Total Intravenous Anaesthetic (TIVA) for the Obstetric Population

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

This guideline has been created to provide practical advice for the provision of total intravenous anaesthesia (TIVA) for the obstetric patient population.

Is there any NICE, SIGN, Royal College, specialist, guidelines etc. available?	NICE Caesarean Section Guidelines Association of Anaesthetists Guideline: Malignant Hyperpyrexia
Associated Policies:	Use of Bispectral Index (BIS) depth of anaesthesia monitors WHAT-KD-004

This guideline is for use by the following staff groups:

All anaesthetic, midwifery and obstetric staff, corporate risk and medical staff where applicable

Lead Clinician(s)

Dr Jaime Greenwood	Consultant Anaesthetist
Approved for use on:	Theatre, Anaesthetics and Critical Care Governance meeting 19.4.23 SCSD Divisional Governance 31.5.23
Review Date:	17th June 2026
This is the most current document and should be used until a revised version is in place	

Key amendments to this guideline

Date	Amendment	Approved by:
April 2023	New Guideline	Medicines Safety Committee

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Total Intravenous Anaesthetics (TIVA) for the Obstetric Population

Objective

Practical guideline for the provision of total intravenous anaesthesia (TIVA) for the obstetric patient population.

Scope

There has been a substantial increase in the use of total intravenous anaesthesia (TIVA) in non-obstetric practice over the past decade, including when rapid sequence induction is used[1]. Extensive literature on acceptability and safety of TIVA has now been published, however, due to a lack of research in Obstetrics, it is usually reserved as the safest option in high-risk women, such as those with Malignant Hyperthermia (MH) susceptibility or some neuromuscular disorders in which maintenance of general anaesthesia with inhalational agents is contraindicated[2,3].

This guideline is designed to provide a practical guide to set up and use TIVA for an obstetric patient, although clinical judgement and experience must also always be taken into account. TIVA is likely to be most suitable for category 2-4 caesarean sections (as opposed to category 1), due to the set-up and preparation of equipment required.

NB. This guideline is based on guidance from the James Cook Hospital, Middlesborough. Many thanks to Dr Christoper Wood and Dr Rebecca Parker for their research and guidance.

Theoretical benefits of performing TIVA for caesarean deliveries:

- Effects on uterine tone & blood loss in PPH:
  - Uterine hypotony is the leading cause of PPH. Inhalational anaesthesia may exacerbate uterine hypotony leading to prolonged bleeding from PPH and is an independent risk factor for haemorrhage-related morbidity[4].
  - Propofol, used as TIVA, has been found to have minimal effect on uterine tone which may reduce bleeding risk[5,6].

- Recovery after anaesthesia:
  - Propofol-based anaesthesia has a lower incidence of PONV regardless of opioid use[7].
  - Optimising recovery after obstetric anaesthesia is crucial to allow early establishment of infant feeding, allowing early mother and baby bonding and maximising wellbeing and positive experience.

- Lower environmental impact of propofol:
  - Emissions of inhalational anaesthetics are a significant contributor to global warming.
  - The use of propofol-based TIVA has been found to have 4 times smaller green-house gas effect than halogenated anaesthetics and nitrous oxide (N_2O)[8].

- Potential benefits of TIVA in high-risk pregnant patients:

- Neuromuscular disorders / malignant hyperthermia susceptibility in mother OR child.
- Intracranial and spinal pathology / cardiac disease where regional anaesthesia is contraindicated.
- Pre-eclampsia due to exaggerated hypertensive response to laryngoscopy and emergence from anaesthesia

Considerations / Further Research Required

- Urgency of delivery
  - TIVA can be time-consuming in drawing-up propofol & remifentanil + setting up pumps.

- Effect on the neonate:
  - Propofol and remifentanil cross the placenta and are cleared from the neonatal circulation rapidly[10,11].
  - A meta-analysis in 2013 comparing the use of remifentanil in patients undergoing general anaesthesia for lower caesarean section reported no observed difference in Apgar score or requirement for additional airway assistance post-delivery[12].
  - Furthermore, Hu and colleagues found no statistically significant differences in the neonatal Apgar scores and neurological adaptive capacity scores with prolonged administration of both propofol and remifentanil prior to fetal delivery[13].
  - As a precaution the neonatal team should be called for delivery when TIVA is used for GA delivery

- Haemodynamic instability
  - Incremental increases in propofol and remifentanil target concentration

