Present State of Reproductive Medicine in Japan – Ethical Issues with a Focus on Those Seen in Court Cases

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Abstract

Background
On July 16, 2004, the decision of a court on the legal status of a baby born by in vitro fertilization (IVF) was handed down in Japan for the first time. It is estimated that there are approximately 284,000 patients who are currently undergoing fertilization treatment in Japan. However, the law and guideline concerning ART are barely maintained and developed. Recently, however, the various issues concerning ART have gradually come to the surface even in Japan, and judicial settlement of them has become difficult. In this study, the present state of ART and the legal status of children born by ART in Japan are investigated with a primary focus on court cases.

Methods
I have extracted court cases concerning ART in Japan. In each case, the allegation of either party, and the opinions from a court are investigated. Also, the movements in Japan concerning ART, including deliberations on the part of the government and the opinions of academic societies, are reviewed. With regard to the attitudes of citizens toward ART, in order to ascertain the degree of understanding among the people and the penetration of knowledge of ART and attitudes toward ART, reference is made to the results of a survey conducted by the use of a Government grant in 2003. I have organized the ethical issues of ART and the legal status of children born by ART with a primary focus on court cases.

Results
There are 4( 6 in the High Court and District Court) judicial precedents. In terms of the issues raised by judicial precedents, the relationship between parents and the children born by ART was decided by using as central criteria “the fact of childbearing” and “the consent of the father”. The government and academic societies displayed cautious attitudes toward the relationship of parents and children born by ART, and in general the children were accepted as “biological children” if there was a genetic relationship between the father and the child. However, many citizens have started to think that "a foster parent is more important than a birth parent", and the conventional ideas emphasizing "blood relationship" are changing.
Conclusion
The number of court cases concerning ART is still small in Japan, but the number of cases will increase because of the expansion of ART and the delay in introducing legal controls on ART. It is difficult to determine the borderlines for these private issues of ART because questions of public interest cannot be completely disregarded. I would like to continue this research, investigating the reports of ongoing government deliberations on ART as well as changes in the outcomes of court cases outcomes and citizen's attitudes toward ART.

Background
On July 16, 2004, the decision of a court on the legal status of a baby born by in vitro fertilization (IVF) was handed down in Japan for the first time. In this case, a plaintiff claimed that a baby born by IVF using the frozen sperm of her late husband should be perceived as his child. Takamatsu District Court dismissed this claim, on the grounds that “the social perception that a baby born in such way is a child of the dead husband is not sufficiently strong”. It is estimated that there are approximately 284,000 patients who are undergoing fertilization treatment in Japan, and the number of babies born by assisted reproduction technologies (ART) has been put at 59,520. However, a framework of law and guidelines concerning ART is virtually non-existent. The fact is that ART is governed by the voluntary rules established by doctors and the reports issued by academic societies. Despite this kind of situation, there are fewer legal conflicts concerning ART in Japan than in other advanced nations. This might be because the level of social awareness of ART has been low due to the emphasis put on the concept of “Blood” in a way that is unique to Japan, and because the rate of expansion of ART has been slow. Recently, however, in Japan too, the various issues concerning ART have gradually come to the surface, and judicial settlement of the issues has become increasingly difficult. This can be seen as a result of the development of medical technology that makes it possible to treat previously untreatable diseases, and of the changes in social trends due to wider recognition of ART. From now on in Japan, the number of intractable or illogical problems is likely to increase because of on the one hand, the expansion of ART and on the other hand, the delay in introducing legal regulations concerned with ART.

In this study, the present state of ART and the legal status of children born by ART in Japan are investigated with a focus on court cases. It is important to consider the roles of ART and to clarify the legal status of children born by ART in Japan, against the background of a steadily declining population. In this regard, the legal framework, deliberations on the part of the government, and the attitudes of citizens could serve as reference points.

Methods

Court cases concerning ART in Japan
The author has extracted court cases concerning ART in Japan. There are relatively few court cases that have come to the surface in Japan, and some cases have been disclosed in public while other cases have not. All possible information about the
undisclosed cases has been collected. In every case, the allegations of either party, and the opinion from a court are investigated.

**Trends in Japan**

Trends in Japan concerning ART, including deliberations on the part of the government and the opinions of academic societies, are reviewed. An expert committee of the Ministry of Health, Labour and Welfare is continuing ongoing deliberations regarding ART, and each academic society continues to present its own reports and opinions and engage in ongoing deliberations.

**Attitudes of citizens toward ART**

With a view to ascertaining the degree of understanding and permeation of conscious awareness of ART among the Japanese people as well as their attitudes toward ART, reference is made to the results of a survey conducted with the help of a Government grant in 2003. In this survey, approximately 8,000 subjects were randomly sampled so as to investigate the attitudes toward ART, and the collection rate was more than 60%.

**Organization of ART matters**

Referring to the results obtained through methods, the paper classifies the ethical issues of ART and the legal status of children born by ART with a focus on court cases.

**Results**

**Court cases concerning ART in Japan (Table 1)**

i) - An issue of who the person in parental authority should be in a case of artificial insemination with donor’s semen (AID)

**Background:** Y (father) and X (mother) got married on November 22, 1990. With the agreement of Y (who was sterile) and X, X received donor sperm and delivered Z (a boy) by artificial insemination on February 6, 1994. Y and X lived separately from March 9, 1996, and Z was nurtured alternately by Y and X. On January 22, 1997, Y and X obtained a divorce through the Family Court, and waged a custody battle. The original judgement [1] handed down on March 30, 1998, gave the custody of Z to Y for the following reasons. “Although Y is not the biological father of Z, the donor of the sperm has not been identified, AID was performed with the agreement of X and Y, and Z is a legitimate child. In addition, X and Y are each qualified to be a person in parental authority. With these points as preconditions, Z looks more stable mentally at Y’s house where he has continuously lived till now.” X immediately appealed.

