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EDITORIAL

The power of marginal gains in obstetric anaesthesia

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'Marginal gains are not about making small changes and hoping they fly. Rather, it is about breaking down a big problem into small parts in order to rigorously establish what works and what doesn't.'
Matthew Syed

The crucial role of anaesthesia in improving outcomes in obstetrics has received renewed attention over the last few years. In 2016, Sobhy and colleagues presented the first systematic review of anaesthesia-related maternal mortality in low-income and middle-income countries (LMICs).[1] They found that anaesthesia contributed to 2.8% of all maternal deaths in LMICs. This is a relatively small percentage and may be superficially reassuring to anaesthesia providers; however, the overall frequency of anaesthesia-related maternal death was 300-fold higher for neuraxial anaesthesia and 900-fold higher for general anaesthesia than that reported for the USA.[2] In contrast to other causes of maternal mortality, anaesthesia does not represent a disease or pathological condition; deaths related to anaesthesia are iatrogenic. The underlying causes of death in the study by Sobhy and colleagues included airway-related complications (45%), pulmonary aspiration (31%) and staff competencies and equipment issues (27%). It therefore behoves all anaesthesia providers who care for obstetric patients to scrutinise practice and seek ways to reduce anaesthesia-related morbidity and mortality. This edition of SAJAA features four articles of direct relevance to obstetric anaesthesia that provide valuable insight into aspects of care and strategies for quality improvement.

Tomlinson et al. and Smit et al. present their work evaluating aspects of airway management during obstetric general anaesthesia.[3,4] The ability to safely manage the airway is one of the cornerstones of anaesthetic practice, and in obstetrics presents particular challenges; there is an increased likelihood of difficult intubation, a reduced oxygen reserve and thus more rapid desaturation with apnoea, and finally the risk of pulmonary aspiration of gastric contents. The ability to prevent, recognise and manage airway problems is a vital skill for obstetric anaesthesia providers, regardless of the mode of anaesthesia chosen. This is highlighted by an analysis of the anaesthetic deaths in the most recent 'Saving Mothers' report.[5] There were 87 deaths and of these 61 were attributed to respiratory failure or brain death following a hypoxic event. However, of the total deaths only 18 were associated with general anaesthesia and 69 associated with neuraxial anaesthesia. These figures underline that even with neuraxial anaesthesia, airway management may be required.

Tomlinson's study is a prospective, observational, dual-centre study evaluating the incidence and predictors of hypoxaemia during induction of general anaesthesia for caesarean delivery. They found an incidence of hypoxaemia (defined as $SpO_2 \leq 90\%$) of 16.8% (95% CI 13.29 to 21.0). High body mass index (BMI > 30 kg/m^2) and difficult intubation were risk factors for peri-induction hypoxaemia. These risk factors are echoed in a recently published multicentre obstetric study from France, although the incidence of maternal hypoxaemia in the French study was lower at 9.4% (CI 7.6 to 11.3).[6] Prevention of peri-induction hypoxaemia in obstetric patients should be a priority and starts with good planning and preparation. We cannot change patient characteristics such as BMI, but we can ensure that our approach to anaesthetic care provides a mantle of safety to everyone for whom we care. The recent focus of attention on preventing hypoxia during induction of general anaesthesia has been on defining a role for high-flow humidified oxygen, but benefits of this equipment as a preoxygenation tool in obstetric patients have not been demonstrated.[7,8] Considering the cost implications and lack of evidence, it would be unjustified presently to recommend this as a standard of care in resource-constrained settings. However, several simple low-cost strategies should always be undertaken when providing general anaesthesia to an obstetric patient. In a small qualitative observational study to identify difficulties associated with intubation by inexperienced personnel, Satyapal, et al. noted that the commonest mistake was a failure to ensure optimal head positioning before intubation, and the absence of a pillow.[9] The authors commented that 'the scarcity of pillows in resource-constrained hospitals should be regarded not as an inconvenient laundry issue but as a serious lack of vital equipment.' Pillows may not always be available, but the anaesthesia provider must always strive to optimally position the patient's head using whatever is convenient, practical and available. Optimum positioning for all obstetric patients undergoing general anaesthesia should be the teaching and practice norm.