- Obesity
  - AABGI Guideline regarding TIVA in the general population: "There is a lack of evidence on whether it is better to use total body weight or another scalar such as adjusted body weight when using a TCI pump with these models in the obese. The Marsh and Schnider pharmacokinetic models and the calculated plasma propofol concentrations may not be accurate in the obese. The maximum body weight accepted by Marsh TCI pumps is 150 kg and pumps using the Schnider model only accept variables that result in a body mass index (BMI) < 35 $kg.m^{-2}$ for women or < 42 $kg.m^{-2}$ for men. When using TIVA in the obese, titration to clinical effect and pEEG monitoring is recommended.''
  - Schneider model will overestimate weight in obesity
    - Calculate ideal body weight for use (45.5 + (0.91 × [height in centimetres − 152.4])).
  - Marsh model will estimate LBM
    - Accurate up to BMI 37 then it paradoxically calculates a decrease in LBM.
  - Minto model will estimate LBM

- Awareness (see table below)

- Obstetric anaesthesia remains a risk factor for awareness with an estimated incidence of ~1:670 cases under general anaesthesia as highlighted by the National Audit Project (NAP) five[14]. Obstetric cases account for 0.8% of general anaesthetics in the NAP5 Activity Survey but ~10% of NAP5 reports of awareness.

- Recovery:
  - The advantages and disadvantages of TIVA over inhalational techniques are not well described for the obstetric population.

- Potential disadvantages:
  - Pain on injection / Risk of gastric aspiration / Incidence of accidental awareness.

- Lack of pharmacokinetic models for TCI developed for pregnant patients.

Table: Risk Factors for Awareness

Risk factors for awareness.	Delivery	Out of hours Junior doctor Difficult intubation Urgent surgery Rapid sequence induction Neuromuscular blocking drugs
	Patient	Young Female patient Obesity History of awareness Cardiovascular instability Chronic opioid abuse.

Indications for TIVA in obstetrics

General	Choice History of severe PONV
Specific	Long QT syndrome (QTc ≥ 500 milliseconds) Malignant hyperthermia risk Myasthenia gravis/neuromuscular disorders Risk of uterine hypotonia

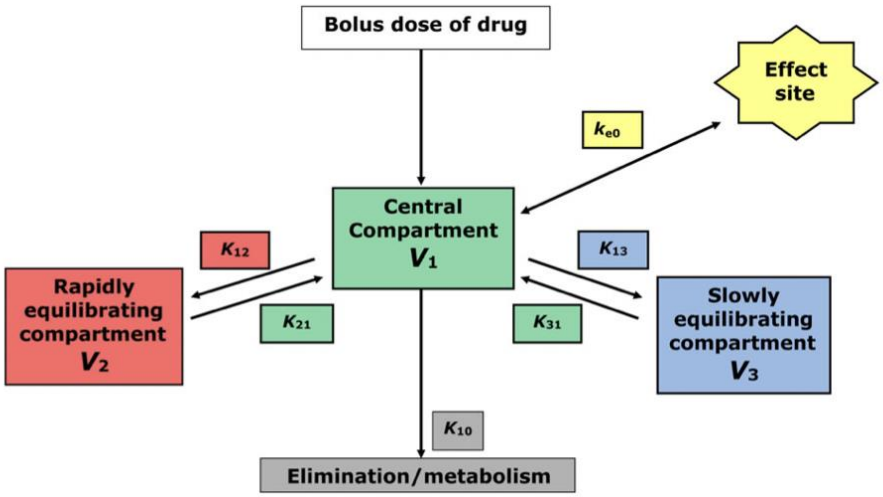
Contra-Indications in obstetrics

Relative	Non consultant led care Out of hours practice Significant cardiovascular instability

Pharmacokinetic models: Table

Remifentanil	**Model**				
	Input		Age, LBM		
	Compartment Variables				
Propofol	**Model**		**Marsh**	**Schneider**	**Eleveld**
	Input		TBW	Age LBM Height Sex	Age Weight Height Sex Co-administered opioid
	Compartment Variables		FIXED = Rate constant VARIABLE= V1,2,3	FIXED= V1 = 5L VARIABLE= V2	
	Key differences For a 85kg patient		V1= 19L Volume 1-3 scaled to patients weight	V1 = 5L	
	Overall	**+**	Fast induction	Smaller induction dose	Obesity
		-	CVS instability	Slow induction	Less experience in practice

