The following guidance is to support the education slides for Intraoperative Cell Salvage training. The education slides have been written to accompany the Intraoperative Cell Salvage education workbook and are designed to be used as a teacher led introduction to the subject prior to practical training and completion of the education workbook and competency assessments. The slides are designed to *promote discussion and interactive teaching*, rather than as a presentation or lecture and should be used in conjunction with questioning, group work tasks etc to allow on-going assessment of the trainees understanding of the subject matter.

Further information for all of the topics covered by the slides can be found in the ICS education workbook.

It is intended that the slides be used as they are, however, blank slides have been added to the end of the presentation which can be used to add in local requirements, practice and policies. These slides can be inserted into the presentation in the appropriate places.

 Where this symbol appears, important information is highlighted in the relevant section of the ICS education workbook.

Slide	Guidance Notes	Relevant ICS Education Workbook Section
1	ICS Education Slides	
2	Training Pathway The suggested pathway is designed to offer comprehensive and flexible learning in the use of Intraoperative Cell Salvage (ICS). 	Section 2 Pages 11-12
3	Basic Blood Facts – Important to understand the composition and function of whole blood as well as the functions of the main components of blood and how these components can be separated.	Section 3 Pages 13-24
4	Learning Outcomes - Describe the main functions of blood - Identify the main components of blood and describe their individual functions - List the allogeneic (donor) blood products available for clinical use	Section 3 Pages 13-24

5	Functions of blood with emphasis on RBC role and separation of blood into constituent parts by density. **Key Points** – Red cells are the heaviest component of blood and it is this property that allows the separation of washed red cells from the waste products in ICS. – Heparin and citrate both inhibit coagulation and this allows for blood to be collected without clotting.	Section 3.1, 3.2, 3.3 Pages 13-17
6	Overview of allogeneic blood components and associated risks. Allogeneic blood products *could* also be covered here. **Key Points** – Allogeneic blood and blood components are extremely safe and the greatest risk is in giving the wrong blood.	Section 3.4, 3.5, 3.6 Pages 18-20
7	Blood Conservation – Allogeneic (donor) blood is a valuable but limited resource – Not without risks e.g. wrong blood incidents – Precautionary measures, introduced due to concerns over variant Creutzfeldt-Jakob Disease (vCJD), together with additional testing have further improved the safety of donated blood. However, the result has been a significant increase in cost. – Individuals who have received a transfusion after 1st January 1980 are no longer eligible to donate blood. This and other restrictions have reduced the already diminishing blood donor population. – Blood shortages may in future result in the restriction of transfusion to treatment of active major bleeding, emergency surgery and life-threatening anaemia.	Section 4 Pages 25-32
8	Learning Outcomes - Identify the principles of blood conservation - Identify the areas where blood conservation can be undertaken in surgical patients - Describe the main methods of blood conservation	Section 4 Pages 25-32
9	As slide 7	Section 4 Page 25
10	**Key Points** – Blood Conservation requires a team approach – Safe and appropriate use of allogeneic (donor) blood should be a priority for all staff – Developing a blood conservation policy for each organisation is essential	Section 4.1, 4.2 Page 26

11	– Attention should be drawn to appropriate transfusion and autologous transfusion techniques	Section 4.3 Page 27
12	Haemovigilance – Haemovigilance comprises organised surveillance procedures relating to serious adverse or unexpected events or reactions in blood donors and recipients. **Key Points** – All staff involved in the transfusion process are responsible for haemovigilance and the reporting of adverse events and reactions	Section 5 Pages 33-36
13	Learning Outcomes - Demonstrate an understanding of the principles of haemovigilance - Identify the risks associated with administration of allogeneic (donor) blood	Section 5 Pages 33-36
14	– The risk of Transfusion Transmitted Infection is low – The most frequently reported hazard of transfusion in Incorrect Blood Component Transfused – There is a legal requirement to report transfusion incidents	Section 5.1, 5.2 Pages 33-35
15	Principles of Intraoperative Cell Salvage – As highlighted in next slide (14), if whole blood is allowed to settle, it will separate into its constituent components. – Red blood cells (RBC) are the most dense component of blood and consequently will settle at the bottom. – A centrifuge can significantly increase this rate of separation and many cell salvage machines work on this principle. **Key Points** – ICS has four key processing stages ▪ Collection ▪ Separation ▪ Washing ▪ Reinfusion	Section 6 Pages 37-44
16	Learning Outcomes ▪ Identify the 4 main stages of ICS ▪ Describe the end product of ICS	Section 6 Pages 37-44

