



Original Article

## Analgesic Efficacy & Opioid Sparing Effect of USG Guided Tranversus Abdominis Plane (Tap) Block After Lower Abdominal Surgeries

Dr. Wasim Salman<sup>1</sup>, Dr. Pervaiz Ahmed Malik<sup>2</sup>, Dr. Tahleel Mohd Jeelani<sup>3</sup>, Dr. Humeera Firdous<sup>4</sup>

<sup>1</sup>Associate Professor & Head Deptt of Anaesthesiology GMC Baramulla

<sup>2</sup>Post Graduate Scholar Deptt of Anaesthesiology GMC Baramulla

<sup>3</sup>Assistant Professor Deptt of Anaesthesiology GMC Baramulla

<sup>4</sup>Medical Officer GMC Baramulla

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### Corresponding Author:

**Dr. Tahleel Mohd Jeelani**

Assistant Professor Department  
Of Anaesthesiology Gmc  
Baramulla

### Email:

[Tahleelmohammad9109@Gmail  
.Com](mailto:Tahleelmohammad9109@Gmail.Com)

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### ABSTRACT

**Introduction:** Traditionally, the TAP block was performed using anatomical landmarks and a blind technique, but this method had a steep learning curve and was associated with higher failure rates and potential complications such as bowel perforation or peritoneal breach. The advent of ultrasonography has revolutionized regional anesthesia by enabling direct visualization of anatomical structures, leading to improved accuracy, safety, and efficacy of the TAP block. Ultrasound-guided (USG) TAP block allows precise placement of the needle and real-time monitoring of local anesthetic spread in the correct fascial plane, reducing the risk of complications and ensuring consistent analgesic outcomes. Consequently, the USG-guided TAP block has become an integral component of multimodal analgesia protocols in modern anesthetic practice.

**Materials and Methods:** This study was conducted at the operation theatre and in-patient department of the Department of General Surgery and Department of Obstetrics and Gynecology, in cooperation with the Department of Anaesthesiology at Government Medical College, Kantbagh, Baramulla, Jammu and Kashmir.

**Results:** Postoperative VAS scores showed a gradual increase from 1.9 at 1 hour to a peak of 3.9 at 8 hours, followed by a decline to 2.8 at 24 hours ( $p < 0.001$ ). The mean time to first analgesic request was  $2.8 \pm 1.1$  hours. The average total tramadol requirement over 24 hours was  $147.9 \pm 55.1$  mg.

**Conclusions:** The USG-TAP block is an effective and safe regional anesthetic technique for postoperative pain management in lower abdominal surgeries. It significantly delays the need for rescue analgesia, reduces overall opioid consumption, and maintains hemodynamic stability, with minimal side effects. These findings support the integration of TAP block into enhanced recovery after surgery (ERAS) protocols to improve pain control and minimize opioid-related complications.

**Keywords:** Postoperative Pain Management, Transversus Abdominis Plane (TAP) Block, Multimodal Analgesia, Opioid-Sparing Techniques, Lower Abdominal Surgery.

### INTRODUCTION

Effective postoperative pain management is a cornerstone of enhanced recovery following surgery, significantly influencing patient satisfaction, early ambulation, reduced morbidity, and shorter hospital stay. Despite advances in multimodal analgesia and surgical techniques, pain following lower abdominal surgeries continues to pose a substantial clinical challenge. Conventionally, opioid analgesics have been the mainstay of postoperative pain control. However, the widespread use of opioids is increasingly being scrutinized due to their well-documented adverse effects such as respiratory depression, nausea, vomiting, ileus, urinary retention, pruritus, sedation, and the risk of dependence. These complications often lead to delayed recovery and increased healthcare costs. Consequently, there has been a growing interest in exploring regional anesthesia techniques that can provide effective analgesia while minimizing opioid consumption.