**Judgement:** Tokyo High Court gave the custody of Z to X on September 16, 1998 [2], for the following reasons. “To determine who should be the person in parental authority for the minor, Z, it is necessary to take into consideration the fact that there is no blood relationship between Y and Z. At the same time, however, it is not the case that the mother should necessarily be designated as the person in parental authority. Basically, given the need for comprehensive consideration from the viewpoint of Z’s well-being and other factors, in the light of Z’s age, it is judged to be reasonable that X should be the person to be given parental authority over Z.”
ii) - An issue of denial of legitimacy in an AID case

*Background:* Y (father) and X (mother) got married on March 31, 1992. Since Y and X could not have a child, the fertility treatment had been continuing since 1993. X became pregnant once by artificial insemination with her husband’s semen (AIH), but had a miscarriage. At the end of 1994, Y and X lived in a state that in practical terms amounted to divorce, but without divorce papers being filed and consequently without X’s name being removed from Y’s family register. In this situation, X delivered Z (a girl) by AID on January 27, 1997. Y named Z and registered the birth of a legitimate child. Subsequently, Y raised doubts about Z’s birth of, and filed a complaint for denial of legitimacy due to X’s adultery. X contested the issue, claiming that Y approved AID in advance, and recognized Z as a legitimate child.

*Judgement:* Osaka District Court accepted the claim of Y on December 18, 1998 [3], for the following reasons. “Y insisted that X engaged in adultery, but this could not be confirmed in the absence of supporting evidence. At the same time, however, X’s assertion that Y had given advance approval to AID was not acceptable since X and Y did not prepare a letter of consent to AID in advance. Giving the child a name and filing notice of the birth could not in themselves be said to indicate Y’s intention to recognize a lawful child.”

iii) – An issue of posthumous recognition in an IVF case

*Background:* Y (father) and X (mother) got married in 1997. Y had suffered from chronic myelocytic leukemia since 1990, and had been continuously treated. After the marriage, both Y and X continued to receive fertility treatment. Six months after the marriage, Y underwent bone marrow transplantation. Since it was probable that Y would develop aspermia due to a side effect of the treatment, Y’s sperms were frozen and put into storage before the transplantation. Y died in 1999. X received IVF by using Y’s sperm, and delivered Z in summer of 2001.

In 2002, X tried to have the birth of Z registered as a lawful child of Y and X, but the application was not accepted since Article 772-2 of Civil Code prescribes that “A child born 300 days or more after the day on which the marriage was dissolved, shall not be accepted as a lawful child”. X did not accept the ruling and appealed to the Family Court [4], but the claim was rejected on December 20, 2001, for the following reasons. “A lawful child shall be the child conceived or born between a man and a woman in a marital relationship. A child that is conceived or born after the marriage was dissolved due to the death of the father, is not a lawful child.” X immediately appealed, but Takamatsu High Court rejected the appeal, “Z could not be presumed to be a legitimate child as defined in Article 772 of Civil Code, nor could she be seen as a legitimate child on the grounds of her conception, since this took place after the marriage was dissolved due to the death of the father [5]”. X filed a special appeal, but it was also rejected.

After that, X filed suit requesting that posthumous recognition accepted as a deputy for Z. In the first trial, Matsuyama District Court dismissed this claim, because “it was not clear that Y agreed to IVF” and “there is still insufficient social consensus that a baby born in such way should be seen as a child of the dead husband” [6,7]. In response to this, X insisted that “Y did agree to IVF”, and argued that “if the Civil Law cannot make presumptions that cover this case, the inadequacy of the law should be compensated for by the Constitution”.

*Judgement:* Takamatsu High Court accepted X’s claim on July 16, 2004 [8]. The court presented for the first time criteria that could form a basis for judgement when it said that “it is sufficient that there are natural blood relations between Y and Z and
that the consent of the father was given, and there are no grounds for requiring that the physical existence of the father at the time of the mother’s pregnancy should be made a condition for recognizing the legitimacy of the child”. However, the prosecution objected to this judgement and filed an appeal with the Supreme Court on July 29, saying that “since there are no judicial precedents, we would like to leave a decision in this case to the judgement of the Supreme Court”.

iv) An issue of birth registration of a child delivered by a surrogate mother

**Background:** A couple in their 50s, living in the Kansai District of Japan, were receiving ongoing fertility treatment. An egg donated by an Asian American woman was fertilized in vitro with the husband’s sperm, after which the fertilized egg was implanted in another American woman, who acted as a surrogate mother and gave birth to twins in October 2002. The couple tried to have the birth of the twins registered at the Japanese Consulate General in America, but the Japanese Ministry of Justice decided to reject the application in November 2003 on the basis of the judicial precedent of the Supreme Court in 1962 [9] that “a person who delivers a child shall be the mother”. After that, the couple tried to have the birth registered with an autonomous body in January 2004, but their submission was also rejected in February. The couple appealed the unacceptable rulings to the Family Court demanding reversal of the rejection.

**Judgement:** The Akashi Branch of the Kobe Family Court decided to reject their claims on August 14, 2004, for the following reasons. The wife is neither the person who provided the egg nor the person who delivered the twins, and “seen from the perspectives of objectivity and precision, the legal mother-child relationship should be accepted only between a person who delivers a child and the child that is delivered”, and this issue “should be handled by adoption”. The couple immediately appealed to Osaka High Court on August 24, 2004, emphasizing that “we find it highly regrettable that even though a birth certificate was issued in America, the birth registration is not accepted in Japan”, and that “judicial precedent of the Supreme Court, delivered at a time when current advances in the field of assisted reproductive technology (ART) were still unknown, to be applied to our case.”

**Movements in Japan**

It may be usual for improvements in legislation in response to progress in medical science to suffer from delays. However, in the case of high-state-of-the-art medical technology that has the potential to shake the foundations of the human race, the need for consolidation on a global level a prompt response is very urgent. Currently, the improvement of legislation concerned with ART is carried out in line with Regulations relating to Human Cloning Techniques and Other Similar Techniques (December 2000) [10] and Guidelines for ES Cells [11]; and that concerned with AID and IVF in line with the guidelines and reports issued by academic societies, reports from the committees, and individual self-restraint established by doctors. A legal framework has not yet been established, and deliberations at the government level are still continuing.

i) **Governmental response to ART in Japan**

With a view to considering from a broad perspective the issues associated with ART, a Technical Committee on ART was set up under the auspices of the High-level Medical Technology Evaluation Committee within the Health Science Council on October 21, 1998, and submitted a “Report on Assisted Reproductive Technologies
using Donor Sperm, Eggs and Embryos” on December 28, 2000. In addition, in order to carry out a further investigation of ART using donor sperm, eggs and embryos, the Assisted Reproductive Technology Committee in was set up on June 11, 2001 within the Health Science Council. In a separate development, the Institute of Assisted Reproductive Technology-related Parent and Child Jurisprudence was set up under the auspices of the Legislative Council on February 16, 2001, and deliberations are continuing.

