

DART—A Voluntary System of Hemovigilance in Denmark

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SUMMARY

Denmark has a long tradition of collecting information concerning the country's activities, and this includes the collation of data concerning transfusion medicine. Data concerning nearly all parts of the transfusion chain, from the giving of blood through to the production of blood components and to the registration of transfusion complications, has been collected for years. Some data is provided on a voluntary and confidential basis by non-official bodies, whereas official bodies as a legal obligation provide other data. Up to this day, a common national hemovigilance system has not been established.

The Danish Registration of Transfusion Risks (DART) was initiated in 1998. The inspiration to initiate a registration of risks in connection with blood transfusion came from the results published by SHOT and from France. The British system SHOT was focused on, because the idea of a voluntary and confidential system was more suited to the Danish mentality, and was therefore more likely to be generally accepted. The DART system was originally organized as a copy of SHOT with the intention of making it possible to compare results from the two systems.

During the first four years DART received 114 reports (91 about a severe risk). Half of the severe events concerned the transfusion of an incorrect blood component, and the other half were concerned immunological complications. Only 5% of the reported events concerned transfusion transmitted infections. The results obtained by DART have given rise to initiatives and recommendations aimed at reducing the transfusion risk.

Denmark has a long tradition of collecting information concerning the country's activities, and this includes the collation of data concerning transfusion medicine. In the last 10 years there has been an increasing interest in the registration of failures and mistakes in connection with treatment in the medical area. From the very beginning registration of failures in the transfusion area has been given a high priority.

The Danish Blood Transfusion Service

The service is hospital based, that is, each of the transfusion centers is an ordinary department in the hospital. This facilitates the communication of information concerning transfusion medicine among the clinicians. In addition, the National Board of Health (NBH) has recommended that every hospital should have a transfusion committee.

All 15 counties have a transfusion center. They function as regional blood transfusion centers for the county, varying in size from 6,000 to 85,000 donations per year. The largest centers are placed in the three university hospitals. In the last five years the blood banks in all counties have been fused into one organization per county. A national body that administers and coordinates the blood transfusion service on a national level does not exist. However, a further centralization in three regions, each with one center, has been under consideration.

The director of the transfusion center, a medical doctor and specialist in transfusion medicine, has full responsibility for the transfusion service in the region. The small blood banks are often incorporated in the department of clinical chemistry or anesthesiology, and normally the chief physicians of these departments contact the regional center for advice.

With the intention of ensuring uniform national performance, the Danish Society of Clinical Immunology (DSKI) has published national guidelines on various aspects of transfusion medicine.¹

In Denmark, blood and blood components are officially regarded as medicinal products. Therefore, according to Danish law, each blood bank must be authorized by the Danish Medicinal Agency (DMA). The blood banks are inspected every other year in accordance with the Danish Medicine Standards, the European Pharmacopoeia and the Good Manufacturing Practice. The National Board of Health has established an Advisory Committee on Transfusion Medicine. The directors of the regional blood transfusion centers meet regularly on a voluntary basis in order to coordinate their efforts. A national law on "Production and Use of Human Blood and Blood Derivatives" was passed in 1997. The NBH has issued a number of regulations and recommendations concerning blood transfusion and blood donation.

Blood Donor Organizations

An independent donor organization has been established in collaboration with each hospital blood bank, and is run on a voluntary basis. They are responsible for the supply of donors to the local blood bank in order to cover the need for blood components.

The hospital blood donor organizations are all members of the nationwide donor organization, Blood Donors in Denmark (BiD).²

BiD is a non-profit association working independently of governmental authorities and without association to the Red Cross. The main aim of BiD is to secure a sufficient number of blood donors anywhere in the country, at anytime. BiD represents the donors on a national level and out of a total population of 5.3 million, more than 260,000 are registered blood donors, i.e. about 10% of the population between 18 and 60 years. All Danish blood donors are voluntary and non-remunerated.

Hemovigilance

In Denmark, data concerning nearly all parts of the transfusion chain, from the giving of blood through to the production of blood components and to the registration of transfusion complications, has been collected for years. Some data is provided on a voluntary and confidential basis by non-official bodies, whereas official bodies as a legal obligation provide other data. Up to this day, a common national hemovigilance system has not been established.

