Review Article

Fluid Management in Pregnancy and Caesarean Section

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Introduction

Fluid management is one of the cornerstones of patient care, particularly during pregnancy & Caesarean Section. Management of the volume state is vital for maintaining adequate cardiac output, blood pressure and oxygen delivery, with maintenance of tissue bed and organ perfusion. In any critical illness this is vital, but in pregnancy particularly so as to preserve uteroplacental flow and placental perfusion. Unlike many other tissue beds, the uteroplacental circulation autoregulates poorly, leaving it reliant on maternal cardiac output, blood pressure and metabolic homeostasis in order to function correctly and avoid fetal compromise. In addition, the pregnant woman undergoes a number of physiological adaptations in pregnancy that impact upon fluid management, including an increase in the circulating volume and a reduction in systemic vascular resistance.

Fluid resuscitation is a key component of patient care, especially in scenarios such as caesarean section, haemorrhage and sepsis[1]. However, injudicious or aggressive fluid therapy and volume overload have been associated with harm in a number of settings including precipitation of pulmonary edema in pregnant women. The complicated obstetric patient may have a number of additional factors that make fluid management more challenging. Amongst other problems, cardiac, pulmonary or renal disease (pre-existing or acquired during pregnancy), sepsis, haemorrhage and hypertensive disorders of pregnancy all pose management dilemmas regarding the administration and optimization of fluid therapy.

Physiological changes in pregnancy that impact fluid management: Normal pregnancy is associated with a number of physiological changes that may impact on fluid management. Pathophysiological changes in the pregnant population need to interpreted in light of the expected physiological alterations. Accurate assessment may be extremely challenging in the setting of acute deterioration superimposed upon complex or chronic maternal illness. In pregnancy, cardiovascular system increases cardiac output, heart rate, circulating volume but decrease systemic vascular resistance[2]. In renal function increase glomerular filtration rate but decrease creatinine. In haematology here is dilutional anaemia.

Which fluid in Pregnancy? Whilst evidence is scarce, in the critically ill pregnant patient, isotonic crystalloids represent a safe initial choice in a wide variety of maternal conditions[3]. Other synthetic colloids and starches have some significant risks associated with anaphylaxis, excess kidney injury and increased mortality and should be avoided in critical ill pregnant women. Cochrane review did not find a difference between crystalloids and colloids in preventing hypotension during caesarean section, rather less adverse effect in crystalloids. Fluid therapy in obstetric haemorrhage, generally isotonic crystalloids are used as first-line fluid resuscitation until appropriate blood and blood products become available.

Pre & Per operative fluid management: Hypotension is the most significant adverse effect in women

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undergoing spinal anaesthesia for caesarean delivery, affecting on average 70% of pregnant women. The administration of intravenous fluids (i.e., crystalloids and colloids) prior to and/or during anaesthesia represents one of the most common strategies to prevent maternal hypotension. Among the intravenous fluids, crystalloid solutions are the most frequently used, with normal saline (NS) and Ringer's lactate (RL) as the most common choices[4]. Colloids are frequently used nowadays for several reasons. Preloading with crystalloids alone have shown poor effectiveness in decreasing hypotension. While crystalloids co-loading is considered superior, variable effectiveness were reported. Systematic reviews and meta-analyses indicate that preloading or co-loading with colloids—specifically hydroxyethyl starches (HES)—is superior to crystalloids alone, with volumes larger than 500 mL offering no significant additional benefits. Current practice advocate combining colloids and crystalloids solutions rather than colloids along.

Post operative fluid management & Care

1. Shift to Post operative care unit (PACU) at least 6 hrs if not 12 hrs
2. IV fluids – 100ml per hour, Ringer lactate/ Normal saline for 6-12 hours
3. Analgesic – inj paracetamol 1000mg 1v infusion 6 hourly (Diclofenac suppository 100mg 12 hrly or 75mg 12 hrly im, better to be avoided)
4. inj ondansetron 4mg & ing pantoprazole 40 mg
5. Start oral fluid by 6 -12 hrs

Complications of Fluid Therapy

Fluid therapy may be harmful if the incorrect fluids are given, if fluids are given in inadequate amounts, or if too much fluid is administered[4]. Correct timing of fluid resuscitation is also vital to maximize benefit and minimize harm.