With a view to consolidating the reports and deliberations emerging from these initiatives, the Assisted Reproductive Technology Committee issued a “Report on the Development of an Assisted Reproductive Technology System using Donor Sperm, Eggs and Embryos” [12] on April 28, 2003. The details of this report are as follows:

1. Persons who can receive reproductive medical treatment using donor sperm, eggs and embryos are limited to legal couples, excluding aged infertile couples (wife’s age of 50 years taken as a guide for an upper age limit).
2. AID and IVF using donor sperm and eggs should be carried out only in the case of those couples who are infertile without being provided with sperm and eggs.
3. Only embryos donated by another couple, who originally obtained embryos for their own use, can be used for embryo transfer, and embryos created by donor sperm and eggs may not be used.
4. Cytoplasm or nuclear substitution of donor eggs is not allowed.
5. Surrogacy is not allowed.
6. Persons whose age is not less than 15 years can request the disclosure of information regarding their blood relationship on the basis of their right to know.

Donors of sperm in the case of (1), (2) and (3) should be male adults aged less than 55 years, and those of eggs be female adults aged not more than 35 years who already have a child. The number of children conceived using sperm or eggs from the same donor should be not more than 10. The donation should be carried out without charge other than actual costs, under a pseudonym. Donation from siblings is not allowed since anonymity is not guaranteed and human relationships in such a case are liable to become complicated. The retention period of sperm and eggs is 2 years, and that of embryos is 10 years. The donor sperm, eggs and embryos should be disposed of when the death of the donor is confirmed. The donor and donee should give informed consent after being fully informed about the procedures as well as the and risks and benefits of ART, and opportunities for the withdrawal of consent and for counselling are assured.

Concerning (4), there is a method of egg rejuvenation in which the egg nucleus of a donor is substituted for that of a donee. This method raises the influence of cytoplasm mitochondria. As the reasons for (5), various issues have been raised, including: a) humans should not be used as a device for reproduction, b) the safety of the third person (surrogate mother) should be considered since pregnancy and childbirth carry great risks, and c) disputes over the child between the infertile couple and a surrogate mother may occur.

In addition, on May 12, 2004 the Bioethics Specialized Investigation Committee in the General Council for Science and Technology announced that it would allow the production of fertilized eggs for ART studies only, also that it would permit IVF using sperm and eggs donated from third persons, the transfer of donor embryos, and the donation of sperm, eggs and embryos from siblings with various conditions attached. Furthermore, the Cloning technology Control Law established in December 2000 regarded fertilized eggs as the germination of life, and allowed the production of fertilized eggs for research purposes on July 23, 2004. There are various arguments for and against this matter in Japan.
ii) Response to ART of other institutions

Compared with the “Report on Development of Assisted Reproductive Technology System using Donor Sperms, Eggs and Embryos” issued by the Assisted Reproductive Technology Committee, the Japan Society of Obstetrics and Gynecology adopts a strict attitude. The society announced on April 10, 2004 that it did not permit use of the fertilized eggs of a third person for fertilization since this would create complications in the parent-child relationship [13]. It approved the performance of fertilized ovum diagnosis for the first time on July 23, 2004, but this was a special arrangement for patients with muscular dystrophy [4]. Before this, a member who performed fertilized ovum diagnosis without permission was expelled from the society, whereupon the member filed a complaint asking for the expulsion to be invalidated on the grounds that prohibition of fertilized ovum diagnosis violates the right of patients to pursue happiness as guaranteed under the Constitution of Japan.

In addition, the society does not allow surrogacy [15] because 1) the welfare of the resulting children should be assigned the highest priority, 2) surrogate conception carries physical risks and psychological burdens, 3) family relationships would become complicated, and 4) a surrogate conception contract is not ethically tolerated by society as a whole (is offensive to public order and morals). A member of the society was expelled because he caused the birth of a child between siblings by the use of a surrogate mother. The society works through written notifications to disseminate its policies to its members. However, its opinions differ in detail from those of the government, and it is not in a position of being able to respond completely to rapid technological changes.

In a separate initiative, in June 1999, the National Institute for Research Advancement (NIRA) [16] launched a “Panel for Cloning and IVF” and prepared a Draft Law on the Morals of Life. The Draft Law would restrict cloning studies and ART, and prescribe the relationships between parents and the child born by ART. It would allow the donation of eggs from an anonymous third person, prohibit the donation of embryos, prohibit donation between siblings, place a ban on surrogate conception or borrowed womb contract, and restrict the age of donors [17,18]. In a separate development, the Japan Federation of Bar Associations provided advice and recommendations on ART through its document "Legal Restrictions on the Usage of Reproductive Technology” [19], issued in March 2000. It recommends formulating a Reproductive Technology Law, assuring the right of children to know their blood relationship, placing a ban on the donation of embryos, surrogate conception, or the use of a borrowed womb, and prescribing conditions limiting the use of ART and penalties, from the viewpoint of the prevention of ART abuse and the protection of the rights of users and resulting children. In yet another initiative, the Japanese Society of Fertility and Sterility [20] submitted a written statement concerning the possibility of permitting IVF using eggs donated from siblings. It states that it is necessary to harmonize the development of law and surrounding social circumstances (e.g., consideration to be given to whether or not to tell the truth to the resulting children, and discussions to be carried on between either party using IVF counsellors). Furthermore, the Japan Society of Fertilization and Implantation submitted “Opinions and Advices concerning Assisted Reproductive Technology with a Donor's Semen” [21] to the Ethical Committee.