Hemovigilance data collected:

1. Donation, production, transfusion, and number of components not used for transfusion
The DMA as a legal obligation since 1994. Data is published in annual reports.
2. Complications in connection with blood donation
BiD since 1998. The first report will be published in 2003.
3. Screening of blood donors (HBV, HCV, HIV and HTLV)
The Department of Epidemiology, the State Serum Institute since 1985. Data also includes the number of patients infected with these viruses due to blood transfusion and the results of look-back for HCV and HIV.
4. Complications and hazards in connection with blood transfusion: DART (see below)
5. The use of blood components
The Danish Transfusion Database (DTDB). The following data is registered for each hospitalized patient: (a) number of blood components transfused; (b) age, gender, diagnoses and treatment; and (c) hemoglobin concentration, platelet count and coagulation factors.
These data makes it possible to compare the use of blood components in different settings with patients undergoing the same kind of treatment, and to evaluate the transfusion policy in relation to the official policy of a hospital or department.

DART

The Danish Registration of Transfusion Risks (DART) was initiated in 1998 by the DSKI, in agreement with the DMA, the official body

for registering drug complications. Reports on drug complications are sent as a legal obligation. However, reports on transfusion complications have not been made before, even though in Denmark, blood is officially defined as a drug.

The inspiration to initiate a registration of risks in connection with blood transfusion came from the results published by SHOT3 and from France.⁴ The British system SHOT was focused on, because the idea of a voluntary and confidential system was more suited to the Danish mentality, and was therefore more likely to be generally accepted.

Consequently, in the autumn of 1998, the DSKI decided to initiate a registration of transfusion risks from the beginning of 1999. The implementation was carried out in three steps:

1. It was decided to copy the SHOT system. The forms of SHOT were translated into Danish directly and used for the registration. This decision offered two advantages. First, it was more efficient to use the ready-made system provided by SHOT. As a consequence, DART could be implemented within a few months. The other advantage was that in using the same questions as SHOT, it would be possible to compare the answers and thereby the results obtained from the two countries.

2. An agreement was made with the DMA. DART was allowed to initiate the DART system on a voluntary and confidential basis, if the DMA was informed immediately about any appearance of a serious or a new kind of transfusion complication. As mentioned above, it was already a legal obligation to report transfusion complications; however, the rule was that the messages should go directly to the DMA.

3. The implementation was announced to all the directors of the transfusion centers at a national meeting. The report forms were thoroughly explained.

Due to the close contact between the clinical department and the transfusion center, the center will almost always be informed about a transfusion complication or a risk to the patient. As a further guarantee, the department must always send a written report back to the center with a description of how the patient reacted to the blood transfusion. If the report does not arrive within a few days after transfusion, the center will call for it. In this way, the centers obtain close to a 100% return rate of reports.

Therefore, when a patient suffers a severe transfusion complication or risk, the person responsible for the local blood bank fills out a report. The report is also sent to the regional transfusion center (this includes data concerning transfusion transmitted infections). This ensures that a local person familiar with the local hospital, and on friendly terms with the persons who may have made an error, fills out the report.

The director of the center, who also knows the local hospital well, must ratify and sign the report. If the report lacks some information, this should be added, perhaps after some local consultations. The report is then sent to the DART center and ratified by the person in charge. Data is then stored in a database omitting any information that could identify the patient or local medical persons.

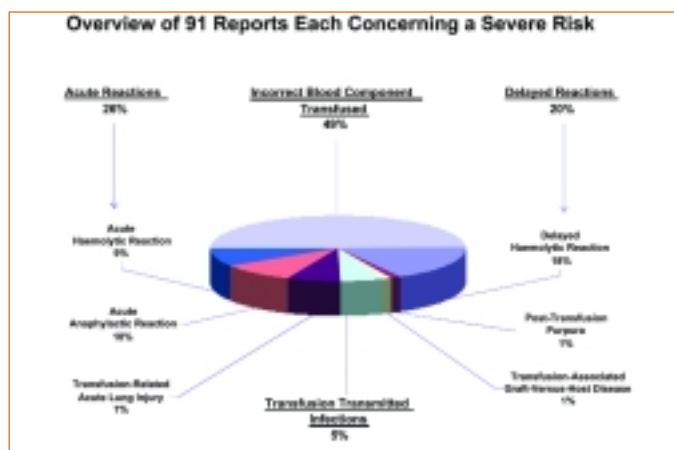
The advantage of this long chain of precautions is that all persons involved know about the previous step, because the distance between the steps is short. Therefore, each person will know enough about the previous step to determine whether the information is right or wrong. If the details are not sufficient, it is easy for the person who knows local people personally to acquire the missing information. This would never have been possible for a person in the DART center. Collection of reports began in January 1999.

Results

During the first four years DART received 114 reports (91 about a severe risk). In Denmark, approximately 450,000 blood components are transfused per year. Thus, the report rate was six per 100,000 components transfused. The number of reports varied only a little from year to year.