Among the various regional blocks, the transversus abdominis plane (TAP) block has gained widespread attention in recent years as a promising adjunct for postoperative analgesia following lower abdominal surgeries. First described by Rafi in 2001, the TAP block involves the deposition of local anesthetic in the fascial plane between the internal oblique and transversus abdominis muscles, thereby blocking the sensory nerves supplying the anterior abdominal wall. The nerves targeted include the lower thoracic (T6–T12) and first lumbar (L1) nerves, which are primarily responsible for transmitting pain from the skin, muscles, and parietal peritoneum of the anterior abdominal wall. This block is particularly advantageous for surgeries involving lower abdominal incisions, such as appendectomy, cesarean section, hernia repair, gynecological procedures, and urological surgeries.

Traditionally, the TAP block was performed using anatomical landmarks and a blind technique, but this method had a steep learning curve and was associated with higher failure rates and potential complications such as bowel perforation or peritoneal breach. The advent of ultrasonography has revolutionized regional anesthesia by enabling direct visualization of anatomical structures, leading to improved accuracy, safety, and efficacy of the TAP block. Ultrasound-guided (USG) TAP block allows precise placement of the needle and real-time monitoring of local anesthetic spread in the correct fascial plane, reducing the risk of complications and ensuring consistent analgesic outcomes. Consequently, the USG-guided TAP block has become an integral component of multimodal analgesia protocols in modern anesthetic practice.

Several studies have demonstrated the efficacy of the TAP block in reducing postoperative pain scores, delaying the first request for analgesia, and decreasing the total requirement of systemic opioids. The opioid-sparing effect of TAP block is particularly valuable, as it not only reduces the incidence of opioid-related side effects but also aligns with the global effort to combat the opioid crisis by minimizing unnecessary opioid exposure in surgical patients. Furthermore, by reducing the reliance on systemic analgesics, TAP block may contribute to enhanced recovery protocols, promote early ambulation, and improve overall perioperative outcomes.

Lower abdominal surgeries typically involve significant postoperative pain arising from both somatic and visceral components. The somatic component, which is primarily due to incision of skin and muscles, is effectively addressed by the TAP block. Although the TAP block does not provide visceral analgesia, its action on the parietal peritoneum and anterior abdominal wall significantly attenuates the somatic pain component, which constitutes a substantial proportion of postoperative discomfort following these procedures. Therefore, the TAP block is best utilized as part of a comprehensive multimodal analgesic strategy rather than a standalone technique.

The efficacy of the TAP block may be influenced by various factors, including the site of injection (subcostal vs. lateral vs. posterior), the volume and type of local anesthetic used, the timing of block administration (preoperative vs. postoperative), and the surgical procedure being performed. Among these, the lateral approach is commonly employed for lower abdominal surgeries, as it effectively blocks the T10–L1 nerve roots, which innervate the infraumbilical region. Bupivacaine and ropivacaine are the most frequently used local anesthetics for TAP blocks due to their prolonged duration of action and favorable safety profiles. Adjuvants such as dexamethasone or clonidine may also be added to enhance the quality and duration of analgesia, although their use remains off-label and requires further validation.

The application of TAP block is particularly relevant in the context of enhanced recovery after surgery (ERAS) protocols, which emphasize opioid-sparing analgesia, early mobilization, and shorter hospital stay. By providing prolonged and site-specific analgesia without systemic effects, the TAP block aligns well with the ERAS principles. Moreover, the simplicity, reproducibility, and minimal invasiveness of the technique make it suitable for a wide range of clinical settings, including resource-limited environments where more advanced pain control methods may not be feasible. The incorporation of TAP block into anesthetic protocols necessitates appropriate training and competency in ultrasound-guided regional anesthesia. Adequate anatomical knowledge, familiarity with ultrasound imaging, and adherence to aseptic technique are essential to ensure the safe and effective performance of the block. Institutional support in terms of equipment availability and standardized protocols is also crucial for widespread implementation.

In addition to efficacy, safety remains a paramount consideration. TAP block is generally considered a low-risk procedure, with a relatively low incidence of complications when performed under ultrasound guidance. Nevertheless, potential risks include intraperitoneal injection, vascular puncture, local anesthetic systemic toxicity (LAST), and transient femoral nerve palsy. These can be minimized with proper technique, appropriate dosing, and vigilant patient monitoring.