17	As slide 15 Details on the different types of ICS system are found in the relevant sections of the workbook. Information relevant to the machines used within an organisation should be discussed at this point. The following slides in this section give an outline of the process, this is covered in greater detail in the practicalities sections of the presentation later on.	Section 6.1, 6.2 & 6.3 Pages 37-40
18	Slides 18 – 22 outline the basic steps of the process. Depending on the system used, these might occur in sequence, concurrently, or both depending on the step. – ICS begins with the collection of shed blood from the surgical field. The blood is anticoagulated as it is aspirated with low suction into a collection reservoir where it passes through a filter.	Section 6.4 Pages 40-42
19	– Separation of RBCs from whole anticoagulated blood occurs through centrifugation.	Section 6.4 Pages 40-42
20	– The RBCs are washed using IV normal saline (0.9% NaCl) solution and then pumped into a bag for reinfusion to the patient – Waste products include anticoagulant, cell debris, free haemoglobin, plasma etc	Section 6.4 Pages 40-42
21		Section 6.4 Pages 40-42
22	**Key Points** – ICS produces an end product of packed RBCs suspended in IV normal saline (0.9% NaCl) solution	Section 6.4 Pages 40-42
23	– Where large blood loss occurs, transfusion of allogeneic (donor) blood products may be required	Section 6.4 Pages 40-42

24	Indications and Contraindications **In this section it recommended that you discuss cases in the trainees department which may be suitable for ICS.** – The routine use of ICS is recommended in many surgical procedures – There is evidence of decreases in allogeneic (donor) blood transfusion when ICS has been used. – The decision to collect blood is often based on a number of factors including: – The anticipated blood loss – Risk factors for bleeding – A low preoperative haemoglobin – Religious or other objections to receiving allogeneic (donor) blood **Key Points** – ICS is of proven benefit in certain elective and emergency surgical procedures where the predicted blood loss is in excess of 20% of the patient's estimated blood volume.	Section 7 Pages 45-54
25	Learning Outcomes - To identify the indications for ICS - To identify the relative contraindications for ICS - To outline when the risks/benefits of using/not using ICS change	Section 7 Pages 45-54
26		Section 7.1 Pages 45-46
27		Section 7.2 Pages 46-48
28		Section 7.2 Pages 46-48
29		Section 7.2 Pages 46-48

30	**Key Points** – ICS should only be used in malignancy when the benefits outweigh the risks. – ICS should be available for obstetric cases where there is the potential for massive haemorrhage.	Section 7.3 Pages 48-52
31	Practicalities: Blood Collection **Practical training could be incorporated into the theory session or delivered as a separate session.** – Whilst the practical set up of the equipment for the blood collection phase of ICS is specific to the machine in use, the basic theory and principles are the same. **Key Points** – The main equipment for blood collection includes an A&A line, a collection reservoir and anticoagulant. – The operator must maintain awareness throughout the procedure in order to prevent errors occurring.	Section 8 Pages 55-56
32	Learning Outcomes - To identify the equipment used for blood collection and describe the function of each component - To name the two main types of anticoagulant used in ICS , describe their functions and mechanism of action - To describe methods of maximising blood collection - To identify areas for potential problems during blood collection	Section 8 Pages 55-56
33	During the blood collection phase of ICS, blood lost during surgery is aspirated from the surgical field, mixed with anticoagulant to prevent clotting, filtered to remove large particulate debris and stored in a collection reservoir ready for processing.	Section 8 Pages 55-56
34		Section 8.1 Page 55
35		Section 8.1 Page 55
36		Section 8.3 Pages 57-58
37	To minimise haemolysis, a wide bore suction tip e.g. Yankauer, should be used and a low vacuum level maintained except in cases of excessively high blood loss where it may be acceptable to increase the vacuum level.	Section 8.4 Pages 58-61

38		Section 8.5 Page 61
39	**Key Points** – In order to maximise blood collection, a number of techniques can be used in conjunction with one another e.g. low vacuum levels, swab washing and suction technique.	Section 8.6 Pages 62
40		Section 8.7 Page 63
41		Section 8.8 Page 64
42	Practicalities: Blood Processing **Practical training could be incorporated into the theory session or delivered as a separate session.** – While the practical set up of the equipment for the blood processing phase of ICS is specific to the machine in use, the basic theory and principles are the same for all machines.	Section 9 Pages 67-78
43	Learning Outcomes – To identify the steps taken in making the decision to process – To list the equipment used for blood processing and describe the function of each component – To describe the risks of overriding the automatic functions of the machine – To identify the steps necessary to complete the blood processing phase	Section 9 Pages 67-78
44	– During the blood processing phase red blood cells (RBCs) are separated from the waste products. – The RBCs are concentrated to produce a high haematocrit and washed with intravenous (IV) normal saline (0.9% NaCl). – The RBCs, now suspended in IV normal saline (0.9% NaCl), are the pumped to a re-infusion bag.	Section 9 Pages 67-78

