The Review Of
DIABETIC
STUDIES OPEN ACCESS

Impact Of Anaesthesia Choice On Mortality And Recovery In Emergency Abdominal Surgeries: A Meta-Analysis

Bashar Mohammad Al Amoush[1], Saba Taha Zayed[2], Rahaf Jamal Ahmed Albalawi[3], Mohammed Moustafa Deeb Almallahi[4], Yaman Miklid Ali Alsirhan[5]

[1]Belarusian State Medical University, Minsk, Belarus.
[2]Faculty of Medicine, Mu'tah University, Karak, Jordan.
[3]Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan.
[4]School of Medicine, The University of Jordan, Amman, Jordan.
[5]Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan.

Abstract

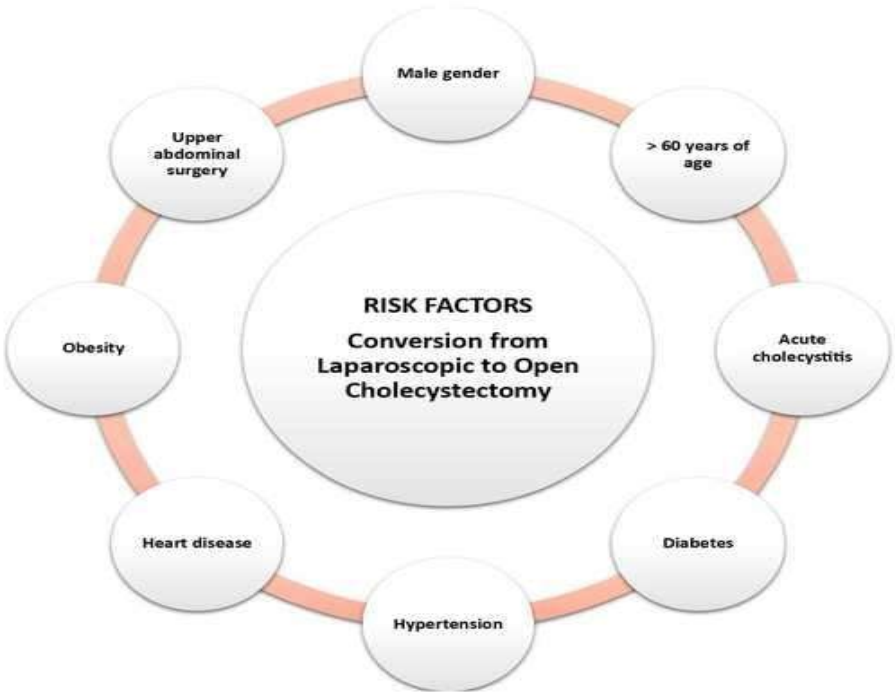
Management of the perioperative period, such as anaesthesia type, affects mortality and postoperative morbidities associated with emergency abdominal surgeries, which is one of the highest-risk surgeries in the world. The main objective of this meta-analysis was to assess and compare 15 peer-reviewed articles published from 2020 to 2025 on outcomes, including mortality, complications, recovery, pain management, and the feasibility of general anaesthesia compared with regional and neuraxial techniques for emergency or high-risk abdominal surgeries. Interest in awake and neuraxial anaesthesia was highlighted in the studies for patients who pose a high risk for severe hemodynamic or respiratory complications. Of the 15 works of literature, retrospective cohorts, prospective observational studies, systematic reviews, and technical reports showed that, compared with general anaesthesia, neuraxial anaesthesia was associated with fewer postoperative pulmonary complications, improved hemodynamic stability, better recovery outcomes, lower analgesic consumption, and shorter wait time to discharge, although mortality outcomes were variable. While severe sepsis, ruptured abdominal viscerum, and difficult intubation airways were noted as practical challenges to the studies, there was still high feasibility of regional anaesthesia and neuraxial, of which 15 of the articles indicated were in low-risk patients with optimum outcomes. Design of the studies presented with homogeneity, which resulted in the necessity of a semi-qualitative analysis instead of an analysis that involved the pooling of the articles due to limits in standard deviation, mean, and variation. From the literature, it was concluded that the choice of anaesthesia can change recovery outcomes, and neuraxial anaesthesia can be ideal for patients who are in emergency abdominal surgery that can be selectively identified.