The distribution of events according to reporting category is shown in Figure 1. Half of the severe events (i.e., all the reports except for the category unclassified) concerned the transfusion of an incorrect blood component (IBCT) (49%), and the other half were concerned immunological complications (45%). Only 5% of the reported events concerned transfusion transmitted infections.

Figure 1



A comparison of DART data with that of SHOT showed a very high level of similarity especially if the data was related to the number of transfused components as the ratio per 100,000 (Table 1).

However, the ratio for IBCT was about double that in SHOT.

The IBCT events (45 cases) included 8 cases with transfusion of ABO major incompatible unit of red cells (1 blood group B patient died after receiving 100 ml type A blood). In 18 cases the unit was labelled with the name and social security number of another person but nevertheless given to the patient (wrong patient), whereas in 27 cases the unit was dedicated to the patient, but the kind of component was wrong (wrong component).

The immunological complications included eight acute hemolytic reactions (2 anti-Wra, 2 anti-Fya and 4 undetermined), nine acute

Table 1

| Adverse Events: Comparison of SHOT and DART | | | | | | |
|---|--------|------|----------|------|--------|------|
| Type of Event | NUMBER | | PER CENT | | RATIO* | |
| | SHOT | DART | SHOT | DART | SHOT | DART |
| Incorrect blood comp. transfused | 699 | 45 | 61 | 49 | 4.4 | 2.5 |
| Immunological complication | 410 | 41 | 35 | 45 | 2.6 | 2.3 |
| Acute transfusion reaction | 146 | 17 | (13) | (19) | 0.9 | 0.9 |
| Delayed transfusion reaction | 141 | 16 | (12) | (18) | 0.9 | 0.9 |
| PTP | 40 | 1 | (4) | (1) | 0.3 | 0.1 |
| TA-GVHD | 13 | 1 | (1) | (1) | 0.1 | 0.1 |
| TRALI | 70 | 6 | (6) | (7) | 0.4 | 0.3 |
| Transfusion transmitted infection | 32 | 5 | 3 | 5 | 0.2 | 0.3 |
| Total | 1141 | 91 | 99 | 99 | 7.2 | 5.1 |

*Adverse events per 100,000 transfused components
 SHOT 1997-2001 = 16 million transfusions (extrapolated from the years 1997-2000)
 DART 1999-2002 = 1,8 million transfusions

Table 2

| Adverse Events: Overall Clinical Outcome. Comparison of SHOT and DART | | | | | | |
|---|--------|------|----------|------|--------|------|
| Type of Event | NUMBER | | PER CENT | | RATIO* | |
| | SHOT | DART | SHOT | DART | SHOT | DART |
| Death | 61 | 3 | 6 | 3 | 0.4 | 0.2 |
| Major morbidity | 166 | 20 | 16 | 22 | 1 | 1 |
| Minor or no morbidity | 819 | 68 | 78 | 75 | 5 | 4 |
| Total | 1046 | 91 | 100 | 100 | 6.4 | 5.2 |

* Clinical outcome per 100,000 transfused components
 SHOT (1997-2001): Transfused components: 16 million
 DART (1999-2002): Transfused components: 1.8 million

anaphylactic reactions (1 anti-IgA and 8 unknown), six transfusion-related acute lung injury, 16 delayed hemolytic reactions (one patient with anti-c in serum died), one post-transfusion purpura (anti-HPA-1a in serum), and one transfusion associated graft-versus-host-disease (the patient died). The ratio for an immunological complication caused by fresh frozen plasma was four times the ratio for red cells transfused.

The clinical outcome is listed in Table 2. Three patients died, corresponding to 0.2 per 100,000 transfused components. Twenty patients had a severe reaction, corresponding to one per 100,000 transfused components. The clinical outcome for SHOT and DART patients was very similar when the ratio was compared (Table 2).

Near Miss

A near miss event is defined as an event with an error that is detected before a “real” error occurs, i.e., an error that could have harmed a patient. The term was originally coined by pri-vate organizations which needed

a very high level of safety, for instance aviation companies, where “near miss” events are more frequent than “real” failures. Near miss in connection with hemovigilance is defined in our study as it was originally by SHOT: any error which, if undetected, could result in the determination of a wrong blood group, or issue of an incorrect or inappropriate component, but which was recognized before transfusion occurred.

Collection of near miss reports began as a pilot study involving the five largest transfusion centers in 2001.

Near miss events reported in 2001 and 2002 are shown in Table 3 according to type as defined by SHOT.

Half of the events reported were failures in connection with the collection of blood samples from the patients. A more detailed analysis of this data showed that 75% of the samples were not collected by a technician, 55% were not collected during normal working hours, and 60% were collected in an acute situation. If these parameters

were combined for each patient only 20% of the samples with an error were taken in a routine situation.