45	Attention should be drawn to how to calculate the blood loss in the collection reservoir (see page 68-69).  Discussion points: What are the benefits of full setup from the start of the procedure? – Ready to process in case of unexpected rapid blood loss – Can be used as a training opportunity **Key Points** – The operator must be able to make an informed decision regarding proceeding to process the blood.	Section 9.1 Pages 68-69
46	**Key Points** – The blood processing set includes a centrifugal system, reinfusion bag, waste bag and tubing, which are all loaded into the ICS machine. – The operator should follow the manufacturer's guidance with regard to loading the processing equipment and running the processing phase of the procedure.	Section 9.4 Page 71-74
47		Section 9.4 Page 71-74
48		Section 9.4 Page 71-74
49		Section 9.5 Page 74
50		Section 9.6 Pages 74-75
51		Section 9.7 Page 75
52	**Key Points** – The operator must maintain awareness throughout the procedure in order to prevent errors occurring.	Section 9.8 Page 76
53		Section 9.9 Pages 76-77

54	Practicalities: Blood Reinfusion – Once the blood collected using ICS has been processed, the next step is reinfusion of the final product to the patient. Many of the principles of reinfusing ICS blood are similar, if not the same, as the principles of transfusing allogeneic (donor) blood.	Section 10 Pages 79-88
55	Learning Outcomes - To identify the equipment used for reinfusion and describe the function of each component - To describe the composition of the final product for reinfusion - To identify the conditions for reinfusion	Section 10 Pages 79-88
56	**Key Points** – ICS blood for reinfusion consists mainly of RBCs suspended in IV normal saline (0.9% NaCl). Other components, such as platelets, may be present in extremely small quantities.	Section 10.1 Pages 79-80
57		Section 10.1 Pages 79-80
58		Section 10.1 Pages 79-80
59	**Key Points** – The reinfusion of ICS blood should be prescribed by the responsible clinician and should follow local policy and national guidelines.	Section 10.2 Page 81
60		Section 10.4 Pages 81-82
61		Section 10.5 Pages 82-84
62	**Key Points** – Care should be taken to: o identify the correct patient o ensure the ICS blood is suitable for reinfusion (i.e. not expired or damaged) o select the correct giving set/filter to use o record the procedure accurately on the documentation approved by the Organisation	Section 10.6 Pages 84-85

63		Section 10.7 Page 85
64	Information & Best Practice This slide relates to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10
65	Learning Outcomes - To outline the operators responsibilities for labelling ICS blood - To discuss the factors to be considered when dealing with patient's with specific religious requirements - To outline the responsibilities of the operator during the procedure - To describe the operators responsibilities with regard to dealing with procedural problems	Sections 8, 9 & 10
66	This slide related to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10
67	This slide relates to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10
68	This slide related to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10
69	This slide related to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10
70	This slide related to information relevant to all 3 Practicalities sections: Collection, Processing and Reinfusion.	Sections 8, 9 & 10

71	Unloading and Discarding – Before unloading and discarding ensure that: o ICS is no longer required o any blood collected up to that point that is intended for washing and reinfusion, is processed o salvaged red blood cells (RBCs) have been reinfused to the patient, or that the reinfusion bag is detached from the processing set – The procedure for unloading disposables is specific to each type of ICS machine and will differ depending on whether you have set up for "collect only" or "full processing." – The manufacturer's machine specific guidelines on unloading should be followed. – The risks associated with this stage are similar irrespective of technical differences in unloading procedures.	Section 11 Pages 89-92
72	Learning Outcomes - Identify *when* unloading of ICS machine and disposables is appropriate - Determine the risks associated with the unloading phase - Describe the appropriate procedure for safely discarding waste products and disposables that is compliant with your hospital policy	Section 11 Pages 89-92
73	As above	Section 11 Pages 89-92
74	Further Information: - www.transfusionguidelines.org.uk – follow the links to Better Blood Transfusion Toolkit then Appropriate Use in order to Access the UK Cell Salvage Action Group Website. - Further resources to support training include the ICS Education Workbook and the ICS Competency Assessments which can both be downloaded from www.transfusionguidelines.org.uk	
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