Pharmacokinetic models: Diagram of compartment model

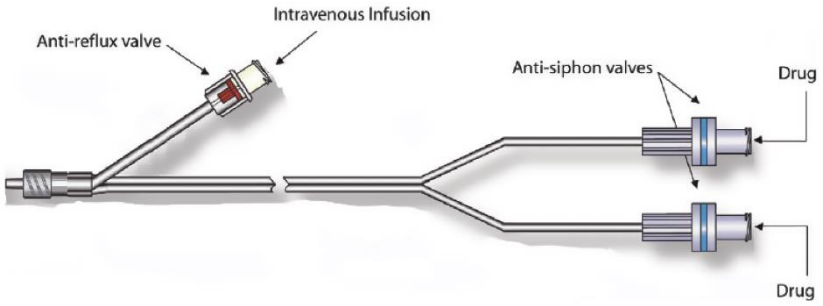


TIVA; Safety Features required

TIVA based safety features	Pump	Correct staff training for pump Maintained Appropriate alarm limits
	Drug	Correct concentration Correct PK model with parameters
	Delivery	Anti-reflux valve Anti-syphon valve

Safety checklist

Safety checklist for TIVA based anaesthetic		✓
Safety	**Consultant lead care**	
Equipment	**Two B Braun Space TCI Pumps + 3rd pump available in case of failure** • Available from main theatres/charged/plugged into mains • Correct programme set for patient characteristics • Correct drug in correct pump • Appropriate alarm limits • **MUST be returned to main theatres after use**	

	TIVA Equipment Box
	• 3 x 50ml Luer-lock syringe (1 spare)
	• A32BL Three way extension set (includes green and clear lines):
	  ○ Anti-syphon valve on the drug delivery line(s)
	  ○ Anti-reflux valve on any fluid administration
	• Labels (Propofol, Remifentanil)
	 	

	Neuromonitoring device (BIS/Massimo Sedline) for depth of anaesthesia (to be found in main theatre recovery	
	Infusion syringes • Correct order (from the top Propofol, Remifentanil, Vasopressor) • Correct drug concentration • Correctly labelled	
Patient	**TWO** Good/ reliable / well secured and visible IV access	
	Specific patient considerations relating to clinical situation	
Plan	Pump failure plan - *See troubleshooting guide below.*	

Perioperative Considerations

- All equipment should be collected and safety checked prior to use.
- A safety checklist (p.8) must be completed for all cases.
- The case must be discussed at the patient safety huddle, including the use of remifentanil if clinically indicated.
- At WRH the recommended induction profile would be use of 1% Propofol and muscle relaxant for induction at standard doses and NOT the pumps for induction dose. For clinicians less confident with use of TIVA for RSI in the obstetric population, this would seem the most familiar technique. Those more confident with TIVA in obs may choose one of the pump variations suggested in Guideline.
- Neurophysiological depth monitoring should be applied prior to induction (If available form main theatre complex – if not continue with enhanced appreciation of awareness risks)
- The method of induction and pharmacokinetic model used should be based on the clinical situation.
- Anaesthetic agents should be titrated to clinical effect **and** with reference to anaesthetic depth monitoring device if used.
- Intubation should only occur when anaesthetic depth is reached (i.e. BIS value <50). The stimulating nature of obstetric procedures necessitates intraoperative opioids.
    - Intermittent bolus technique
    - Remifentanil Infusion
- The timing of longer acting intraoperative opiates is dependent upon the clinical situation but unless specifically indicated should be withheld until after cord clamping.
- Maintenance of anaesthesia by the continuous infusion of remifentanil could contribute to the maternal hemodynamic stability and reduce the occurrence of intraoperative awareness[9].
- All patients should receive longer acting opiate analgesia following delivery of the baby.
- End of case procedures should be followed for all patients.