Attitudes of citizens toward ART

The attitudes of Japanese citizens toward ART is shown in a preliminary report, “Research on Attitudes of Citizens toward Assisted Reproductive Technology”,
issued as Scientific Special Research carried out with the help of a Grant in Aid for Scientific Research from Health, Labour and Welfare Ministry in 2003. This research was conducted by using 8,000 male and female subjects aged 20 to 79 years [22]. Figure 1 shows the attitude of Japanese citizens toward heredity. The Japanese have traditionally shown strong feelings regarding “genetic blood relationship” and “continuation of the blood line”, and it might be possible to think of these as being specific to an insular country. However, the results of research suggest that the consciousness of heredity has become weakened, and that many people have come to think that “a foster parent is more important than a birth parent”. In addition, results showed that many feel the improvement of medical technology to be a necessary condition for the pursuit of happiness. Figure 2 shows the penetration ratio of knowledge about ART in Japan. Approximately 50% of subjects knew about AID, IVF (donor sperms and donor eggs), and surrogacy. When the persons who answered “I’ve heard something about ART” are included, knowledge about ART has penetrated to approximately 90%. On the other hand, half of the subjects did not know about IVF (embryo transfer), and the penetration ratio of knowledge of IVF is low. Furthermore, when the question as to whether each type of ART should be socially accepted was asked (Figure 3), approximately 30% of subjects answered “I do not know”, and many of them would not accept IVF using sperms and eggs donated from third persons, or surrogacy using eggs donated from third persons. Most subjects accepted other forms of ART, and especially, about 50% of the subjects would accept surrogacy using the fertilized egg of a couple who would like to receive ART (hereafter “the concerned couple”) (borrowed womb). In “Research on the Attitudes of Doctors and Citizens toward Assisted Reproductive Technology” performed in 1998 [23], the relationship between the children born by ART and their parents was investigated. Figure 4 shows national consciousness regarding parent-child relationships. Approximately 60% of subjects agreed that the children born by AID/IVF using sperms or eggs donated by third persons, by IVF using eggs from third persons, and by borrowed womb, should be regarded as biological children of the concerned couples. Even embryos from third persons and surrogacy are accepted by approximately 40% of subjects. The subjects who answered “I do not know” were the second largest group. Approximately 10% agreed that children born by ART should be regarded as adopted children of the concerned couples, and only 2% agreed that children born by borrowed womb should be regarded as adopted.

**Organization of ART matters**

There are broadly 9 patterns of ART (Table 2) as follows: I) AIH, II) AID, III) IVF using sperm and eggs from a concerned couple, IV) IVF using donor sperm and eggs from the wife in a concerned couple, V) IVF using sperm from a husband in a concerned couple and donor eggs, VI) IVF using donor embryos, VII) borrowed womb using the embryos of a concerned couple, VIII) surrogacy using the husband’s sperm and donor eggs, and IX) surrogacy using donor sperm and donor eggs.

**I) AIH**

AIH is the most commonly performed form of ART. Sperm and eggs from the concerned couple are used, and the wife herself gives birth. The resulting child is, of course, their biological child. Knowledge of AIH has penetrated socially to 70% of the population. It is often carried out as the first step in treatments for sterility of an uncertain cause. AIH is not covered by health insurance, and costs about 20,000 yen (around 175 US dollars). As problems concerned with AIH, one could cite the usage
of the husband’s sperm without his consent and the usage of frozen sperm after the husband’s death, but these cases have not actually been brought to the surface yet.

**II) AID**
The relationship between the resulting children and their father can become problematic since donor sperm is used in AID. In this case, according to judicial precedents, the resulting child is regarded as a biological child when the consent of the husband is confirmed by a “clear indication of intention” or a “written form”, and denial of the biological child at a later date is not allowed, using the concepts of “betrayal” and “the importance of results” as criteria. Most of the problems concerning AID are linked to the father-child relationship, for example, “custody claim” and “denial of legitimacy”. According to the research on the attitude of citizens (hereafter, “the research”), the social penetration ratio of knowledge of AID reaches 60%, and 50% accept AID. The history of sperm donation in Japan dates back more than 50 years, and there is no particular problem in regarding a resulting child as a biological child if the wife gives birth and the husband “agrees” to AID. As shown in judicial precedents, it is appropriate to regard the resulting child as the biological child of a concerned couple.

**III) IVF using sperm and eggs from a concerned couple**
There are no major problems here since both sperm and eggs of the couple are used and the wife gives birth. This method is similar to AIH, but the mechanical action of in vitro fertilization intervenes. Judicial precedents of IVF concerning the parent-child relationship include only the aforementioned case of posthumous recognition, and the judgement was made based on “consent” and “presence of relationship by blood”. The court recognized the action of the husband in storing his sperm as “consent to IVF”, and accepted the resulting child as his biological child, stating that “it is not necessary that perception of paternity is during the husband’s life”. Problems that can arise with this kind of IVF may be concerned with posthumous recognition of the child born by the use of the husband’s sperm after his death as in the quoted case, and confusion of embryos. According to the research, approximately 50% are knowledgeable about and 90% have heard something about this type of IVF. This is one of the most commonly performed fertilization procedures as the step subsequent to AIH. Recognition of a resulting child as a biological child is not problematic, and does not spark much social criticism.

**IV) IVF using donor sperm and eggs from a wife and V) IVF using sperm from a husband and donor eggs**
In these types of IVF, a wife gives birth, and one of the parents has a genetic relationship with their child. As with III, recognition of a resulting child as a biological child is not problematic when “consent” and “presence of relationship by blood” of either parent are present. According to the research, approximately 50% are knowledgeable about and 80% have heard something about these types of IVF. Regarding the parent-child relationship, 60% agrees that children born by these types of IVF should be regarded as biological children of the couple. The Government sets rules for cases of IVF using donor sperms or eggs, and the Japan Society of Obstetrics and Gynaecology identifies sperm donation ethically with AID [24]. Problems that can occur with these types of IVF include the legal status of children born by IVF without consent and the confusion of sperm or eggs.
VI) IVF using donor embryos
There are some obstacles in the way of regarding a resulting child as the biological child, since donor embryos are used and there is no genetic relationship between the couple and the child although the wife gives birth. This method is similar to the strange case of a person who makes a contract as a surrogate mother and ends up being given the resulting child. The requirement of “consent” in judicial precedents is satisfied, but the problem of how the “genetic” relationship should be viewed remains to be solved. The government had until now allowed the usage of embryos with some conditions attached, but the Japan Society of Obstetrics and Gynaecology does not approve of it, since the parent-children relationship can become complicated. The resulting child will have two different couples as his/her parents (i.e., the biological parents, and a birth mother and social father). According to the research, approximately 50% know about or have heard about IVF, and only 30% accept it. Concerning the parent-child relationship, 40% agree to the recognition of the resulting child as the biological child, but another 40% answer that they do not know. To obtain social agreement to recognizing the resulting child as the biological child, more time is required. Serious consideration should be given to the position of the wife who delivers the child, but at this stage in time, it might be appropriate to regard the resulting child as an adopted child.

