Phlebotomy Risks and Complications

“The most common and most seemingly harmless invasive procedure in medicine is not always harmless, I had discovered.”

Jane Kendall Medlab Central
Palmerston North

An ancient practice

- Leeches were used for bleeding by Syrian physicians as early as 100 BC.
- The art of bloodletting was flourishing well before Hippocrates in the fifth century B.C. By the middle ages, both surgeons and barbers were specializing in this bloody practice.

The early phlebotomists

- Barbers advertised with a red (for blood) and white (for tourniquet) striped pole. The pole itself represented the stick squeezed by the patient to dilate the veins.

- Bloodletting came to the U.S. on the Mayflower.

Risks and complications then

- The practice reached unbelievable heights in the 18th and early 19th centuries.
- The first U.S. president, George Washington, died from a throat infection in 1799 after being drained of nine pints of blood within 24 hours.

Techniques continued to improve

On October 8, 1897, Becton made what is believed to be the company’s first sale — a Luer all-glass syringe that sold for $2.50.

1925-1950

- BD Yale Luer-Lok™ Syringe
- BD’s first sterile disposable product was a blood collection set developed and sold to the American Red Cross.
Safety Engineered devices

- 1988 First Safety-Engineered Syringe
- 1992 Collection Set, offering needlestick protection following blood-drawing procedures.

Phlebotomists’ risks

- Death or serious harm are possible
- Blood body fluid incidents
- Ergonomics
- Environment
- Technique
- Security
- 3 rules
- Patient risks - a couple of examples

Today - A Little Sting’ Can Become a Debilitating Injury

“Ow, ow, ow! Are you using a really big needle?”

The phlebotomist assured me everything was fine: “Maybe a little alcohol got in there and made it sting.”

A few hours later, peeled off the pressure bandage on my arm. Blood was still oozing from the puncture site. I put on a fresh Band-Aid and didn’t think anything of it. It was only a blood draw.

Significant ongoing complications

- In the following days my right arm throbbed as if it had been tenderized with a baseball bat
- Over the next months the pain eased if I rested my arm, but it always came back: an aching in the inner elbow, numbness in my little finger and a sensation of cold in my hand.

But a year later

- I couldn’t address an envelope without pain and needed help cutting a waffle.

- The most common and most seemingly harmless invasive procedure in medicine is not always harmless, I had discovered.

I eventually found an arm surgeon

- the needle had gone through my vein and caused dangerous but invisible bleeding into my arm.
- to prevent permanent loss of the use of my arm, as well as a condition called “claw hand” that causes your digits to curl up like a sea anemone.
- Seeing that my little finger was already starting its inward curl, I made the appointment.
The recovery

- After surgery to repair damage to my ulnar nerve, tendon and bone, I was hooked up to two pain pumps and lived for months on a diet of pain pills and patches.

Today

- I'm back to swimming laps, but my elbow aches if I type for too long or curry the dog with vigor.
- I've become an evangelist on the potential dangers of phlebotomy, rolling up my sleeve at every opportunity to display my six-inch scar and telling people to take unusual pain or prolonged bleeding at the time of a blood draw seriously.

What are the risks

- There are no studies showing how often patients are hurt during routine blood draws, but a 1996 study of blood donors (a larger needle is used in blood donation than in routine venipuncture) found that
  - 1 in 6,300 donors suffered a nerve injury.

Let's review the process

A patient arrives for a blood test

Trypanophobia

- Trypanophobia is the extreme fear of medical procedures involving injections or hypodermic needles.
- The name that is in common usage is simply needle phobia.

23 deaths

- Although most phobias are dangerous to some degree, trypanophobia is one of the few that actually kills.
- In cases of severe trypanophobia, the drop in blood pressure caused by the vasovagal shock reflex may cause death.
Needle phobic

- Jackie Chan

  the martial art action movie star who performs all his own stunts, cannot be insured due to the almost certain guarantee of injury during filming as he is terrified of needles.