Practical TIVA administration Guidance

Setup	**Safety checklist for equipment/prerequisites (see above)** **Inform obstetric and neonatal teams of opiate use.** **Apply neurophysiological monitoring prior to induction**	
Induction	**Induction agents (options for induction)**	**Rapid Sequence induction (RSI) *Recommended method** • Standard intravenous induction with bolus of propofol. Start propofol TCI at reduced rate (i.e. 4 microgram/ml) and titrate to BIS value. **OR** • TCI with high initial infusion rates (e.g. 1200 ml/hour) with rapid reduction in rate. Note, even at high infusion rates, TCI induction doses are delivered slower than manual administration.
		Slow induction (1 - 3 microgram.ml-) "Low to high induction technique" making slow incremental increases in target concertation"
		Rapid induction (4 – 6 microgram/ml) Initial plasma site (Marsh PK model) propofol target concentrations increased rapidly
	Opioids	Bolus (fentanyl / alfentanil) OR Continuous Remifentanil Infusion
	Neuromuscular blocking drugs	Suxamethonium followed by Atracurium OR Rocuronium
Maintenance	**Propofol**	Titrated to effect **3 - 8 microgram/ml**
	Remifentanil	Titrated to effect **2 - 8 ng/ml**
Anaesthetic depth	**Confirm depth of anaesthesia using processed EEG monitoring** **Prior to skin incision ensure BIS <50**	
End of case	Use regional anaesthesia and/or long acting opioids before stopping remifentanil infusion. Assess degree of paralysis by neuromuscular monitoring and reverse if clinically indicated. Consider stopping infusion when dressing applied Remove giving set and flush cannula prior to transfer to recovery	
Obesity	The Marsh and Schneider pharmacokinetic models and the calculated plasma propofol concentrations may not be accurate in the obese. Marsh: The maximum body weight accepted by Marsh TCI pumps is 150 kg. Accurate up to BMI 37 then it paradoxically calculates a decrease in LBM. Schneider: Schneider model will overestimate weight in obesity. Calculate ideal body weight for use (45.5 + (0.91 × [height in centimetres − 152.4])). Pumps using the Shneider model only accept variables that result in a body mass index (BMI) < 35 $kg.m^{-2}$ for women or < 42 $kg.m^{-2}$ for men. When using TIVA in the obese, titration to clinical effect and pEEG monitoring is recommended.	

Troubleshooting

Pump Failure or loss of IV access	3 options	Switch to volatile anaesthetic if no contra-indication Re-start pump in manual mode using mls/hr Restart pump in TCI mode
Rapidly deepen anaesthesia	Overpressure pump rate followed by titration	
Alarm limits	Confirm cannula function Consider increasing pressure limits	

Appendix 1. Quick look Process for Obstetrics TIVA set-up

Draw Up	• 1% Propofol (intubating dose) • Muscle relaxant (e.g. Suxamethonium 150mg) • 50ml syringe of 1% propofol • 50ml syringe of remifentanil 2mg in 40mls (50microgram/ml)
Prepare	• **Pump set up with preferred PK model (e.g. Marsh with values below)** • **Standard AAGBI monitoring** • RSI and intubation preparation as per DAS / AAGBI guidelines • 2 x cannulas: minimum 2x18G (TIVA + oxytoxin/phenylephrine infusions as required) • TIVA extensions + fluid (Hartmanns) to A3 connector to patient

Anaesthetise	• WHO sign in (not anaesthetist leading) / Airway check
	• Preoxygenate
	• Give intubating dose of 1% Propofol and muscle relaxant
	• Immediately start infusions at:
	  ○ Propofol: Target 4microgram/ml (3-8 range approx.)
	  ○ Remifentanil: Target 4nanogram/ml (2-8 range approx.)
	• Aim for BIS / SedLine value <50 for intubation if using
	• Consider use of NDNMB as required
	• Long-acting opioids after delivery of baby
	• Titrate anaesthetic to response and ensure adequate depth of anaesthesia +/- BIS monitor

N.B. Obesity	Marsh PK model will estimate LBM up to BMI 37 or 150kg If >150kg, use standard clinical acumen and BIS / SedLine to gauge depth of anaesthesia and titrate propofol/remifentanil to response. NOTE: PK models will not take into account intubating dose of propofol or concurrent use of Remifentanil Marsh facilitates quicker rise in drug plasma level Aiming for initial target of 4microgram/ml rather than 6microgram/ml will aim to mitigate the inherent front loaded dose

	Most of the time, this approach suits this clinical context but beware of CV depression.

Monitoring

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the Policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
	WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
3,4	Theoretical benefits and contraindications/further research required	Regular review of literature to ensure that these remain up to date	Yearly			Yearly
7	Safety Checklist	Audit of safety checklist use	6 monthly			

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REFERENCE FOR THE GUIDELINE – Dr Jaime Greenwood (Consultant Anaesthetist)

Contribution List

Contribution List

This key document has been circulated to the following individuals for consultation;

Designation
Dr Julia Blackburn (Anaesthetic Specialist Registrar)
Dr Oliver Williams (ACCS Anaesthetic Trainee)
Dr Jaime Greenwood (Anaesthetic Consultant, Obstetric Anaesthetic Lead)

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee

Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and included as an appendix to key document when submitted to the appropriate committee for consideration and approval.

