Intra-operative Cell Salvage in Abdominal Aortic Aneurysm Repair

Janet Birchall, Biddy Ridler, Alan Cohen, Rita Bourn and Heather Sethi

NBS Clinical Audit and Effectiveness 2006
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Use of Intra-operative Cell Salvage in Abdominal Aortic Aneurysm Repair

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Executive Summary:

The Department of Health circular, Better Blood Transfusion 2 (BBT 2) 2002/2009 requires hospitals to avoid unnecessary use of donor blood and to explore effective alternatives to allogeneic blood including peri-operative and post-operative cell salvage. The National Blood Conservation Strategy 2004 for the National Blood Transfusion Committee (NBTC) and the National Blood Service (NBS) recommends that intra-operative cell salvage (IOCS) should be considered for patients undergoing surgery where the anticipated blood loss exceeds 1000ml. Consequently, the Southwest Regional Transfusion Committee initiated an audit to look at the use of IOCS within the region. Abdominal aortic aneurysm (AAA) repair was selected as the target operation, as blood loss of over 1000ml occurs in both elective and emergency situations and there are no contraindications to its use.

Audit Aims and Objectives

- To identify the percentage of cases where IOCS is used for AAA surgery and to determine the reasons why IOCS is not used.
- To provide information regarding use of allogeneic blood in AAA surgery when IOCS is and is not used.

Method

All Trusts/hospitals in the region were invited to participate. A proforma was designed to collect data prospectively on each AAA repair from 21st November 2005 to 21st February 2006. Theatre staff completed the proforma for each case. Co-ordinators were recruited in each Trust/hospital to ensure data was collected and the proformas were returned to the NBS Clinical Audit Department for analysis.

Results

15 NHS Trusts/hospitals participated. In one Trust/hospital no AAA surgery was performed during the audit period. One eligible Trust/hospital in the region declined to participate.

All 14 Trusts/hospitals who reported cases used IOCS. Six Trusts/hospitals (43%) used IOCS for all cases.

There were 127 cases of AAA repair during the audit period. IOCS was used in 79% (100/127) of cases.

Most cases (69%) of AAA surgery were performed as elective procedures and in 85% of these IOCS was used. IOCS was used less frequently in emergency surgery although usage was still high at 72% of cases.

The most common reason given for not using IOCS was ‘lack of trained staff’; this was not ‘out of hours’ related. Lack of trained staff accounted for 15 out of the 27 cases where IOCS was not used.

When IOCS was used, 124 donor red blood cell (RBC) units were transfused in 98 cases (mean 1.3 units per patient; range 1-15 units).
When IOCS was not used, 103 donor RBC units were transfused in 27 cases (mean 3.8 units per patient; range 1-30 units). In the 15 cases when lack of trained staff prevented IOCS, the mean amount of donor RBC units transfused was 6.3 units per case.

Conclusions
- All Trusts/hospitals who contributed data to the audit have access to cell salvage machines.
- IOCS was used in 79% of all cases, compared with 43% of cases reported nationally by the Vascular Society of Great Britain and Ireland in the most recent National Vascular Database Report (2004).
- The main reason for not using IOCS was ‘lack of availability of trained staff’. This was largely independent of whether the surgery was routine/emergency or in/out of routine hours.
- When IOCS was not used because of lack of trained staff, the use of donor RBC units was high at an average of 6.3 units per case, compared with 1.3 units per case when IOCS was available.

Recommendations
Trusts/hospitals should be made aware of their performance with the use of IOCS and of the performance of other Trusts within the Region. This will be achieved by distribution of this audit report to all Trusts/hospitals in the South West region.

Although the use of IOCS was high, further improvement requires an increase in the number of staff trained in the use of IOCS. The South West Regional Blood Transfusion Committee is committed to help fund staff to train in IOCS and welcomes applications for such funding.