Given the backdrop of increasing surgical volumes, heightened patient expectations, and the imperative to minimize opioid use, the TAP block represents a valuable addition to the anesthetic armamentarium for lower abdominal surgeries. Its ability to provide effective analgesia with minimal systemic side effects makes it a particularly attractive option in vulnerable populations such as the elderly, those with respiratory compromise, and patients at high risk of opioid-related adverse events.

## Aim and objectives

The aim of the present study is to evaluate the postoperative analgesic effectiveness and opioid sparing effect of USG guided transverse abdominis plane block after elective lower abdominal surgeries.

## The primary objective of the study is:

To calculate quality of TAP block and post-operative analgesic efficacy in patients undergoing lower abdominal surgeries.

The secondary objectives of the study are:

- To measure the time for first demand of analgesic in the postoperative period.
- To measure the total quantity of analgesic required in the postoperative period.

## MATERIALS AND METHODS

### Study location:

This study was conducted at the operation theatre and in-patient department of the Department of General Surgery and Department of Obstetrics and Gynecology, in cooperation with the Department of Anaesthesiology at Government Medical College, Kantbagh, Baramulla, Jammu and Kashmir.

**Study population:** All patients > 18 years age of either sex scheduled to undergo lower abdominal surgeries under general anaesthesia in the study institution during the period of the study were considered as the study population.

**Study Design:** An observational descriptive study with a prospective design will be conducted.

### Study Duration:

The total duration for the present study was 12 months from the acceptance of the thesis protocol.

### Outcomes

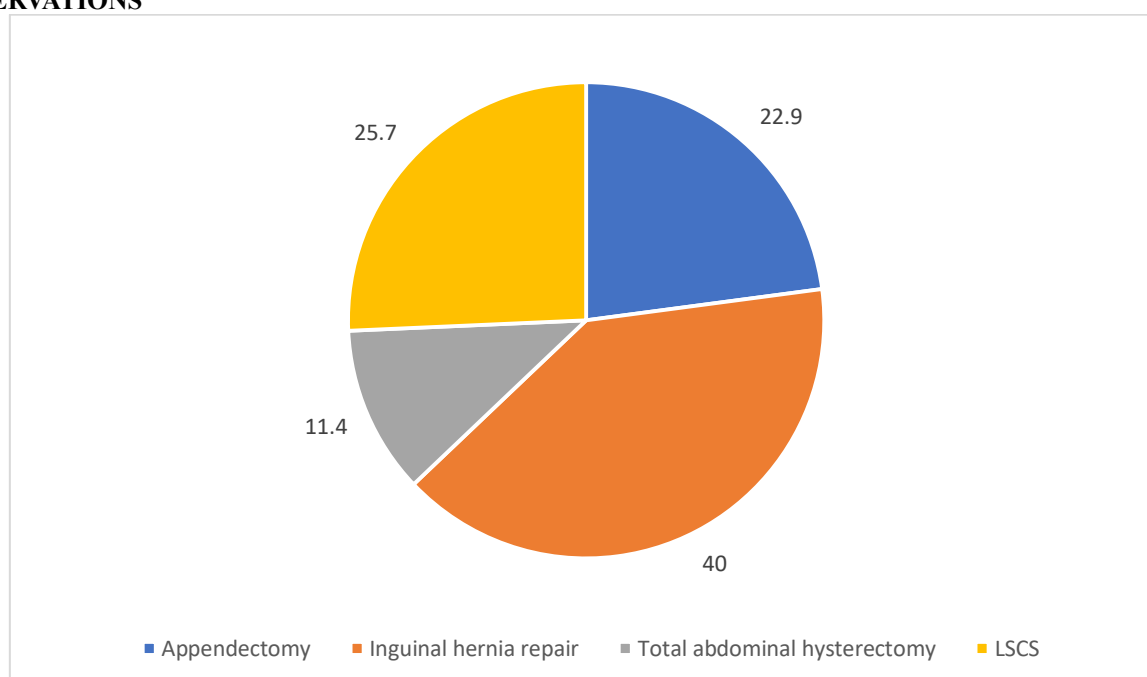
the primary outcome for the present study is VAS for postoperative pain scoring on movement at 1, 2, 4, 8, 12, and 24, hours postoperatively. The secondary outcomes include analgesia duration, postoperative tramadol requirement and frequency of nausea, vomiting or any other adverse effects.