VII) Borrowed womb using the embryo of a concerned couple
Under this procedure, a third person gives birth using the embryo of a concerned couple. A couple, who worked as entertainers in Japan, used surrogacy abroad, and the birth registration of the resulting child was rejected. This case aroused discussion in Japan. In this case, the claim was rejected because the “mother did not actually deliver the child”, based on the judicial precedents that “the legal mother-child relationship should be accepted only between a person who delivers a child and the child that is delivered”, and “the resulting child should be regarded as an adopted child”. There are no genetic problems, and the recognition of the resulting child as the biological child of the concerned couple should not be brought into question. If “the fact of childbearing” in judicial precedents is an important point, it follows logically that the surrogate mother who delivers a child should be seen as the mother of the resulting child even though there is no genetic relationship between this surrogate mother and the child, as described in IX below. There are arguments for and against surrogacy, but from the point of view of the welfare of the child, the best way forward would seem to be to allow the couple who have a genetic relation the resulting child to be seen as its parents and to allow them to register him/her as their biological child. According to the research, the penetration rate of knowledge about surrogacy has reached 50%, and about 50% of subjects accept the concept of a borrowed womb. In addition, 60% agree to the recognition of the resulting child as the biological child.

VIII) Surrogacy using the husband’s sperm and donor eggs
Genetically, there is no problem on the husband’s side about recognizing the resulting child as the biological child, when a surrogate mother gives birth by using her own eggs and the husband’s sperm. However, there are some problems on the wife’s side since there is “no fact of childbearing” and “no genetic relationship with the child”, although there is “consent” to surrogacy. The child is born under a surrogate-motherhood contract. However, when looked at cool-headedly and rationally, this situation is very similar to that in which a wife recognizes and takes in as her own
a child born between her husband and another female. In terms of judicial precedents, the wife who did not actually deliver the child should be considered as the mother of the child by adoption. The government also emphasizes the idea that “the person giving birth is the mother”, and regards the husband as the father and the surrogate mother as the mother. According to the research, 50% of subjects know about this type of surrogacy, and approximately 30% accept it. Approximately 50% agree to the recognition of the resulting child as the biological child of the concerned couple. Both the government and academic societies have publicly announced their view that at this point in time surrogacy should not be accepted. However, surrogacy is not legally restricted, and the cases of children born by surrogacy with outside Japan are increasing. For the sake of the resulting children, the government should change its present policy of treating them as foreigners. The child who has a genetic relation with the husband should be recognized as his biological child even though a surrogate mother delivers the child. The relationship of the wife with the child should be settled by adoption. Problems that can occur in the case of surrogacy include custody battles between the concerned couple and a surrogate mother, what to do when the resulting child is born with a handicap, and one-sided dissolution of a contract by a surrogate mother during pregnancy. Such cases have not as yet been reported in Japan.

IX) Surrogacy using donor sperm and donor eggs
In this case, a surrogate mother gives birth by using an embryo from a third person, and the concerned couple is not involved at all. This case is almost identical to a simple adoption, in which a couple takes in a child from a surrogate mother. The only difference is that the adoption depends on a surrogate-motherhood contract with the concerned couple. The most desirable procedure is for the couple to take in a child by general adoption, and the necessity of this surrogate-motherhood contract is very questionable. There would seem to be no problems in treating this case as a case of general adoption. Problems that may occur are similar to those mentioned in VII above.

Ethical issues of ART
Broader speaking, against the background of the likely continuing technological development of ART, it is possible to identify the following 6 issues (Table 3). 1) Technological issues: There are as yet unexplained technical areas and side effects related to ART. There is concern that various problems will come to the surface as ART technology is developed. 2) Social issues: The degree of social penetration of knowledge and understanding of ART is likely to become problematic. In court trials to date, the parent-child relationship has been decided in the light of what was socially acceptable at the time [25]. It will become necessary to provide psychological support to either party receiving ART. 3) Legal issues: The law cannot catch up with the development of scientific technology, and there will be inconsistencies in many cases. Improvement of legislation requires time, and the issue of how we deal with problems until the necessary laws enacted will remain. 4) Economical issues: Since ART is expensive, the major load rests on the concerned couple. Therefore, some can receive ART and others cannot. This could lead to unfair and unreasonable situations in which only rich persons can have children by using ART. 5) Family issues: The relationship between the child born by ART and the child’s parents may well become complicated. How we deal with the right of children to know their blood relationship will remain an issue. 6) Ethical issues: It is difficult to decide how far science can edge, and should be permitted to edge, into the field of human reproduction. Social
ethics change over time, and the future development of society’s ethical view will remain a key component in any future discussions of ART.

**Discussion**

**Court cases**
The number of court cases concerning ART is small in Japan. In some cases, the trial is still continuing, thus rendering the legal status of the resulting child unstable. The degree of understanding of the position of those couples that want to have children is also still insufficient. The thinking of courts can be categorized as follows. a) The person who gives birth should be seen as the mother of the resulting child. b) The father should agree to ART. c) Posthumous recognition can be accepted if there is a genetic relationship between the father and the child. d) In those cases to which a), b) or c) is not applicable, the resulting child should be regarded as being adopted. e) The judgement should be made in the light of what is socially acceptable.