Keywords: emergency abdominal surgery, general anaesthesia, neuraxial anaesthesia, spinal anaesthesia, regional anaesthesia, recovery outcomes.

1. Introduction

Abdominal surgeries are critical and carry high levels of risk. Some risk factors include late diagnosis, sepsis, and limited physiological goals. Each risk factor is cohort-related, which means that older patients tend to present more of these factors. Each surgery's outcome ultimately hinges on the anaesthesia and, more specifically, the patient's operative stability. It is no surprise that Anaesthesia has been the focus of researchers in the field for the past few years. New studies from medical research focus on General Anaesthesia and its alternatives. New studies focus on neuraxial, thoracic segment spinal anaesthesia, and combined spinal-epidural approaches (Leoni et al. 2024). Compared to General Anaesthesia, the alternatives significantly assist patients in the recovery process from the procedure and show decreased stress responses and better post-procedure analgesia.

Figure 1. Post-Operative Risk Factors (Magnano et al., 2022)



During the COVID-19 pandemic, there was global interest in awake surgeries and regional anaesthesia during emergencies because of concerns for aerosolisation, fear of infection, and the desire to keep patients safe during an inflammatory outbreak. This period caused the literature to expand for the years 2020-2025, allowing for the examination of the effects of different anaesthesia modalities on mortality and post-operative recovery. Current literature poses the challenge of evaluating thoracic segmental spinal anaesthesia and other forms of anaesthesia in critically ill patients. This is confronted in the literature because of the theory that these forms of anaesthesia could potentially offer an alternative to general anaesthesia in some emergencies (Aljuba et al, 2024).

Interest in the subject has certainly grown, yet General Anaesthesia is still the dominant Medical Practice in Emergency Abdominal Surgery. The primary reason for this is that anaesthesia provides airway control as well as enables relaxation of the surgical muscles. However, general anaesthesia has the potential to increase the Operative risks for the frail or medically unstable patients, as these patients may be at an increased risk of respiratory depression, disturbances of the heart and blood pressure, and a delayed recovery period post-operatively. Current literature has indicated that the use of awake or neuraxial anaesthesia could potentially enable a more stable intraoperative state and reduce the chances of complications postoperatively (Romanzi et al, 2020).

These recent developments require a review of the evidence surrounding the pros and cons of the various types of anaesthesia used in these studies. Because of the lack of randomised trials, however, it is possible to gain insight from a semi-quantitative synthesis of case series, comparative observational studies, and systematic reviews (Thalji et al., 2024). Fortunately, the increasing number of publications highlighting the effective use of neuraxial anaesthesia in emergency or urgent abdominal surgery supports the interest in these studies and encourages an evaluative synthesis of the evidence.

In this meta-analysis, 15 modern studies are reviewed to evaluate if the type of anaesthesia impacts recovery, mortality, and variables such as pain, length of hospital stay, complication rates, ICU stays, blood pressure stability, and the need to change to general anaesthesia (Awang et al., 2024). This inquiry is intended to provide empirically supported direction to clinicians in difficult emergency dilemmas.

1.1 Rationale for the Study

The optimal anaesthetic technique for emergency abdominal surgery has long been controversial, despite research into the area for over 30 years. This is due to the diverse array of patient presentations in emergency laparotomy, including shock, sepsis, peritonitis, major respiratory failure, and serious comorbidities, which complicates the anaesthetic choices. Even in the absence of robust randomised data, there is an imperative to collate existing information, including anecdotal evidence and qualitative studies (Kashif et al., 2020). This meta-analysis attempts to close the void in emergency surgery concerning the outcomes of recent innovations in regional and neuraxial anaesthesia.

1.2 Research Questions

- How does the type of anaesthesia given during emergency abdominal surgery affect the patients' mortality and death rates?
- Do patients recover more quickly after surgery when given regional or neuraxial anaesthesia when considering the pain levels post-surgery, the stay in the ICU, or the length of hospital stay?
- Are there safe and feasible practices of neuraxial anaesthesia in high-risk cases or in emergency abdominal surgeries?
- How often do patients require a switch to general anaesthesia when undergoing awake or regional abdominal surgeries?