Identification-CLSI

- Accurate patient id is crucial
- Phlebotomy errors may cause serious harm up to and including death-Lab Medicine 2005

- Do no harm
- Safety- salus-freedom from harm

- WBIT International rate of 1 in 1986 samples

Patient misidentification

- Misidentification and problems in communicating results, which affect the delivery of all diagnostic services, are widely recognized as the main goals for quality improvement.

- The lesson we have learned is that each practice must examine its own total testing process to discover its weaknesses and identify appropriate remedies.

Communication is not always easy

- There are risks
- No assumptions

Be prepared

- Situations can change very quickly
Workplace ergonomics a safe environment

We will wash our hands

- The CDC says poor hand hygiene contributes to the country’s 1.7 million annual health care-associated infections. (US)
- About 99,000 patients die of these infections each year, the agency says.

Simple Interventions May Reduce Transmission of Epidemic Respiratory Viruses

- Physical measures were highly effective in the prevention of transmission of severe acute respiratory syndrome, according to a meta-analysis of 6 case-control studies.

Hospitals’ high-tech tools track who’s washing their hands

The HyGreen hand-hygiene sensing device detects the alcohol in the gel used to wash hands and sends an infrared signal to his badge to record the washing event.

If he enters a 7-foot zone near a patient’s monitor without washing his hands, the badge will vibrate as a reminder.
Why?

- Miami Children’s achieved hand-hygiene compliance rates above 90% from September 2010 to March 2011 and saw an 89% drop in health care-associated infections after the HyGreen system was installed.

Tourniquets

Educated phlebotomist chooses a safe site for collection

- Arm-Mastectomy-drips-burns-scars
- Hand vs Wrist
- Feet vs Legs
- Alternative technique
- Other sites-Neck

Infection post heel puncture as newborn affecting a 16yr old girl

- Appropriate equipment
- Correct technique
- Order of draw
- Tourniquet
- Clean the site
- Underfilling
- Allergies
- Transport
- IVs
- Choking

Unseen risks

- 57 Yr old Male in ED with pneumonia
- HB = 90G/L
- Group and hold requested
- Progesa history A Pos, Auto AHG reactive antibody
- Dat on current sample IgG=4+ C3d =0
- Everything positive
Haemoglobin is up and down

![Graph showing haemoglobin levels]

Significant error and significant clinical risk.

- Hb 89, 72, 89 then 89, 67, 91
- Phlebotomist did not follow correct protocol for collection of blood leading to incorrect test results. This in turn created significant work load in the blood bank (6 crossmatches and samples sent to reference lab.)

The ESR test is a laboratory test that serves as a general sickness index in conjunction with the patient’s clinical history and physical examination findings

- Cells sediment through plasma
- This can be very rapid

Risks and Complications

- Patient finally did have 3 phenotype matched units transfused on the 25 of November 2010.
- He died on the 30th of November from sepsis caused by Candida albicans
- Had past history of Chronic lymphocytic leukaemia, Nocardiasis, recurring ITP and pneumonia.
- Unknown cause of the positive DAT.

Hyperkalaemia another unseen risk- University of Texas 2010

- Pseudohyperkalaemia is an in vitro phenomenon caused by the mechanical release of potassium from cells during the phlebotomy procedure or specimen processing.
- Serum potassium measurement should be repeated to exclude pseudohyperkalaemia in patients with a normal electrocardiogram and no risk factors for hyperkalaemia

Evaluation of a Patient With Hyperkalemia

- Common causes include fist clenching during the phlebotomy procedure, application of tourniquets, and use of small-bore needles.
- Pathologic causes are seen mostly in the setting of hematologic disorders, such as thrombocytosis (platelets >500,000/cm^3) and pronounced leukocytosis (leukocytes 70,000/cm^3).
- Cell shifts or abnormal renal excretion
- Contamination with potassium EDTA in certain sampling tubes can cause a spurious increase in plasma potassium concentration accompanied by a very low plasma calcium concentration.
Volume collected—University of Toronto 2007

- ICU adult patients
- Small increases in average phlebotomy (3.5 ml/day, 95% confidence interval 2.4–6.8 ml/day) were associated with a doubling in the odds of being transfused after day 21.
- Conclusion: Anemia, phlebotomy, and transfusions, despite low hemoglobin triggers, are common in ICU patients long after admission. Small decreases in phlebotomy volume are associated with significantly reduced transfusion requirements in patients with prolonged ICU LOS.