Based on the concept of a), the cases of I, II, III, IV, V and VI of ART are not problematic, provided a husband agrees to ART, since it is the wife who gives birth. On the other hand, in the case of VII, when a surrogate mother gives birth by using the couple’s embryo, the surrogate mother who does not have a genetic relationship with the resulting child will be considered to be the mother of the child. It is arguable that court thinking confuses “childbearing”, i.e. the fact of giving birth, with “genetic relationship”, and puts too much emphasis on “childbearing”. This is a consequence of following the Supreme Court’s decision of 1962 that “the parent-child relationship shall arise naturally based on the fact of childbearing without depending on recognition on the part of the mother” [26].

Based on the court thinking as set out in b) and e) above, the cases of II, IV, V and VI pose genetic problems. Theories about the legal status of resulting children in case II include: i) When the husband agrees to ART, the resulting child should be considered as a legitimate child in line with the legitimacy presumption of Article 772 of the Civil Code, ii) The resulting child should be considered to be a legitimate child that is not covered by the legitimacy presumption of Article 772 of the Civil Code since the husband has no blood relationship with the child even though he agreed to ART, and iii) This case is not covered by Article 772 of Civil Code, but if the husband is willing to adopt the resulting child, it can be adopted subject to the wife’s agreement. A lot of people support theory i). However, the situation gets a little complicated when both husband and wife claim custody at a time of divorce. Most people think it is preferable that both the husband and the wife should have child custody based on theory i). However, some hold the view that the wife has the right to have custody since the husband has no blood relationship with the child. Many judicial precedents follow the principle of mother priority and allow the mother to have custody when the child is young. In addition, the courts display the line of thinking that the “father should be decided not based on biological or genetic viewpoints, but on social acceptance”. If the husband consents and the ART performed is socially acceptable, the resulting child will be seen as the child of the husband. The court stated that “legally, we cannot completely reject ART that has been developed in response to the requests of couples that desire to have children” and “each case should be individually decided based on social acceptance until the enactment of legislation” [27].

There are several opinions concerning the court thinking expressed in c). Some people have no negative opinions about the claim for posthumous recognition because
“there is a genetic relationship between father and child” and “the welfare of the child should be respected”. These people are further divided into two groups: one group “approves posthumous recognition without reserve when there is a blood relationship”, and the other “approves it while stipulating the father’s agreement as a requirement”. Other people have negative opinions about the claim for recognition because “the legal relationships will become complicated” and “this relationship goes beyond the legal parent-child relationship regulated by Civil Law”. In Japan, the judicial precedent in 2004 accepted posthumous recognition since there was a genetic relationship. A similar trial was the Woodward case in the US [28]. In this case too, posthumous recognition was accepted since “there was a genetic relationship” and the “husband’s agreement could be confirmed”. The late husband was named as the father in the birth certificate of the resulting child and entitlement to a survivor’s pension was permitted. However, posthumous recognition tends to be denied in Japan. The Ministry of Health, Labour and Welfare prescribes that sperm can only be stored for 2 years and should be disposed of when the death of the donor is confirmed, and does not accept posthumous reproduction [29]. From the viewpoint of welfare of children, it might be preferable for the children who have a genetic relationship with their father and mother to be regarded as their biological children. It has also been reported that there are some problems in the environment of a child growing up with only one parent [30].

The court thinking as expressed in d) becomes problematic in the cases of VII, VIII and IX. In the surrogacy trial that surfaced in 2004, the court ordered that the resulting child should be treated as an adopted child. In the case of VII, a third person gives birth, but the embryo comes from the concerned couple. There are no genetic problems, but the surrogate mother will be seen as the “mother” if childbearing is emphasized. This results in the concept of two mothers, a “biological mother” and a “social mother”. However, looking at the situation from the children's standpoint, the parents who have a genetic relationship with them should be recognized as the parents in terms of the entry in the family register. It is disadvantageous for the children to be regarded as adopted as long as the family registration system exists. Specifically from the viewpoint of the welfare of resulting children, it is disadvantageous for them to be treated as adopted or registered as foreigners. According to the research on attitudes of citizens toward ART, 60% agreed that children born by surrogacy should be recognized as the biological children of their genetically related parents, while 10% thought that they should be seen as adopted children. Only 2% thought that the resulting children should be seen as the surrogate mother’s biological children. In consideration, therefore, both of the attitudes expressed by the citizens of Japan and the right of children to pursue happiness, the children born in case VII should be regarded as the biological children of the concerned couple.

**Surrogacy**

In Japan, surrogacy was first carried out in May 2001 (the surrogate mother was a sister of the wife) [31], and the second carried out on March 5, 2003 (the surrogate mother was a sister-in-law of the husband) [32]. In these cases, relatives of the concerned couple became surrogate mothers by using the fertilized eggs of infertile couples. The arguments for and against surrogacy have continued until today, and the position is still that the necessary legislation has not yet been enacted. People who are against surrogacy cite the following reasons; a) risks, b) custody battle, c) complication of family relationships, d) fear of commercialization, e) no social consensus, and f) usage of humans as a tool. The government and the Japan Society
of Obstetrics and Gynaecology are against surrogacy for the reasons given in a), b), e) and f). However, concerning the reason in a), the risks of childbearing for a surrogate mother are the same as those for a general mother, and are not special [33]. The risks for a child born from a surrogate mother are also the same as those for a child born from a general mother [34]. Concerning b), no custody battle has actually been waged in Japan. Even in the US, there were custody battles in 2000 in only 8 out of 20,000 cases (0.04%) [35]. Custody battles will continue to occur for all sorts of reasons, and there is no justification for claiming that the number of battles will be particularly large in surrogacy cases. Regarding c), those who hold this view claim that surrogacy is not acceptable since it depends on a contract and lacks the stability that is essential for any system that impinges on the parent-child relationship [36]. However, the children who have already been born should be flexibly treated from the viewpoint of their welfare. The problems regarding the parent-child relationship in the case of surrogacy are almost identical to those found in other forms of ART. In addition, a lot of citizens support the idea that “a foster parent is more important than a birth parent” (Figure 1). Concerning d), there are some differences among countries in respect religious background and the traditional way of thinking. In Korea, the highest priority is assigned to maintaining the paternal bloodline. There is a social atmosphere in which surrogacy is accepted, provided the sperm is from the husband, as a means of ensuring that the paternal bloodline is continued [37]. In the UK, Canada and Spain, surrogacy is accepted as long as it is not commercial. On the other hand, in Austria, Germany and France, surrogacy is clearly restricted [38]. Regarding e), some of the members in the Japan Society of Obstetrics and Gynaecology insist that “surrogate pregnancy is not acceptable, but it should be allowed under certain conditions if it is the only option”. In addition, they carefully state that “In future, surrogacy will be accepted by more people as socially-accepted ideas change. If a social consensus to accept surrogate pregnancy were to obtain, surrogacy would come under review again in exceptional cases” [39]. According to the research on citizen’s attitudes, approximately 50% accepted the concept of a borrowed womb (Figure 3). Concerning f), a surrogate-motherhood contract is not just a means of reproduction. A concerned couple and a surrogate mother communicate with each other for at least 10 months during pregnancy, and the surrogate mother does not give birth just as if she is carrying out a job without knowing the faces of her counterparts. In many cases, surrogate mothers felt that they carried out an act of friendship for infertile couples, and thought they had a good experience [40].