Future re-audit to identify further change and improvement.
Background:

The Department of Health Circular, Better Blood Transfusion 2 (BBT 2) 2002/2009 requires hospitals to avoid unnecessary use of donor blood in clinical practice. It also advises hospitals to review and explore the use of effective alternatives to allogeneic blood including the use of peri-operative and post-operative cell salvage.

The National Blood Conservation Strategy (2004) for the National Blood Transfusion Committee (NBTC) and the National Blood Service (NBS) recommends that intra-operative cell salvage (IOCS) should be considered for patients undergoing surgery where the anticipated blood loss exceeds 1000ml. The Southwest Regional Blood Transfusion Committee requested an audit to look at the use of IOCS within the region. Abdominal aortic aneurysm (AAA) repair was selected as the target operation, as blood loss of over 1000ml occurs in both elective and emergency situations and there are no contraindications to its use.

Aim

To provide information to Southwest NHS Trusts/hospitals regarding their use of allogeneic blood in surgical procedures where there is excessive blood loss and IOCS is an option.

Objectives

To identify the percentage of cases where IOCS is used for AAA surgery in Trusts/hospitals throughout the Southwest region

To determine the possible reasons why IOCS is not used

To record the use of allogeneic blood in AAA surgery, in relation to the usage of IOCS.

Method

All Trusts/hospitals, including private hospitals, in the South West region were invited to participate in the audit. Transfusion practitioners were recruited to act as audit co-ordinators. In those Trusts/hospitals without transfusion practitioners, an alternative person (e.g. theatre sister or charge nurse) was identified as the audit co-ordinator. Approval of the Caldicott guardian for each Trust/hospital was obtained before starting the audit.

A proforma (Appendix A) was designed to collect prospective data on each AAA repair. This was piloted in one Trust before widespread use within the region. Instructions were given (Appendix B) regarding how the data were to be collected. Theatre staff (nurses, operating technicians or anaesthetists) collected the data for each case of AAA repair.

The audit ran for three months from 21st of November 2005 to 21st February 2006. At the end of this period, the co-ordinators returned all proformas to the NBS Clinical Audit Department for analysis. Missing data were collected retrospectively from theatre records, the vascular database, or from other documentation where possible.
Results

Fifteen NHS Trusts/hospitals which carry out AAA repair within the Region agreed to participate in the audit. One eligible hospital declined to participate. One hospital did not carry out any AAA repair cases during the audit period; therefore, fourteen Trusts/hospitals provided data.

There were 127 cases of AAA repair during the audit period. IOCS was used in 100/127 (79%) cases and not used in 27/127 (21%) cases.

Number of cases and use of IOCS by Trust/hospital

All 14 Trusts/hospitals used IOCS. In 8/14 (57%) Trusts/hospitals, IOCS was not used for all cases.

Figure 1
IOCS Used According to Urgency of Surgery

Most cases (69%) of AAA surgery were performed as elective procedures and in 85% of these IOCS was used. Emergency surgery was associated with a lower incidence of IOCS, although this was still high at 72%. IOCS was used in only 45% of patients requiring ‘urgent surgery’ (within the next 24hrs); however, this was the smallest group with only 11 cases.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Ruptured</th>
<th>IOCS used</th>
<th>IOCS not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
<td>87</td>
<td>74</td>
<td>13</td>
</tr>
<tr>
<td>Urgent /Unplanned</td>
<td>11</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Emergency</td>
<td>29</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>127</strong></td>
<td><strong>21</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

IOCS Used and Time of Surgery

107 cases occurred in normal working hours and in 22 (21%) IOCS was not used. There were 17 cases out of hours and IOCS was not used in 5 (29%). There was no information for three cases.

Reasons Given when IOCS Not Used

The most common reason for not using IOCS was ‘lack of trained staff’ (figure 2). Lack of trained staff accounted for 15 out of the 27 cases where IOCS was not used. Only three of these cases were out of hours (table 3).

In two Trusts/hospitals there was ‘lack of trained staff’ in 50% or more of all AAA cases (table 2).