Discussion

Hemovigilance is a term for the monitoring of morbidity and mortality arising from blood transfusion. In order to make it possible to compare data from different settings, national and/or international, data should be correlated to the activity. Danish hemovigilance data, given as the number of abnormal events per 100,000 activities or events, is shown in Table 4.

The DART system was originally organized as a copy of SHOT with the intention of making it possible to compare results from the two systems. As shown in Tables 1 to 3, the data for actual failures and for near miss failures from the two countries is very similar. So, data collected in two organizations and systematized in the same way, but in different areas, gave the same incidence of risks. From these similarities we can infer with confidence that the results are

Table 3

| Near Miss Events: Comparison of SHOT and DART | | | | | | |
|---|--------|------|---------|------|--------|------|
| | NUMBER | | PERCENT | | RATIO* | |
| | SHOT | DART | SHOT | DART | SHOT | DART |
| Sample errors (wrong pt/label) | 423 | 74 | 52 | 58 | 2.6 | 4 |
| Request errors | 62 | 0 | 8 | 0 | 0.4 | 0 |
| Sample handling / testing errors | 106 | 30 | 13 | 23 | 0.7 | 1.7 |
| Comp. selec. hand. and testing | 145 | 15 | 18 | 12 | 0.9 | 0.8 |
| Comp. issue. transp. coll. admin. | 75 | 9 | 9 | 7 | 0.5 | 0.5 |
| Miscellaneous errors | 1 | 0 | 0.1 | 0 | 0.01 | 0 |
| Total | 812 | 128 | 100 | 100 | 5.1 | 7.0 |

*Near miss events per 100,000 transfused components
 SHOT (1997-2001): Transfused components: 16 million
 DART (1999-2002): Transfused components: 1.8 million

Table 4

| Hemovigilance Data_Denmark 2001 | | | |
|--------------------------------------|-------------|--------------------|-------------|
| Denmark 2001 | Denominator | Numerator | Ratio |
| | Number | Number | Number |
| | A | B | A/B*100,000 |
| Registered donors | 260,000 | Inhabitants | 4.900 |
| New donors / year | 25,000 | Inhabitants | 500 |
| Blood donations / year | 356,000 | Donors | 137,000 |
| Blood donations (year) | 356,000 | Inhabitants | 6,792 |
| Components issued (year) | 470,000 | Inhabitants | 8,868 |
| Eryt. comp. not used (year) | 26,000 | Inhabitants | 491 |
| Severe donor accidents (year) | 11 | Blood donations | 3 |
| Severe complication (pt.) (year) | 23 | Blood transfusions | 5 |
| New seropositive (registered donors) | 8 | Registered donors | 4 |
| Seropositive (new donors) | 24 | New donors | 96 |
| Blood donations per year | 356,000 | | |
| Blood donors | 260,000 | | |
| Blood transfusions / year | 470,000 | | |
| Inhabitants | 5.3 mill | | |

representative of the real number of risks. The intention behind a hemovigilance system is that it should not hold details about every risk but provide a representative number of cases making it possible to implement an evidence-based change of a location in the transfusion chain in order to diminish the risk.

In order to improve transfusion safety, the results obtained by DART have given rise to the following initiatives:

- An annual report has been sent to the directors of hospital blood banks, to the chairmen of the transfusion committees, and to the national health authorities with the intention of increasing the knowledge about the results. In the annual report, recommendations have been given on how to avoid risks.

- Standard operating procedures (SOP) for labelling blood samples, handling and issuing blood components and identifying patients before transfusion, have been written and distributed. Those with special responsibility for blood transfusion safety in departments have been educated on how to implement these SOPs.

The following recommendations have actually been implemented as a consequence of the DART results:

- To decrease the risk of TRALI: fresh frozen plasma from men only is used for transfusion.
- To decrease the risk of transfusion transmitted bacterial infection: bacterial monitoring of all platelet units produced.

Discussions have started on how to implement a computer-based system for bedside checking of identification of the blood components (or drugs) against those of the patients.

Conclusion

A systematic, countrywide, voluntary, and anonymous registration of transfusion risks in Denmark has shown that:

- Incorrect blood components are transfused far more often than expected (3/100,000 transfusions).
- The anticipated rare immunological complications such as transfusion-related acute lung injury, post-transfusion purpura and transfusion-associated graft-versus-host-disease occur all at least once in 1.8 million transfusions of blood components.
- Fatal complications caused by transfusion of an incorrect component or an immunological reaction occur with the same ratio as transmission of hepatitis by blood transfusion (0.2/100,000).

A voluntary reporting system can yield useful information about the relative risks of the recognized transfusion complications. This will help ensure that future spending can be wisely directed.

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