On the other hand, people are for surrogacy for the following reasons; g) the right to have children, h) reinforcement of traditional family values, i) children’s welfare, and j) as a measure to counteract the decrease in the number of children. Regarding g), support for surrogate mothers is derived from “freedom of thought and conscience”, guaranteed in Article 19 of the Japanese Constitution [41], while support for the couples who want to have children is derived from “the right to pursue happiness”, guaranteed in Article 13. The expansion of this issue would lead to the opinion that the logic of parents who want to have children can be given priority over the welfare and right of children born by ART [42]. However, the desire to have children is a human instinct. On the basis of the perception that sterility is a disease, if a means to have children is provided by technological development, we cannot simply reject it. The pain of not being able to have children can be understood only by the parties directly concerned. Regarding h) and i), some insist that the best advantages for children can be obtained when they are regarded as the biological children of concerned couples, and when the wives who have a clear awareness of their duties as
the children’s social mothers and are willing to nurture them become their legal
mothers [43]. It can be argued that the couples whose desire to have children is so
great that they will even go as far as to use the procedure of surrogate mothers are
likely to nurture the resulting children with affection. The number of children abused
by parents is increasing in Japan. The parents who have their children through
surrogacy can be better for and bring more profit to children than those who abuse
their children delivered by natural means. Regarding j), not much can be expected
from this justification in Japan, which is leaning in the direction of prohibiting
surrogacy, but the number of cases of children born through surrogacy outside Japan
is increasing. Statistical data of accumulated ART cases [44] shows that one out of
every 100 babies is born by IVF. This suggests that ART is useful as a measure to
counteract the decrease in the number of children.
Surrogacy will be accepted some day after social perceptions change and its
technology and usefulness are confirmed. In the UK, AID used to be a crime, and
then it was regarded as an undesirable but not illegal treatment. Finally, AID was
accepted as a form of medical care that should be covered by national health
insurance [45]. There are cycles of approximately 12 years between each concept of
AID. In present-day Japan, the trend is toward prohibition of surrogacy. In terms of
judicial precedents, the relationship between parents and a child born by surrogacy is
dealt with by adoption procedures. I intend to continue this research by following
future developments concerning AID.

Ethical Issues of ART

i) Technological issues
How far ART, in which there are still unexplained technological aspects and side
effects, will continue to make progress may become problematic. For instance, the
method, whereby the nucleus of an aged egg is transplanted into a young egg, is
thought to be related to the decrease in ATP production in mitochondrion [46]. In
some studies, transplant of cytoplasm mitochondria into the ooplasm was used for
infertility treatment [47], and the nucleus taken from the aged egg has been infused
into the enucleated young egg in actual treatments [48]. However, the possibility of
influence from the cytoplasm mitochondria of the young egg cannot be ruled out. In
addition, cloning technology [49] can be used in ART, but there are still unexplained
aspects as well as technological problems in moving to actual applications. However,
if cloning advances, it will be possible for the aged egg to be rejuvenated, thus
facilitating pregnancy.

ii) Social issues
According to a questionnaire survey carried out by a publishing company with 3,433
female subjects receiving infertility treatment [50], approximately 50% had a job at
the time of the survey, and about 39% had experienced a need to change or quit their
job because of the treatment. In addition, they experienced not only physical, but also
psychological pain caused by responses or words from the people around them, due to
their infertility. There is prejudice against ART in Japan, and no psychological
support whatever is provided to either party receiving ART. Measures to stabilize the
social and legal status and to protect the welfare of the parties concerned should be
taken. With regard to this issue, there are many factors to be solved including
differences in thinking between the husband and the wife or differences between
countries.
iii) Legal issues
When we focus primarily on the welfare of resulting children, it is clear that prompt improvement of legislation is required. However, since the law is unable to catch up with the development of scientific technology, inconsistencies will arise in many cases. It is important to create a system in which responses can be promptly deliberated and implemented in such cases. In the US, there is the Uniform Parentage Act 2000 (UPA2000). The legal status of resulting children and of a surrogate-motherhood contract are prescribed in the Act [51], and it serves as a source of reference.

iv) Economical issues
In Japan, the cost of health insurance is a charge on individual incomes. At a cost of about 30% of the actual expense, the people are able to use medical institutions. However, ART is not covered by the insurance, and the patients should bear 100% of the costs. From April 2004, each public body gave a subsidy of 100,000 yen (approximately 870 US dollars) for one course of treatment of ART with a limit of not more than twice (in the case of Metropolitan Tokyo). The amount of the subsidy is small, but the granting of a subsidy in itself indicates a step forward. However, the major burden still rests on the patients who are continuing to receive ART, and some people are forced to abandon it for financial reasons. The situations in which high-income earners can have children by ART and low-income earners cannot sometime occur.