**Figure 2**

![Reasons for not using IOCS](image-url)
**Table 2**  
Reasons Given for Not using IOCS by Trust/hospital

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Cases recorded</th>
<th>IOCS not used</th>
<th>Lack of trained staff</th>
<th>Not deemed necessary</th>
<th>Machine failure</th>
<th>Not stated</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>5</td>
<td>2</td>
<td>40%</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>13</td>
<td>10</td>
<td>77%</td>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>G</td>
<td>9</td>
<td>1</td>
<td>11%</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>5</td>
<td>1</td>
<td>20%</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>14</td>
<td>1</td>
<td>7%</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4</td>
<td>1</td>
<td>25%</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>8</td>
<td>50%</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>4</td>
<td>3</td>
<td>75%</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>70</td>
<td>27</td>
<td><strong>38.6%</strong></td>
<td><strong>15</strong></td>
<td><strong>8</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

**Table 3**  
Procedures in/out of hours by Trust/hospital when Lack of Trained Staff Identified

<table>
<thead>
<tr>
<th>Hospital</th>
<th>IOCS not used</th>
<th>Lack of Trained Staff</th>
<th>In Hours</th>
<th>Out of Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>15</strong></td>
<td><strong>12</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
</tbody>
</table>

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Use Of IOCS and Effect on Donor Red Cells (RBCs) Transfused

IOCS was used in 100 cases. In 35 (35%) donor RBCs were required, in 63 no RBCs were required and in two this information was not recorded. 124 units of donor RBCs were transfused in 98 cases (mean 1.3 units per patient; range 1 - 15 units) (Figure 3).

IOCS was not used in 27 cases. In 15 (56%) of these, donor RBCs were required, in 12 (44%) no RBCs were required. 103 units of donor RBCs were transfused (mean 3.8 units per patient, range 1 - 30 units) (Table 4 and Figure 4).

In 12/15 (80%) cases where lack of trained staff prevented IOCS being used, donor RBCs were required. 94 units of donor RBCs were transfused (mean 6.3 units per patient). ‘IOCS considered unnecessary’ was the second largest category. In general this was a reasonable decision however in two cases a total of seven units of donor RBCs were transfused.

<table>
<thead>
<tr>
<th>Reason IOCS not used</th>
<th>Number of cases</th>
<th>Number of cases transfused donor blood</th>
<th>Number of cases where donor blood transfused not stated</th>
<th>Total number of units donor blood transfused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of trained staff</td>
<td>15</td>
<td>12</td>
<td>0</td>
<td>94</td>
</tr>
<tr>
<td>Not deemed necessary</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>IOCS malfunction</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Not stated</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>15</td>
<td>0</td>
<td>103</td>
</tr>
</tbody>
</table>
Use of Intra-operative Cell Salvage in Abdominal Aortic Aneurysm Repair

**Figure 3**  Units of Donor RBCs Transfused during AAA Surgery for % of Cases where IOCS was used

![Graph showing blood transfusions](image)

**Figure 4**  Units of Donor RBCs Transfused during AAA Surgery for % of Cases where IOCS was not used

![Graph showing blood transfusions](image)
Use of Intra-operative Cell Salvage in Abdominal Aortic Aneurysm Repair

Blood Volumes Lost, Salvaged and Returned

Mean intra-operative blood loss: 2200mls per patient (range 200-15,000)
Mean volume of cell saved red cells returned: 659mls per patient (range 111-3020)

Figure 5  Volumes of Processed Red Cells Reinfused

Patient Death in Theatre

There were 4 cases of patient death in theatre. All occurred during emergency surgery for aneurysmal rupture.