Inappropriate fluid type: Colloids may be associated with anaphylaxis, whilst starches have been associated with excess renal Failure and mortality in ICU populations and should be avoided[5,6]. The tissue accumulation of hydroxyethyl starches is widespread and rapid, and may be harmful. Although starches have been used safely to prevent hypotension during caesarean section, any effects on the fetus from prolonged exposure in utero are unknown. Excess crystalloid fluid administration in women with postpartum haemorrhage may result in worsening anaemia, shock and coagulopathy. Use of hypotonic (or less commonly hypertonic) fluids may lead to severe dysnatremias and other electrolyte abnormalities, with resultant potentially catastrophic neurological complications[2]. Excessive administration of chloride-rich fluids may lead to a normal anion gap metabolic acidosis.

Inadequate fluid volume: Fluid resuscitation is an integral part of the treatment of a variety of complex and critical illnesses. In particular, sepsis, trauma and haemorrhage require early, balanced and focused fluid resuscitation in the early stages. There is still debate about optimal strategies in the non-pregnant population, and little to no evidence in the maternity group, but lack of fluid resuscitation is associated with poorer outcomes.

Excessive fluid volume: Normal pregnancy is marked by an increase in the maternal circulating volume. Both pre-existing and superimposed conditions such as cardiac disease and renal dysfunction may exacerbate this, and hypertensive disorders of pregnancy may be associated with significant edema and varying degrees of volume state disturbance[5,6]. Pre-eclamptic women are also at considerably increased risk of developing pulmonary edema, which has been associated with increased maternal mortality.

Specific Scenarios

The hypertensive disorders of pregnancy are a unique group of disorders that are, along with obstetric haemorrhage & sepsis leading causes of maternal morbidity & mortality.

Hypertensive disorders of pregnancy: The multisystem nature of these disorders can make fluid therapy challenging, and there have been conflicting findings and views over time about the circulation and volume state in these women, as well as how best to manage them. Injudicious fluid management has been implicated as a contributor to maternal death. Intravascular volume state is contracted in pre-eclampsia and severe pre-eclampsia is associated with maternal cardiovascular changes, including altered maternal left ventricular (LV) morphology. Left ventricular systolic function may be impaired, but often the development of LV hypertrophy and reduced LV relaxation occurs, resulting in primarily diastolic

dysfunction[7]. This, combined with capillary leak, abnormal lung permeability and severe hypertension contributes to the increased risk of pulmonary edema.

Practice points regarding fluid management in hypertensive disorders of pregnancy[6,7]: Multisystem disorder with multiple organ systems affected. Preservation of uteroplacental flow is vital in the antepartum period. Intravenous fluid may worsen hypertension (and its sequelae). Maternal circulatory dynamics are altered. There may be significant maternal cardiac effects. These women are very prone to volume overload and pulmonary edema. Renal failure may be prominent, exacerbating volume overload and hypertension. Minimizing intravenous fluid volumes is recommended.

Obstetric haemorrhage: Obstetric haemorrhage is one the leading causes of maternal mortality worldwide. Management should focus on stopping the bleeding, replacing circulating volume, and avoiding/ameliorating the consequences of massive haemorrhage, including coagulopathy, acidosis, hypothermia and end organ dysfunction. There are a variety of guidelines discussing fluid management and blood product administration in obstetric haemorrhage. A recent international consensus statement (incorporating FIGO) suggests initial restrictive resuscitation with crystalloid solutions, using 1–2 ml per ml of blood loss. Continuous resuscitation with crystalloid solutions at the expense of blood product replacement should be avoided as worsening oxygen delivery and dilutional coagulopathy will result. The ideal blood component ratio and fluid regime in massive obstetric haemorrhage is still under investigation and requires further research,