v) Family issues
The pain of not bring able to have children cannot be understood by people who have children, and we need to listen carefully to the heartfelt voices of patients in this condition. The right of parents to self-determination on whether or not to have children should be respected (Articles 11 and 13 of the Japanese Constitution), but some people do not accept ART on the grounds that custody battles will arise and that the welfare of resulting children takes precedence. If the question of genetic relationship is emphasized, there is the possibility that relations between parents and the children born by ART will become complicated. In addition, the right of the children to know details of their blood relationship remains an issue. Children have both “the right to know” and “the right not to know” [52], and until now, global attitudes toward the children’s rights have varied. Giving to the children the right to know their blood relationship means that the anonymity of donors is no longer protected. This has the potential to bring about a decrease in the number of donors.

vi) Ethical issues
It is difficult to decide how far science can, or should be permitted to, edge into the field of human reproduction. In addition, with regard to the donation of sperms, eggs and embryos, and the lending and borrowing of the uterus, it is difficult to draw a clear line between “human elements” and “material elements (tools)”. Some are for the opinion that donation should be accepted not only from anonymous third persons, but also from relatives and close acquaintances. Others are against this because the “anonymity of donors cannot be protected” and “society does not accept complicated parent-child relationships”. In addition, there is an opinion that options should be left for those people who cannot receive sperm, eggs or embryos donated by a third person. The expansion of this issue would lead to the opinion that the logic of parents who want to have children can be given priority over the welfare and rights of
children born by ART. ART will be improved and public opinion regarding the ethical appropriateness of ART will change in future [54], but it may take some time.

Conclusions
The number of court cases concerned with ART is still small in Japan, but the number of cases is likely to increase because of the expansion that ART is undergoing and the delay in introducing legal control on ART. In terms of judicial precedents, the criteria used for deciding the relationship between parents and the children born by ART have been “the fact of childbearing” and “the consent of the father”. Posthumous recognition was accepted if there was a genetic relationship between the father and the child. In those cases in which there was no “fact of childbearing” or no “consent of the father”, the resulting child was regarded as an adopted child. Judgements were made in the light of what was socially acceptable. The government and academic societies have displayed a cautious attitude toward the relationship of parents and children born by ART. However, many citizens have started to think that “a foster parent is more important than a birth parent”, and the conventional ideas emphasizing the “blood relationship” are changing.

On the basis of these results, it might be reasonable to regard the resulting child as “a biological child” in the cases where either sperm or eggs are donated by a third person, and as “an adopted child” in the cases where embryos are donated, and where the wife gives birth. The thinking has been that the resulting child should be regarded as “a biological child” in the case of a borrowed womb, as the “husband’s biological and the wife’s adopted child” in the cases of surrogacy, and as “an adopted child” in the cases where embryos are donated. It is difficult to determine the borderlines of these private issues of ART because questions of public interest cannot be disregarded. There are numerous ethical issues surrounding ART, including technological, economical and family issues. In Japan, where regulations on science and technology are currently being strengthened, it is likely that vigorous discussions on ART will be conducted from now on. We would like to continue this research, investigating the reports of ongoing government deliberations on ART as well as changes in the outcomes of court cases and citizen’s attitudes toward ART.

List of abbreviations,
Assisted reproduction technology (ART), In vitro fertilization (IVF), Artificial insemination with donor’s semen (AID), Artificial insemination with husband’s semen (AIH), Intended Parents (IP), Gestational Surrogacy (GS), Traditional Surrogacy (TS)

Competing interests
The authors declare that they have no competing interests

Authors' contributions
None declared
Acknowledgements

None declared

References

4. The 516th (Ka) in 2001.
5. The 5th (lah) in 2002.

10. The Guidelines for Derivation and Utilization of Human Embryonic Stem Cell


13. Ethical Review Board apprehension about reproduction supporting clinical practice by embryo transfer

    [http://www.jmda.or.jp/] (in Japanese)


17. Meetings for the study such as clone / IVF: A Bioethics Law tentative plan and comparison with pertinent law. In NIRA 2001, 14(6): 53-61. (In Japanese)


19. Japan Federation of Bar Associations

20. Japanese Society of Fertility and Sterility
    [http://www.jsfs.or.jp/jsfs.html] (In Japanese)

21. Japan Society of Fertilization and Implantation

22. Research on Attitudes of Citizens toward Assisted Reproductive Technology
52. Yoshimura Y: In vitro fertilization with donor’s semen and surrogacy. *Igakunoayumi* 2003, **201(13)**: 1113. (In Japanese)
53. Aono Y: Ethics in research of Reproductive Medicine. *Igakunoayumi* 2003, **204(13)**: 1083. (In Japanese)

**Figures**

**Figure 1** - National consciousness about medical technology and heredity
This figure shows the attitude of Japanese citizens toward heredity. Results show that many feel the improvement of medical technology to be a necessary condition for the pursuit of happiness.

**Figure 2** - Social penetration of knowledge about ART
This figure shows the penetration ratio of knowledge about ART in Japan. Approximately 50% of subjects knew about AID, IVF (donor sperms and donor eggs), and surrogacy.

**Figure 3** - The national consciousness that “you admit ART socially”
This figure shows the question as to whether each type of ART should be socially accepted. Most subjects accepted other forms of ART.

**Figure 4** - Consciousness about parental relationships in ART
This figure shows national consciousness regarding parent-child relationships. Even embryos from third persons and surrogacy are accepted by approximately 40% of subjects.

**Tables**

**Table 1** - Judicial contest instance of ART in Japan
The number of court cases concerning ART is small in Japan. In some cases, the trial is still continuing, thus rendering the legal status of the resulting child unstable.
Table 2 - AIH/ AID/ IVF/ Surrogate mother
There are broadly 9 patterns of ART.

Table 3 - A problem of ART
This table shows 6 issues of background of technological development of ART.
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Figure 2  Social penetration of knowledge about ART
Figure 3  The national consciousness regarding “social preparedness to accept ART"
Figure 4 National Consciousness regarding parent-child relationships in cases of ART
Figure 1 National consciousness about medical technology and heredity
Additional files provided with this submission:

Additional file 3 : Reproductive Table3.pdf : 111Kb
http://www.biomedcentral.com/imedia/1065162703805309/sup3.PDF

Additional file 2 : Reproductive Table2.pdf : 107Kb
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Additional file 1 : Reproductive Table1.pdf : 200Kb
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