Table 5

<table>
<thead>
<tr>
<th>Hospital</th>
<th>IOCS used</th>
<th>Blood Collected</th>
<th>Blood reinfused</th>
<th>Volume reinfused</th>
<th>Donor blood given, units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>Yes</td>
<td>5277ml</td>
<td>Yes</td>
<td>1200ml</td>
<td>6</td>
</tr>
<tr>
<td>N</td>
<td>No</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>P</td>
<td>No</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>
Discussion

Participation in this audit was excellent. Only one eligible Trust/hospital did not wish to be involved. Caldicott Guardians responded quickly and did not hold up progress of the audit. The major role of the co-ordinators in managing data collection within each Trust/hospital is acknowledged.

All Trusts/hospitals who took part had IOCS machines available and in 100 out of a total of 127 cases (79%) IOCS was used. This compares favourably with a national figure of 43% taken from the National Vascular Society Annual Report (2004).

Both elective and emergency surgery was associated with a high use of IOCS for 85% and 72% of cases respectively. Urgent surgery was the smallest category (11 cases) and IOCS was used in only 45% of these. It is unclear whether this latter result is significant or simply a result of the small sample size.

‘In hours’ surgery was associated with the use of IOCS in 79% of cases which was similar to 71% ‘out of hours’.

The most common reason stated for not using IOCS was “lack of available trained staff” (56%). This was not an ‘out of hours’ phenomenon; 80% of these cases occurred during routine working hours. In two out of 14 Trusts/hospitals there was lack of available staff for at least 50% of their AAA surgery cases.

When IOCS was used a mean of only 1.3 donor RBC units per case were required (124/98), compared with 3.8 donor RBC units (103/27) when IOCS was not used. This increased to 6.3 units per case when there was a lack of trained staff.

Given that a unit of donor RBCs costs £131.8, and the undiscounted cost of an IOCS disposable kit, as quoted by leading manufacturers, is between £60 - £110 (average £85), this equates to a saving of around £245 [(2.5 x £131.8) - £85] per case with IOCS. This saving increases to around £574 [(5 x £131.8) - £85] when IOCS was not used because of lack of an available operator.

From the available data in the audit sample, the average volume of washed red cells returned to the patient when IOCS was used was 659 mls. In this audit this equates to approximately 2.4 units of donated RBCs (275mls per donor unit) and agrees with the predicted saving as above.

Conclusions

- All Trusts/hospitals who participated in the audit have access to cell salvage machines.

- IOCS was used in 79% of all cases, compared with 43% of cases reported nationally by the Vascular Society of Great Britain and Ireland in the most recent National Vascular Database Report (2004).

- Impact on donor red cell use:
  - Where IOCS was used, the mean number of donor RBC units transfused per case was 1.3 (range 1-15)
  - Where IOCS was not used, the mean number of donor RBC units transfused per case was 3.8 (range 1 - 30) with an additional cost implication of around £245.

- Where IOCS was used, the mean volume of red cells returned to the patient was 659mls, (range 111 - 3020mls)
Use of Intra-operative Cell Salvage in Abdominal Aortic Aneurysm Repair

- The main reason for not using IOCS was lack of availability of trained staff. This was largely independent of whether the surgery was routine/emergency or in/out of routine hours. When trained staff were not available a mean of 6.3 donor RBC units were used, with an additional cost implication of £574.

**Recommendations**

Report to be distributed to all South West Trusts/hospitals who perform AAA surgery.

Trained staff must be available for IOCS to be a valuable resource both from a clinical governance and cost-effective perspective. The Regional Blood Transfusion Committee is committed to help fund staff to train in IOCS.

Re-audit to identify change as a result of this audit

**Audit Critique**

The audit proforma (Appendix A) requested the number of donor units transfused in theatre to be recorded. This was unclear because the person entering the data could not be sure whether this meant red cell units or other blood components, such as fresh frozen plasma or platelets. Clarification was sought post data collection in several cases.

The definitions for AAA repair surgery were given as elective, urgent and emergency. The correct definition for urgent should be unplanned in accordance with the Vascular Society of Great Britain and Ireland.