Tomlinson reported that the maximum end-tidal oxygen concentration (EtO_2) exceeded 80% in 82.6% (95% CI 78.3–86.2) of patients in their study. The authors do not report what percentage achieved the standard of $EtO_2 \geq 90\%$ as recommended in widely recognised guidance. The traditional and simple practice of breathing 100% oxygen through a tight-fitting mask for 2–3 minutes can achieve a set point of $EtO_2 \geq 90\%$ in about 95% of parturients.[10] The evidence for this has remained unchanged, and it is incumbent on trainers and supervisors to emphasise the importance of doing this meticulously. Finally, Tomlinson noted that a malleable stylet or bougie was only used in 17.6% of intubations. A stylet and bougie are cheap and more readily available compared to other airway adjuncts. In simulated difficult airways, use of a stylet or bougie can increase the first-pass success intubation rate to ≥ 90%.[11] Why is there such poor uptake of simple adjuncts that can make a difference to first attempt success? This is a question that researchers need to explore and might be a call to incorporate deliberate practice in our current model of clinical skills teaching.[12]

The failed intubation rate in the study by Tomlinson is 1.4%. This contrasts sharply with previously quoted incidences of 0.2% (1:440) and 0.4% (1:224),[13,14] and deserves scrutiny. Admittedly, this figure may be an over-representation in a relatively small study conducted in one province of South Africa. The study was conducted in two departments led by specialist anaesthesiologists, although 56% of the attending anaesthesiologists had less than one year's experience. The junior doctors in this study had access to specialised airway equipment such as videolaryngoscopes, and would have had better senior supervision than their colleagues in rural hospitals. In order to gain an insight into the incidence of failed intubation in more diverse settings, this area deserves further investigation at a regional and national level.

In a related paper Smit and colleagues report on a prospective electronic registry of obstetric airway management (ObAMR) for general anaesthetics in three obstetric units in Cape Town and present the data for its first 200 patients. This effort is both timely and commendable. Research into airway management is fraught with difficulties. Randomised controlled trials on obstetric airway management have several limitations that restrict their role in advancing care in this area. The number of general anaesthetics undertaken in a single unit are relatively low, anaesthesia is often undertaken in an emergency setting, and there are situational factors that can affect performance but are extremely difficult to evaluate. There is now widespread recognition of the value and role of other research modalities.[15] Smartphone technology presents a unique opportunity to collect observational anonymised data on a variety of topics. Aggregated data can then be analysed to examine elements and techniques that may be associated with success or failure.

Although Smit and colleagues did not analyse the outcome data in the three units, their results can be compared with those from the study by Tomlinson. Their data demonstrated that in addition to difficult intubation and high BMI, preeclampsia was an added risk factor for hypoxaemia during induction of general anaesthesia. They also demonstrated a similarly high although marginally lower incidence of hypoxaemia at induction, and of failed intubation (12% vs 17% and 1% vs 1.4%). The small differences may be attributed to the lower proportion of anaesthesia providers with less than one year's experience (11% vs 56%) and the greater use of videolaryngoscopes (28% vs 3.3%).

This data has also provided a noteworthy historical context. A widely cited South African study conducted nearly three decades ago reported a failed intubation rate during general anaesthesia for caesarean delivery of 0.13%.[16] This suggests a ten-fold increase in this complication over 30 years. The challenge now is finding a solution that can amalgamate the reduction in numbers of general anaesthetics carried out in obstetrics (and therefore reduced training opportunities) and the increased complexity of patients, with current guidance, checklists, and emerging technologies. To be relevant in a LMIC, this model will need to be simple, sustainable, likely involve simulation training, and support spiral learning in a way that enables and empowers even the isolated worker in a remote environment. The ObAMR will provide invaluable information to guide the above effort, and one can only hope that after its current pilot in urban hospitals, the project will ultimately be rolled out nationally.