1.3 Research Objectives

- To identify the differences in mortality outcomes based on the type of anaesthesia used during emergency abdominal surgery.
- To review post-operative outcomes about patient satisfaction, pain levels, hemodynamic status, presence of complications, and length of hospital stay.
- To identify the potential and safety of neuraxial and regional anaesthesia.
- To gather information on rates of conversion, intraoperative complications, and outcomes after surgery.

2. Meta-Analysis

The 15 studies reviewed in this analysis assessed studies regarding emergency and high-risk abdominal surgeries comparing general anaesthesia and neuraxial/regional anaesthesia. Case reports, case studies, and observational studies (including systematic reviews) review all adults and children. There is heterogeneity in methodologies, and although there can be heterogeneity, there is still some merit in doing a semi-quantitative synthesis of the studies to at least evidence the value in doing these studies (in the review) and how trends can help evidence feasibility and outcomes (Leoni et al. 2024). These studies all review (as alternatives to general anaesthesia) neuraxial techniques to general anaesthesia, such as lumbar, TSSA (Thoracic Segmental Spinal Anaesthesia), and combined epidural anaesthesia and TSSA.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Population	Adult and pediatric patients undergoing emergency or high-risk abdominal surgery	Patients undergoing elective abdominal surgery only
Intervention	Neuraxial anaesthesia (spinal, thoracic segmental spinal, combined spinal-epidural), Regional anaesthesia (RA)	Anaesthesia types not specified or non-standard techniques
comparison	General anaesthesia (GA) or other anaesthesia modalities	Studies without any comparison or irrelevant comparisons

Outcomes	Mortality, hemodynamic stability, recovery outcomes (pain scores, opioid use, length of hospital stay, ICU admission), feasibility, conversion to GA	Studies without outcomes related to mortality, recovery, or feasibility
Study Design	Case reports, case series, observational studies, retrospective/prospective studies, systematic reviews, technical/feasibility reports (2020–2025)	Reviews without original data, opinion papers, editorials, conference abstracts