Please complete assessment form on next page;

NHS Worcestershire Acute Hospitals NHS Trust

Herefordshire & Worcestershire STP - Equality Impact Assessment (EIA) Form
Please read EIA guidelines when completing this form

Section 1 - Name of Organisation (please tick)

Herefordshire & Worcestershire STP		Herefordshire Council		Herefordshire CCG	
Worcestershire Acute Hospitals NHS Trust	✓	Worcestershire County Council		Worcestershire CCGs	
Worcestershire Health and Care NHS Trust		Wye Valley NHS Trust		Other (please state)	

Name of Lead for Activity	**Dr Jaime Greenwood**

Details of individuals completing this assessment	**Name**	**Job title**	**e-mail contact**
	Julia Blackburn	**Anaesthetic Registrar**	**Juliablackburn@nhs.net**
Date assessment completed	**20/3/23**		

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	**Title:** **New guideline: Total Intravenous Anaesthetic (TIVA) for the Obstetric Population**			
What is the aim, purpose and/or intended outcomes of this Activity?	Practical guideline for the provision of total intravenous anaesthesia (TIVA) for the obstetric patient population.			
Who will be affected by the development & implementation of this activity?	✓ ✓	Service User Patient Carers	❑ ❑ ❑ ❑	Staff Communities Other _____

	❑ ❑ Visitors			
Is this:	❑ Review of an existing activity ✓ New activity ❑ Planning to withdraw or reduce a service, activity or presence?			
What information and evidence have you reviewed to help inform this assessment? (Please name sources, eg demographic information for patients / services / staff groups affected, complaints etc.	See above reference list			
Summary of engagement or consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	Not required			
Summary of relevant findings	See guideline details			

Section 3

Please consider the potential impact of this activity (during development & implementation) on each of the equality groups outlined below. **Please tick one or more impact box below for each Equality Group and explain your rationale**. Please note it is possible for the potential impact to be both positive and negative within the same equality group and this should be recorded. Remember to consider the impact on e.g. staff, public, patients, carers etc. in these equality groups.

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Age		✓		This guideline can be used for all service users of childbearing age (who are the intended target population of the guideline)
Disability	✓			This creates a guideline for TIVA use in many patients, but it is indicated for patients with preexisting conditions such as Myasthenia gravis/neuromuscular disorders, and therefore it may improve their care.
Gender Reassignment		✓		Some of the pharmacological models will require the sex of the patient to be inputted, but this is unlikely to negatively impact the care they receive.
Marriage & Civil Partnerships		✓		No relevant effect
Pregnancy & Maternity	✓			This creates a guideline for TIVA use in many patients and therefore it may improve their care.
Race including Traveling Communities		✓		No relevant effect
Religion & Belief		✓		No relevant effect
Sex		✓		

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
				This guideline only applies to pregnant women
Sexual Orientation		✓		No relevant effect
Other Vulnerable and Disadvantaged Groups (e.g. carers; care leavers; homeless; Social/Economic deprivation, travelling communities etc.)		✓		No relevant effect
Health Inequalities (any preventable, unfair & unjust differences in health status between groups, populations or individuals that arise from the unequal distribution of social, environmental & economic conditions within societies)		✓		No relevant effect

Section 4

What actions will you take to mitigate any potential negative impacts?	Risk identified	Actions required to reduce / eliminate negative impact	Who will lead on the action?	Timeframe
	n/a	.		
How will you monitor these actions?	**n/a**			
When will you review this EIA? (e.g in a service redesign, this EIA should be revisited regularly throughout the design & implementation)	**n/a**			

Section 5 - Please read and agree to the following Equality Statement

1. Equality Statement

1.1. All public bodies have a statutory duty under the Equality Act 2010 to set out arrangements to assess and consult on how their policies and functions impact on the 9 protected characteristics: Age; Disability; Gender Reassignment; Marriage & Civil Partnership; Pregnancy & Maternity; Race; Religion & Belief; Sex; Sexual Orientation

1.2. Our Organisations will challenge discrimination, promote equality, respect human rights, and aims to design and implement services, policies and measures that meet the

diverse needs of our service, and population, ensuring that none are placed at a disadvantage over others.

1.3. All staff are expected to deliver services and provide services and care in a manner which respects the individuality of service users, patients, carer's etc, and as such treat them and members of the workforce respectfully, paying due regard to the 9 protected characteristics.

Signature of person completing EIA	
Date signed	
Comments:	
Signature of person the Leader Person for this activity	
Date signed	
Comments:	

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.