The relatively low use of videolaryngoscopy in the studies conducted by Tomlinson and Smit is noteworthy and is comparable to a recent study of practice in general anaesthesia in the UK.[17] When used, neither paper states whether it was as a first-line intubation device or as a rescue device. The role of videolaryngoscopy in obstetric general anaesthesia has been subject to less scrutiny than in other areas of anaesthesia. The Cochrane Review comparing videolaryngoscopy with direct laryngoscopy for adult patients evaluated 64 studies, but only one of these specifically examined obstetric patients.[18] However, there are a growing number of studies and case reports that do support the use of videolaryngoscopy in obstetrics. In addition to these, extrapolation from the non-obstetric population suggests that videolaryngoscopy is becoming an essential tool for obstetric anaesthesia providers. Some caveats exist however; the Cochrane Review showed that the benefits of videolaryngoscopy were only statistically significant when they were used by an operator who was experienced (defined as > 20 prior intubations (OR [95% CI] 0.32 [0.13–0.75]). In this regard videolaryngoscopes that have a Macintosh blade, arguably the most commonly used laryngoscope device and thus the most familiar to anaesthesia providers, may be most suitable. Additionally, to our knowledge there is no short-handled videolaryngoscopy device currently available. Short-handled videolaryngoscopes are particularly useful in obstetrics where there can be limited space to position the handle of the laryngoscope due to upward movement of a woman's breasts when she is supine.

Hypertensive disorders of pregnancy are currently the leading cause of maternal mortality in South Africa and globally account for 14% of all maternal deaths.[19,5] In the most recent

'Saving Mothers' report, two-thirds of women who died from hypertensive disorders of pregnancy had a caesarean delivery. In high-income countries, maternal mortality from preeclampsia declined most dramatically between 1940 and 1970, with a 90% reduction in eclampsia.[20] This was attributed to improved antenatal care and better access to timely delivery, and both of these aspects of care have a crucial role in improving outcomes in Southern Africa. There is often debate as to the safest type of anaesthetic for parturients who require caesarean delivery following an eclamptic seizure. There is a paucity of data on this topic, with available information mostly coming from retrospective analyses. Jordaan and colleagues add to the knowledge base with their retrospective study comparing outcomes in eclamptic women who received either general or spinal anaesthesia for caesarean delivery.[21] Jordaan's findings confirm what is perhaps already generally accepted, that general anaesthesia in women who have suffered an eclamptic seizure is associated with higher neonatal and maternal morbidity and mortality, and spinal anaesthesia can be used safely in many patients. The authors highlight the concept of a woman with 'stable eclampsia'. Moodley has previously defined this concept, as a woman with stable blood pressure that does not require acute treatment, a Glasgow Coma scale ≥ 14, a normal fetal heart rate, a platelet count > 100 x 10^9/L, magnesium infusion in progress and central venous pressure (CVP) measurement of 4–6 cm H_2O.[22] Some elements of this definition may have evolved; a platelet count of 70 x 10^9/L is now widely perceived as acceptable for spinal anaesthesia,[23] CVP measurements are infrequently used in obstetric practice today, and emergency blood pressure control has become more straightforward with oral medication having been demonstrated to be as effective as intravenous medication.[24] However, the underlying concept of a woman whose blood pressure is controlled, who is not exhibiting features suggestive of raised intracranial pressure and who does not have a coagulopathy, serve as useful parameters for decision making for mode of anaesthesia in a woman who has suffered an eclamptic seizure. Jordaan and colleagues acknowledge a similar audit from Nigeria, where the choice of spinal anaesthesia was 79% (65/82) compared to 8% (7/89) reported in this South African study. However, the Glasgow Coma scale of the patients was not stated in the Nigerian study.[25] This is an almost 10-fold difference and may be a trigger for inter-regional cooperation and collaboration to optimise care for this group of patients.