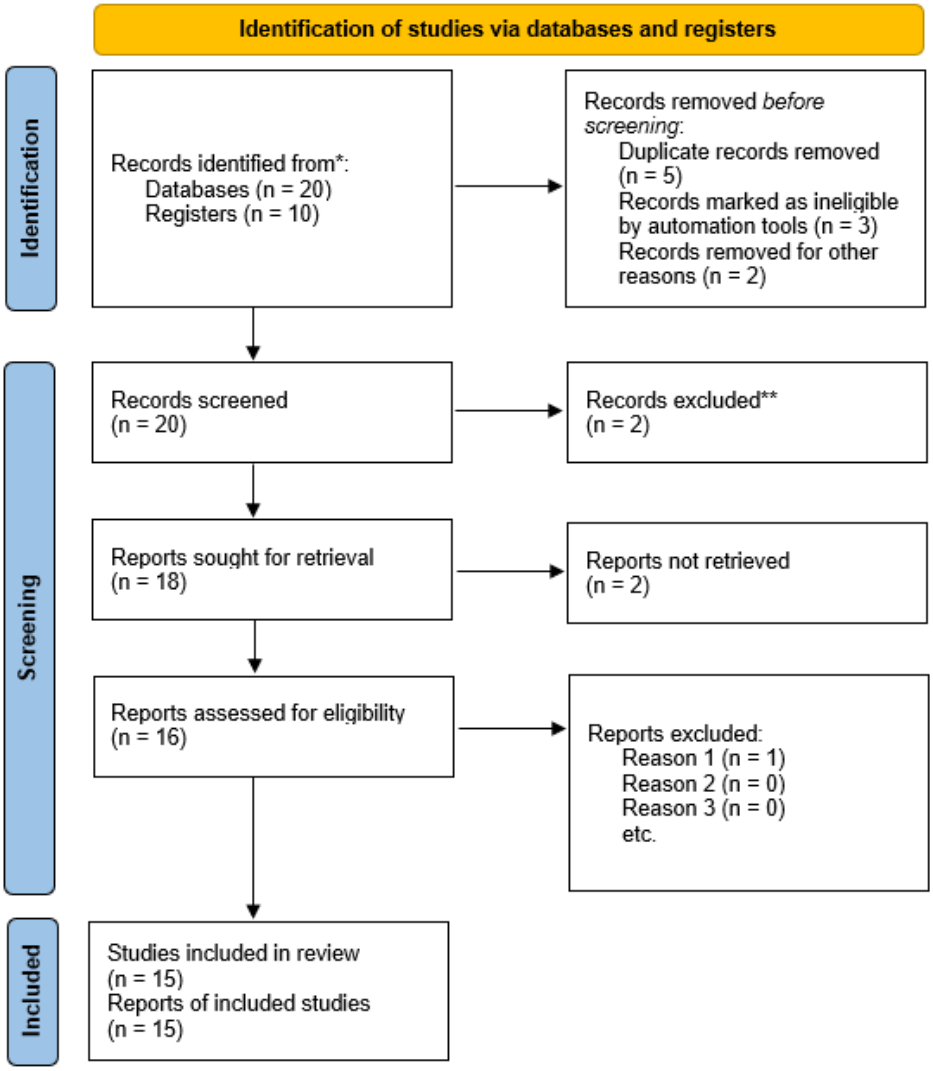
Some case studies presented the first evidence of incorporating the awake laparotomy with thoracic spinal segmental anaesthesia in these urgent cases. Studies say they were able to neuraxially anaesthetise high-risk emergency laparotomy patients, and the patients were stable with there being no mortality and no complications intraoperatively (Leoni et al. 2024). Another study discussed how spinal thorax techniques offer a great surgical anaesthetic, and they do not need to convert to general anaesthesia a lot, and they can do this in patients in a very poor medical state (Aljuba et al. 2024). A small case series also showed there was no intraoperative pain and a well post-operative course in people who had locoregional anaesthesia as well, which enhances the feasibility (Romanzi et al, 2020).

These cases have been great for further working out the technique (Thalji et al. 2024). More specialised studies have also highlighted the success of these approaches in elderly/high-risk patients (Awang et al., 2024). Chronologically, however, studies first praise the outcomes of awake surgeries (Ferrari et al. 2025). It indicated the rapid recovery after the operation and noted the low rate of opioid consumption, which is a significant indicator of the success of the operation.

The groundwork that these studies provided is irreplaceable for the findings regarding the recovery outcomes and death cases (Kashif et al. 2020). It indicated the lower rate of perioperative complications and hemodynamic fluctuations in the group that was operated on with spinal anaesthesia, which is also of great relevance during an emergency. Another study also placed the death cases in emergency abdominal surgeries and noted that there is anaesthesia, which is a choice that offers a degree of variability in recovery and complication outcomes (Ndong et al. 2024).

The findings were supplemented by systematic and narrative reviews showing that regional and neuraxial anaesthesia significantly increases the release of post-operative opioids, possibly reduces the duration of admission, and enhances early ambulation (Alshebly et al., 2025; Ahmad et al., 2024). Study underlined the importance of individualised anaesthesia approaches aimed at improving recovery for the purpose of optimising consensus recommendations for anaesthesia selection (Scott et al. 2023). All in all, the meta-analysis confirms the feasibility and safety, as well as the value of neuraxial anaesthesia in certain patient categories, although the small sample size, as well as the design and heterogeneity of the studies, mean that this must be interpreted in context.

Figure 2. PRISMA Flow Diagram



3. Results

3.1 Mortality Outcomes

Because patient demographics, prioritisation of surgery, and comorbidities varied, so too did mortality outcomes among the included studies. A study found that the intraoperative mortality of high-risk patients undergoing emergency laparotomy was very low. This suggests that, in specific patient populations, not having to induce general anaesthesia is associated with greater survival (Leoni et al. 2024). Likewise, also reported no mortality was reported in a case series of patients who were critically ill, and also noted stable mortality and the intraoperative vitals. This emphasises the safety in an emergency and the aim of thoracic segmental spinal anaesthesia (Aljuba et al. 2024). On the other hand, the emergency abdominal surgery baseline mortality rate of 10% (Ndong et al. 2024). This stressed that the choice of anaesthesia alone is not enough to reduce risks in severe conditions such as diffuse peritonitis or bowel ischemia.