Anemia of Critical Illness: Etiology

- Phlebotomy. Blood loss from phlebotomy, once considered insignificant, can no longer be overlooked.
- It can contribute to a reduction in hemoglobin concentrations, a condition referred to as iatrogenic or nosocomial anemia.
- Observational study conducted in 1136 patients from 145 Western European ICUs. During a 24-hour period, in almost half of the patients, blood was drawn 5 or more times, with an average total volume of 41.1 ml of blood.
- There was a significant positive correlation between organ dysfunction and the number of times blood was drawn ($r = 0.34$, p<0.001).

In another study

- The authors found that 50 patients who spent part or all of their hospitalization in the ICU underwent phlebotomy a mean of 3.4 times/day, with a mean blood sample volume of 41.5 ml/day and total mean volume of 762 ml.
- Patients in the ICU who had arterial catheters had even more blood drawn (total volume 944 ml) compared with those who did not have such catheters (300.9 ml).
- However, in 50 patients who spent all their hospitalization on a general medicine ward, blood was drawn only 1.1 times, with a mean volume of blood of 12.4 ml/day and a total volume of 175 ml.

Transfusions in the Critically Ill Pediatric Patient:

- Critically ill patients in pediatric intensive care units (PICUs) are at significant risk for developing anemia.
- The causes are multifactorial and include overt and occult bleeding, extravascular blood loss due to hematostatic phlebotomy, underlying disease, chronic anemia and treatment causing bone marrow suppression.[1] An inadequate erythropoietin response to anemia in critically ill children has been described.[2]

Infant transfusions

- Possible cardiovascular instability and dilutional coagulopathy, as well as metabolic and thermal alterations.
- During extremely large transfusions, sodium citrate anticoagulant binds ionized calcium and may result in transient hypocalcemia.
- Rapid transfusion of RBCs containing high concentrations of extracellular potassium can result in fatal cardiac disturbances in small infants, especially when accompanied by acidosis.
- Hypothermia is a concern when rapid transfusions are needed for pediatric patients owing to their large surface area:weight ratio.

Hematoma: The most common complication of phlebotomy procedure.
Other complications

- **Phlebitis**: Inflammation of a vein as a result of repeated venipuncture on that vein.
- **Petechiae**: These are tiny non-raised red spots that appear on the skin from rupturing of the capillaries due to the tourniquet being left on too long or too tight.
- Faint
- Seizure
- Assumptions-communication
- Patients-parents guardians friends

Other risks

- **Thrombus**: This is a blood clot usually a consequence of insufficient pressure applied after the withdrawal of the needle.
- **Thromboembolitis**: Inflammation of a vein with formation of a clot
- **Sepsis**: This is a systemic infection associated with the presence of pathogenic organism introduced during a venipuncture.
- **Trauma**: This is an injury to underlying tissues caused by probing of the needle.

Avoid damaged sites

- **A. Sclerosed veins** - These veins feel hard or cordlike. Can be caused by disease, inflammation, chemotherapy or repeated venipunctures.
- **B. Thrombotic veins**
- **C. Tortuous veins** – These are winding or crooked veins. These veins are susceptible to infection, and since blood flow is impaired, the specimen collected may produce erroneous test results.

Avoid the artery

- Severe bleeding
- Compartment syndrome
- Amputation

Avoid the nerve

Nerve damage

- £20,000 for nerve damage following needle puncture to take blood.
- In 2005 S had blood taken by a GP healthcare assistant.
Nerve damage OUTCOME

- S developed compartment syndrome (lack of oxygen to muscle due to pressure on muscle compartment) and nerve damage.
- Although S made a full physical recovery from his compartment syndrome and nerve damage he developed a depressive psychological reaction.