**References**


2. ‘A National Conservation Strategy for NBTC and NBS report from the working party on alternatives to transfusion and the NBS sub group on appropriate use of blood’. January 2004, James V


**Glossary**

- **Abdominal Aorta**: The main trunk of the systemic arterial circulation. The abdominal aorta extends from the renal arteries to above the bifurcation
- **Aneurysm**: A localised dilation of the wall of the abdominal aorta.
- **Caldicott Guardian**: Person nominated to govern the use of confidential patient/donor information
- **Donor Blood**: Donated blood for use with another non-identical person
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
<td>Routine admission from waiting list. The procedure can be deferred without risk</td>
</tr>
<tr>
<td>Emergency</td>
<td>Unscheduled procedure: there should be no delay in surgical intervention irrespective of the time of day</td>
</tr>
<tr>
<td>Intra-operative Cell Salvage</td>
<td>Intra-operative cell salvage recovers blood lost from the operative area, filters, spins, washes, re-filters and then returns as red cells back to the patient</td>
</tr>
<tr>
<td>Unplanned</td>
<td>Patients who have not been scheduled for routine admission from the waiting list but who require surgery on the current admission for medical reasons. They cannot be sent home without surgery</td>
</tr>
</tbody>
</table>
# Proforma for SW Regional Audit of Intra-operative Cell Salvage in Abdominal Aortic Aneurysm

**Hospital Code**

**Surgeon (optional)**

**Anaesthetist (optional)**

**Procedure No.**

**Procedure Date**

1. **Elective** ☐ **Urgent** ☐ **Emergency** ☐ *Please tick ☑*

2. **Ruptured?**  Yes ☐  No ☐

3. **Predominantly in or out of routine hours?** (please tick)  In ☐  Out ☐

4. **Total Intra-operative blood loss (salvaged and unsalvaged)**

5. **IOCS kit opened?**  Yes ☐  → *Go to question 6*  No ☐  → *Go to question 7*

6. **Volume of blood collected**

   **Volume of processed red blood cells returned to patient**

   *(if not enough blood collected to reinfuse, enter 0 mls.)*

   → *Go to question 8*

7. **Why not?** *Please circle one of the codes below:*

   - A  IOCS equipment not available at our Hospital
   - B  IOCS equipment in hospital but not available for this case
   - C  Lack of availability of trained personnel for this case
   - D  IOCS not deemed necessary (by surgeon or anaesthetist)
   - E  Other *(please define below)*

8. **Was donor blood used in theatre?**  Yes ☐  No ☐

    *If Yes, state the number of units transfused*

9. **Death in operating theatre?**  Yes ☐  No ☐

**Comments:**

**Name of person completing this form (please print)**

**Job Title**

**Signature**

---

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**13**
Appendix B

South West Regional Transfusion Committee

Intra-operative Cell Salvage (IOCS)
in Abdominal Aortic Aneurysm Repair

Dear Colleague

Thank you for agreeing to act as the co-ordinator for this clinical audit. Enclosed in the pack are 30 proformas with your hospital ID entered and a Freepost envelope.

Can you please start data collection on Monday 21st November 2005 and continue for 3 months until Tuesday 21st February 2006.

Instructions:

- Before data collection starts please discuss the audit with your theatre manager/s who is responsible for informing their staff. For the audit pilot, the nurses and ODA’s completed the proformas.

- A secure place should be located for keeping the data folder and completed proformas.

- Please check the data folder regularly to ensure data is being collected for all cases of AAA repair. This is particularly important when you are covering more than one hospital.

- A separate proforma should be completed for each case of abdominal aortic aneurysm repair. At the end of the audit period please photocopy all the completed proformas, retain these, and return the originals in the Freepost envelope provided.

- If you begin to run short of proformas do not make further photocopies, as the NBS data scanner cannot read them. Contact the NBS Clinical Audit Department and more proformas will be sent to you.

Finally could you please either phone or e-mail Heather Sethi to confirm receipt of the audit folder and do not hesitate to contact either of us if you have any queries.

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