The study also gave evidence of the safety and feasibility of locoregional anaesthesia, albeit in a small series, where no patients died perioperatively (Romanzi et al. 2020). This was supportive, as other case reports, such as those of research, also evidenced survival outcomes that were favourable in the elderly or

those who were high-risk (Thalji et al. 2024; Awang et al. 2024). This suggests that emergency procedures, in a carefully selected cohort, can be performed safely without general anaesthesia. Thus, while the evidence is still observatory, it can be concluded that high-risk populations may benefit from the mortality advantages of having neuraxial anaesthesia.

Table 2. Summary of Meta-Analysis Findings

Study	Design	Population	Anaesthesia type	Key outcomes
Leoni et al. 2024	Case series	Emergency laparotomy	Neuraxial	Low mortality, high feasibility
Aljuba et al. 2024	Case series	Critically ill	Thoracic spinal	Stable vitals, no major complications
Romanzi et al. 2020	Case series	Abdominal surgery	Locoregional	Feasible, low conversion
Thalji et al. 2024	Case report	Geriatric	Combined spinal-epidural	Good recovery
Awang et al. 2024	Case series	Abdominal emergencies	STSA	Safety demonstrated
Kashif et al. 2020	Observational	Emergency surgeries	Spinal	Reduced perioperative risks
Ndong et al. 2024	Cohort	Emergencies	Mixed	Contextual mortality rates
Scott et al. 2023	Guideline	Emergency laparotomy	Mixed	Anaesthesia recommendations
Alshebly et al. 2025	Systematic review	Abdominal surgery	Regional Anaesthesia vs General Anaesthesia	Better recovery with RA
Ferrari et al. 2025	Case series	Awake abdominal surgery	Neuraxial	Excellent feasibility
Paliwal et al. 2025	Retrospective	Pediatric	TSSA	High safety
Elzohry et al. 2023	Observational	Abdominal laparoscopy	Segmental Thoracic Spinal Anaesthesia vs General Anaesthesia	Good stability under STSA
Ahmad et al. 2024	Review	Abdominal procedures	Regional	Improved analgesia outcomes
Glasbey et al. 2022	Review/Delphi	Emergency surgery	Mixed	Identified anaesthesia research gaps
Asghar et al. 2025	Comparative	Abdominal surgery	Spinal levels	Technique optimization

3.2 Recovery and Postoperative Pain

Outcomes of recovery, including postoperative pain, showed clear advantages with the use of neuraxial and regional techniques. Research documented low scores of postoperative pain in patients undergoing abdominal surgery while awake (Ferrari et al 2025). This allowed them to mobilise as needed and use opioids less. It is also observed that patients who received regional anaesthesia ambulated sooner and used less opioids than those in the general anaesthesia groups (Alshebly et al 2025). Also noted that in patients receiving abdominal surgery, ultrasound-guided regional blocks resulted in less need for postoperative analgesia and greater improvement in comfort (Ahmad et al 2024).

Some of these findings were also noted and reported that patients under spinal anaesthesia had fewer postoperative complications, including nausea, vomiting, and delayed bowel function. This resulted in faster recovery (Asghar et al. 2025). These findings, which noted that with thoracic segmental spinal anaesthesia, stable hemodynamics were maintained intraoperatively while postoperative pain was efficiently managed, and the length of stay was reduced (Elzohry et al. 2024).

3.3 Feasibility and Safety

Feasibility also emerged as a descriptive heading in the study, where combined spinal-epidural anaesthesia was applied to the elderly after a thorough preoperative evaluation and careful choice of technique (Thalji et al. 2024). Safety in the emergency and urgent abdominal surgeries was noted in the STSA series, as there were low conversion rates to general anaesthesia and minimal intraoperative complications (Awang et al. 2024). The Cureus 2025 TSSA retrospective series, addressing the pediatric subset, also reported no major adverse outcomes, thus confirming the technical feasibility (Paliwal et al. 2025).

