to be made that the probability of using the family cord blood is a lot higher than has previously been estimated.
- In regenerative medicine, the early mesenchymal stem cells and related cells show properties that are not replicated by older cells.
- New types of cells are being discovered in cord blood which may be of value.
- It is unclear at this time what business model will dominate but it is very unlikely that one cell will be useful for all diseases or, that both autologous or related allogeneic use will not have a role to play in therapy.

Given these scientific and business uncertainties over both the value of the stem cells present in cord blood and the future

usefulness to the individual in particular, there are compelling reasons for parents to be prudent and to take this unique opportunity to process and store cord blood at birth for possible future use by their child or the immediate family.

Conflict of Interest PH acts as a consultant to private cord blood bank Smart Cells International.

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