BREACH OF DUTY

- It was S’s case that the healthcare assistant failed to follow proper procedures in attempting to take blood from his vein leading to his artery being punctured by the needle.

No patient to patient transmission

- Nosocomial outbreak of hepatitis B virus infection involving two hospitals in the Republic of Ireland.
- A definitive cause for each transmission event was not identified, although lapses in adherence to standard precautions, safe injection and phlebotomy practices could not be ruled out.

HDC: Blood test delay at fault for man’s death

An elderly man suffering from a advanced renal failure and sepsis died at an Auckland hospital after a delay in staff receiving his blood test results, the Health and Disability Commissioner says.

The 83-year-old was admitted to Franklin Hospital on a Saturday in mid-2009 suffering from four ulcers on his legs.

He was initially diagnosed with a chest infection, was prescribed antibiotics and a blood test was ordered for the Monday.

Over the next three days the man deteriorated, but it was not until his blood test became available on the Tuesday afternoon it was discovered the pneumonia, Commissioner Ron Pateman says.

The patient was rushed to Middlemore Hospital, but because of the advanced stage of his renal failure and sepsis, staff could only offer palliative care.

Can’t get a venous sample—Telegraph 2009

Bethany Tormeend collapsed and died three weeks after being taken to her local doctor’s surgery in Newark, Nottinghamshire.

She was suffering from an acute kidney disease and weighed just 35lb (15.9kg) at the time of her death, Nottingham Coroner’s Court heard.

But instead of sampling out a simple blood test which would have diagnosed her illness, Bethany’s GP, Dr Julie Barron, referred her to Newark Hospital for the test.

But when the youngster arrived a week later nurses found she was too thin for them to find a vein and referred her back to her doctor’s surgery.

Ten days later Dr Barron tried to draw a blood sample from Bethany but could not find a vein. The GP then managed to refer the schoolgirl to a specialist nephrologist but could only get an appointment a month later.

Education and alternatives

- Bethany, of Rollard Avenue, Newark, died on January 22, 2007 from kidney failure.
- She first saw Dr Barron when taken to her GP by her father Mark Needall on December 29, 2006.
- Dr Malcolm Lewis, a specialist in kidney diseases at the Royal Manchester Children’s Hospital said he believed Dr Barron should have put in an urgent request for Bethany to see a specialist nephrologist when she first saw her.
- Had she done so a blood sample would have been taken within a week and the youngster would have been immediately sent to a specialist renal unit, he said.
- Dr Lewis added: “My expectation would be that had Bethany been sent on December 29, she would have lived.”
Outcome

"She went from eating a meat dinner to choking on food and she was sleeping quite a bit."

The Coroner's court heard that on January 23, four days after she was De Bunker, Bethany was so tired she had to be given a pep talk by school by her father.

Later that day she collapsed and Mr. Henderson was called to the school to take his daughter to hospital but within minutes of arriving the young girl collapsed again and died.

Nottinghamshire Coroner Dr. Nigel Chapman asserted a verdict of death by sudden heart attack. But he said that Bethany's

Exploring the iceberg of errors in laboratory medicine.

• Department of Laboratory Medicine, University Hospital of Padova, Italy.

• However, in a patient-centered approach to the delivery of health care services, there is the need to investigate any possible defect in the total testing process that may have a negative impact on the patient.

Most errors are identified in our area pre-analytic and post-analytic steps.

Errors in Laboratory Medicine

• In many of these reports, it is suggested that the reported errors are only the tip of the iceberg and that the consequences on patient outcomes are likely to be worse than described.

• Documentation--Follow up--Feedback

• A hemolyzed sample is probably less problematic than sample mismatching or a TAT that is too long in a critical situation.

• However, abnormal hemolysis that prevents sample analysis can lead to a request for a new sample, which prolongs the TAT and could potentially be very harmful for critical patients.

Do it once do it right

• Another fundamental step is to create a culture in which the existence of risk is acknowledged and injury prevention is recognized as everyone’s responsibility.

• Hopefully lessons have been learned and nobody else suffers in similar circumstances.

The bottom line

• The educated health professional will be able to avoid most risks and complications