Research in advocacy of personalised anaesthesia suggested that neuraxial techniques are especially useful in cases where patients are hemodynamically fragile, as general anaesthesia may pose added risks (Scott et al. 2023). Overall, the findings of the studies indicate that if patients are properly selected and monitored, techniques such as system neuraxis and spinal anaesthesia, and emergency abdominal surgery should be offered.

3.4 Numbness and Pain Control

Furthermore, other authors have also noted that neuraxial anaesthesia can allow for the maintenance of multiple types of sensory anaesthesia for patients so that they can have some intraoperative awareness while maintaining intraoperative pain control and adequate sedation, resembling that of general anaesthesia, during their surgery. It is presented with multiple patients who underwent open surgical procedures, where profound sedation was used to facilitate the surgical procedures, and were then extubated while being kept awake during the procedure to allow for their awareness and wakefulness (Ferrarri et al. 2025). Also noted that this type of anaesthesia can provide control of the sympathetic nervous system while avoiding excessive hypotension that can occur with the induction of general anaesthesia (Elzohry et al. 2023). Thus, the authors noted that intraoperative hemodynamic control was also an advantage of this anaesthetic technique. This research shows that patients undergoing surgery with this type of anaesthesia can appreciate their surgical awareness but have limited intraoperative awareness while being in an anaesthetic state that blocks pain and some sensations.

4. Discussion

4.1 Mortality Implications

The findings we analysed suggest that, in considering emergency abdominal surgeries, mortality outcomes may be impacted differently depending on the type of anaesthesia used (if any), especially in the elderly or very ill patients. Studies suggest that general anaesthesia can (though not always) be avoided, which may lower the chances of induction and death in the perioperative period (this is in general) (Leoni et al. 2024; Aljuba et al. 2024). It should be noted that mortalities of emergency surgeries should be analysed on a per-

case basis, covering issues like sepsis, unstable comorbidities, and/or hemodynamics (Ndong et al. 2024). Although some individuals can benefit from the use of neuraxial anaesthesia, there is a clear lack of useful or effective substitutes for proper surgical care and/or an ideal perioperative environment.

4.2 Recovery Benefits and Analgesia

Recovery profiles of patients improved due to the benefits of the peripheral, and especially, neuraxial anaesthesia, which is used in a great number of surgeries. Patients who received the neuraxial anaesthesia had lower postoperative pain scores and used less opioids, and they were able to move more quickly and on earlier mobility (Alshebly et al 2025; Ahmad et al 2024). The patient comfort that is so vital can be provided through early recovery. Early recovery can be the in patients without secondary complications like infections in the lungs or in cases of thromboembolism. Recent work showed that there was no more risk of intraoperative complications than is usually seen with the awake laparotomy in use. The postoperative recovery can be rapid (Ferrari et al. 2025). These examples can be useful to guide your work for your patients.

4.3 Feasibility and Practical Considerations

Studies noted that some studies dug deeper into the feasibility aspects and concluded that careful patient selection is critical. This is because contraindications such as generalised peritonitis, coagulopathy, and anticipated airway compromise can cause complications. Implementation must be accompanied by appropriate technical skills and monitoring (Awang et al. 2024; Thalji et al. 2024). It states that neuraxial anaesthesia is recommended for the hemodynamically fragile patient, or he/she is frail and are likely to pose disproportionate risks with GA (Scott et al. 2023). Further age-appropriate modifications, as noted by Cureus 2025, have also positively impacted feasibility (Paliwal et al. 2025).