Fluid and Blood & Blood Products Mangement

- Infuse till blood & blood products available
- Infuse up to 3.5 L of warmed Clear fluids
  - 2 L of isotonic crystalloid (Hartman's solution)
  - 1.5 L of isotonic colloid (succinylated Gelatine)
- Blood transfusion ASAP (Best of cross matched)
  - If immediately needed- Group O Rh D Negative K negative PRBC
  - Switch to group specific PRBC as soon as possible
- FFP:
  - If PT/ APTT prolonged & haemorrhage continuing – 12-15 ml / kg of FFP (eg: 1000 ml need for 70 kg that means 4 units 250 ml each)
  - If haemorrhage continues after transfusion of 4 units PRBC & coagulation tests are unavailable – transfuse 4 units of FFP
- Platelet Concentrates:
  - If platelet count <75×10^9/ L & haemorrhage continues- transfuse 1 pool of platelets (5 Donors) RDP or SDP
- Cryoprecipitate:
  - If fibrinogen< 2 g/ L & haemorrhage continues - transfuse 2 pools of cryoprecipitate (10 units)

Sepsis: Initial fluid resuscitation in sepsis is vital to restore circulating volume and prevent sepsis induced end organ dysfunction. secondary to hypoperfusion 7. However, in different healthcare settings and different patient populations the expected benefit has not always been observed. Generally pregnant women can be managed in a similar fashion to non-pregnant women, although caution needs to be applied to avoid iatrogenic fluid overload in the setting of pre-existing volume expansion.

Practice points regarding fluid management in sepsis: An initial fluid bolus should be administered promptly to restore circulating volume and cardiac output/blood pressure. An isotonic crystalloid is recommended as first line. Initial bolus should be approximately 20 ml/kg up to a suggested maximum of 2 L. Depending on the situation and environment, a second bolus may be indicated but strong consideration should be given to early vasopressor support. Excessive fluid administration and ongoing positive fluid balances may be harmful.

Recommendations for best clinical practice5,6

1. Hypotension following spinal or combined spinal epidural anaesthesia at caesarean section causes both maternal and fetal/neonatal adverse effects.
2. Hypotension is frequent and, therefore, vasopressors should be used routinely and preferably prophylactically.
3. α-agonist drugs are the most appropriate agents to treat or prevent hypotension following spinal anaesthesia. Although those with a small amount

of b-agonist activity may have the best profile (noradrenaline (norepinephrine), metaraminol), phenylephrine is currently recommended due to the amount of supporting data.

4. Left lateral uterine displacement and intravenous (i.v.) colloid pre-loading or crystalloid coloading, should be used in addition to vasopressors.
5. The aim should be to maintain systolic arterial pressure (SAP) at ≥ 90% of an accurate baseline obtained before spinal anaesthesia, and avoid a decrease to < 80% baseline.
6. Maternal heart rates can be used as a surrogate for cardiac output if the latter is not being monitored; both tachycardia and bradycardia should be avoided.
7. Women with pre-eclampsia develop less hypotension after spinal anaesthesia than healthy women. Abrupt decreases in blood pressure are undesirable because of the potential for decreased uteroplacental blood flow.
8. Women with cardiac disease should be assessed on an individual basis; some conditions are best managed with phenylephrine (an arterial constrictor without positive inotropic effect), whereas others respond best to ephedrine (producing positive inotropic and chronotropic effect).

Conclusion

Fluid therapy is a critical aspect in pregnancy and perioperative care in Caesarean section. This review articles provides recommendations from various guidelines for fluid therapy to ensure optimal patient outcomes in pregnancy and delivery. It is essential to individualize fluid therapy based on patient's clinical status, laboratory values, and urine output.

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