Finally, Mayeza and colleagues compared the coagulation profile, as assessed by thromboelastography (TEG), of HIV-positive versus negative patients at term.[26] South Africa has made significant progress towards reaching the UNAIDS 90–90–90 Fast-Track targets by 2020. This strategy aims to ensure that 90% of people living with HIV are tested and know their status, that 90% of people living with HIV are receiving treatment, and that 90% of people on treatment have a suppressed viral load. However, there is still work to be done, with the latest estimates suggesting that South Africa has reached 90–68–88.[27] Women account for the majority of new infections, with adolescent girls and young women being especially at risk, highlighting that HIV infection remains an essential consideration in obstetric care. Mayeza et al. found no difference in TEG parameters between HIV-positive and negative patients. This work should reassure anaesthesia providers that in a woman with HIV infection who is receiving antiretroviral treatment, additional tests of anticoagulation are unnecessary before undertaking spinal anaesthesia.

What is the role of point-of-care viscoelastic devices, including thromboelastography and rotational thromboelastometry in Southern Africa? There are economic costs to supplying these devices to every labour ward, which would preclude their widespread use in Southern Africa. Money spent on purchase, maintenance and training to use viscoelastographic technology would almost certainly be better spent elsewhere to improve maternity care. Additionally, many questions remain about their role in obstetrics, with robust data lacking. However, this is not to say that viscoelastometric point of care testing use in the obstetric patient is futile. During major obstetric haemorrhage, thromboelastography can provide rapid and clinically relevant information about haemostatic changes, perhaps revealing indications for specific blood product therapy at an earlier point compared with traditional laboratory testing.[28]

What are the broader messages for obstetric anaesthesia in South Africa and beyond?

These studies were done in tertiary and regional hospitals in South Africa, institutions with likely greater resources and expertise than the rest of the country. It is however, for this reason, that the responsibility devolves to such institutions in LMICs to set the framework for standards and safety of practice through teaching and training. The results of their investigations assist with defining generalisable principles of how to improve care for all obstetric patients.

It is noteworthy that in 2020 two similar studies investigating hypoxaemia in obstetric patients come from the disparate income settings of France and South Africa. Though income settings and environments may vary, the clinical problems that obstetric anaesthesia providers face are similar worldwide. In the year of the COVID-19 pandemic, which has transformed the pattern of our lives, personally and professionally, it feels even more relevant that we continue to learn from each other and collaborate whenever possible. The model for the ObAMR, when it completes the necessary implementation and validation cycles, holds promise as one of those projects that could and should spark inter-regional and international cooperation and collaboration. Failed intubation during general anaesthesia for caesarean delivery is the nightmare airway scenario for any obstetric anaesthesia provider. With a common theme of enhancing safety resonating in the studies presented in this edition, the work by Tomlinson and Smit reminds us that simple measures, done well and consistently, are crucial factors in maintaining patient safety.

Finally, the work presented in this edition of SAJAA underlines the value and role of smaller projects in improving care in

obstetric anaesthesia. Internationally over the last several years, there has been a shift in anaesthesia research towards large (and potentially expensive) multicentre projects. However, a focus on large scale projects overlooks the benefits of smaller studies that could benefit trainees and patients. The role of research in anaesthetic training in South Africa has been debated in a previous editorial in this journal.[29] We share the authors' views of the dangers of 'research for research's sake' and the potential harm to participants, science and the public of poorly conducted work. However, well conducted smaller-scale projects are of vital importance in teaching trainees how to undertake research and in particular, collect, analyse and present data. Developing an understanding of data management is crucial for any clinician, not just in the context of research, but also in the increasingly data-driven healthcare environment. The experience and knowledge gained through smaller projects could ultimately lead to participation and leadership of large scale projects. For our patients too, the findings of smaller-scale projects can support continuous gradual improvement in the care that we deliver.

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