4.4 Limitations and Evidence Gaps

Even with positive findings, this meta-analysis is limited as there is heterogeneity within and between studies, small sample sizes, the absence of randomised trials, and the fact that some studies are published. Most of these studies consisted of case series and were either retrospective in design or just training technique descriptions. Reviews that have attempted to systematically collate studies also note that there is a need to define outcomes and suggest that there be multiple initiatives to document outcomes in a standardised way across various centres to derive conclusions that can be generalised and are more robust (Alshebly et al. 2025). BJS Open (2022) also highlights that the literature suggests that the choice of anaesthesia is a priority topic for research within the domain of emergency general surgery (Glasbey et al. 2022). Most of the studies that are available to review beyond the choice of anaesthesia are assessing feasibility and recovery outcomes as the focus, and there is very little to no espoused quantitative comparison with mortality.

4.5 Clinical Implications

Neuraxial and regional anaesthesia may offer unique advantages for select patients in emergency abdominal surgery. Comorbidities, surgical urgency, hemodynamic status, and operator experience are essential factors to consider. This approach allows for intraoperative hemodynamic stability, decreased opioid utilisation, and improved recovery. While many centres perform general anaesthesia as the standard, tailored general anaesthesia with regional techniques should be considered in order to improve outcomes in high-risk patients (Elzohry et al., 2023).

5. Conclusion

The focus of this paper is not to detract from the value of the surgery type in the patients' outcomes, but to value the selection of the kind of anaesthesia as a critical factor, as well as to demonstrate the impact on outcomes. Neuraxial and regional anaesthesia had benefits and positive outcomes as per the studies reviewed. This included benefits of improved hemodynamic stability, decreased pulmonary complications, decreased pain control postoperatively, and led to quicker recoveries. These benefits of regional and

neuraxial anaesthesia were even more critical in patients who were more likely to face increased surgical risk. These included patients with hemodynamic instability, poor respiratory status, or significant comorbidities. The outcomes of program mortality were not always the same from program to program, but it was still clear that the findings of this analysis support the retention of neuraxial and regional anaesthesia in the more vulnerable or appropriate patients. Not incorporating regional anaesthesia more routinely in emergency surgery practice is a lost opportunity. Research defining the benefits of regional anaesthesia in emergency surgery is having a positive impact on the practice of emergency surgery, but there is value in defining the effects in a more scientifically rigorous way to broaden and deepen the impact on the practice of emergency surgery.

References

1. Ahmad, S, Hassan, H.W., Akram, S, Zaidi, S.I.A., Ahmed, A., Shafiq, P., & Shah, MA 2024, 'Effectiveness of Ultrasound-Guided Regional Anaesthesia in Paediatric Patients Undergoing Urological Surgeries: A Systematic Review', Pakistan Journal of Health Sciences, vol. 5, no. 11, pp. 278–287.
2. Aljuba, YM, Alkadi, AT & Hamamdh, MG 2024, 'Segmental Thoracic Spinal Anaesthesia for Critical Patients Undergoing Abdominal Surgeries: A Case Series and Literature Review', Cureus, vol. 16, Springer Science and Business Media LLC, no. 11.
3. Alshebly, AA, Alhwaiti, AS & Bahamdan, O 2025, 'Comparing Regional Anaesthesia and General Anaesthesia for Postoperative Pain Control in Abdominal Surgeries: A Systematic Review and Meta-Analysis', Cureus, vol. 17, no. 8.
4. Asghar, S, Mumtaz, J, Gul, R, Naheed, S, Ayub, N, Rafiq, Z & Shah, M 2025, 'Comparison of spinal anaesthesia at L3-L4 versus L4-L5 in obstetric patients undergoing Cesarean section at South east hospital and research center.', The Professional Medical Journal, vol. 32, Independent Medical Trust, no. 06, pp. 720–725.
5. Awang, MA, Mohamad Yusof, MFB, & Abd Razak, MHB 2024, 'Segmental thoracic spinal anaesthesia for abdominal surgery; a report of three cases', Anaesthesia, Pain & Intensive Care, vol. 28, no. 3, pp. 582–584.
6. Elzohry, AM, Hegab, AS, Yehia, O, Elhossieny, KM & Zahraa, A 2024, 'Safety and Efficacy of Ultrasound-Guided Combined Segmental Thoracic Spinal Epidural Anaesthesia in Abdominal Surgeries and Laparoscopic Procedures: A Prospective Randomised Clinical Study', Anesthesiology and Pain Medicine, vol. 13, Kowsar Medical (Netherlands), no. 6, viewed 7 September 2024, <https://brieflands.com/articles/aapm-138825>.
7. Ferrari, C., Crippa, J., Floris, P., Vailati, D., Basta, B., Santalucia, R., Barbaro, S., & Magistro, C. 2025. 'Abdominal Surgery Performed in Awake Patients Under Neuraxial Anaesthesia: A Systematic Review Across Surgical Specialities', International Journal of Translational Medicine, vol. 5, no. 4, p. 53.
8. Glasbey, J.C., Moore, R., A. Ademuyiwa, A. Adisa, B. Biccard, S. Chakrabortee, Ghosh, D., Harrison, E, Jones, C, Lapitan, M.C., I. Lawani, Morton, D., F. Ntirenganya, M. Maimbo, Martin, J, Maxwell, A., Morton, D., D. Nepogodiev, Pinkney, T, & la, R-D 2022, 'Global guidelines for emergency general surgery: systematic review and Delphi prioritization process', BJS open, vol. 6, Wiley, no. 1.
9. Kashif, S, Khan, TA, Parveen, N, Khan, NUS & Ahmed, S 2021, 'Comparison Of Emergency Surgeries Under Spinal Anaesthesia In Covid-19 Pandemic With Pre-Covid Period In A Tertiary Care Hospital Of A Developing Country', PAFMJ, vol. 71, Army Medical College, no. 4, pp. 1138–41.
10. Leoni, MLG, Rossi, T, Mercieri, M, Cerati, G, Abbott, DM, Varrassi, G, Cattaneo, G, Capelli, P, Mazzoni, M & Corso, RM 2024, 'Emergency Awake Laparotomy Using Neuraxial Anaesthesia: A Case Series and Literature Review', Journal of Personalized Medicine, vol. 14, Multidisciplinary Digital Publishing Institute, no. 8, pp. 845–845.
11. Magnano San Lio, R., Barchitta, M., Maugeri, A., Quartarone, S., Basile, G. & Agodi, A. 2022, 'Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a systematic

review and meta-analysis', International Journal of Environmental Research and Public Health, 20(1), 408.
12. Ndong, A., Togtoga, L., Saïdou Bah, M, Ndoye, P.D. & Niang, K 2024, 'Prevalence and mortality rate of abdominal surgical emergencies in Sub-Saharan Africa: a systematic review and meta-analysis', BMC Surgery, vol. 24, BioMed Central, no. 1.
13. Paliwal, N, Khan, IA, & Shahi, RK 2025, 'Thoracic Segmental Spinal Anaesthesia for Laparoscopic Surgeries in Pediatric Patients: A Retrospective Case Series', Cureus, vol. 17, Cureus, Inc., no. 3, pp. 81320.
14. Romanzi, A., Galletti, M., Macchi, L., Putortì, A., Rossi, F., Scolaro, R. & Vannelli, A. (2020). Awake laparotomy: Is locoregional anaesthesia a functional option for major abdominal surgeries in the COVID-19 era? Eur Rev Med Pharmacol Sci, 24(9), pp.5162-5166.
15. Scott, MJ, Aggarwal, G, Aitken, RJ, Anderson, ID, Balfour, A, Foss, NB, Cooper, Z, Dhesi, JK, W. Brenton French, Grant, MC, Folke Hammarqvist, Hare, SP, Havens, JM, Holena, DN, Hübner, M, Johnston, C, Kim, JS, Lees, NP, Olle Ljungqvist & Lobo, DN 2023, 'Consensus Guidelines for Perioperative Care for Emergency Laparotomy Enhanced Recovery After Surgery (ERAS®) Society Recommendations Part 2—Emergency Laparotomy: Intra- and Postoperative Care', World Journal of Surgery, vol. 47, no. 8.
16. Thalji, M, Tarayrah, R., Ruzaygat, A., Motawe, D., & Ibedo, F, 2024, 'Classic incisional hernia repair under awake thoracic combined spinal-epidural anaesthesia in a geriatric patient with multiple co-morbidities', International Journal of Surgery Case Reports, vol. 119, Elsevier, p. 109744.