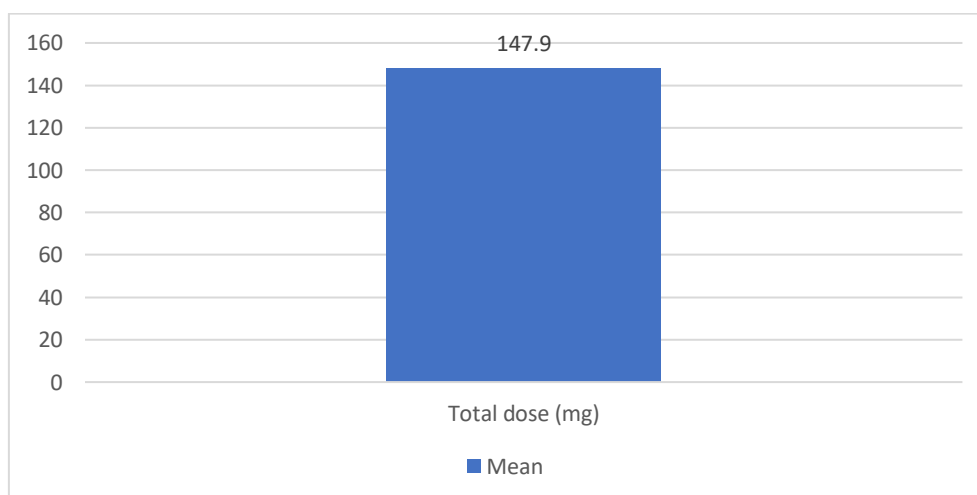
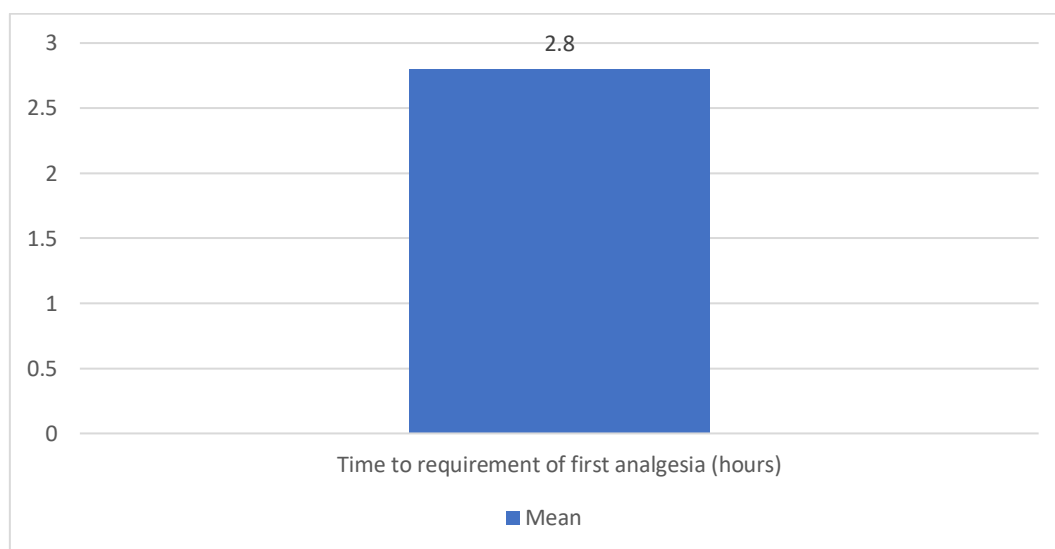
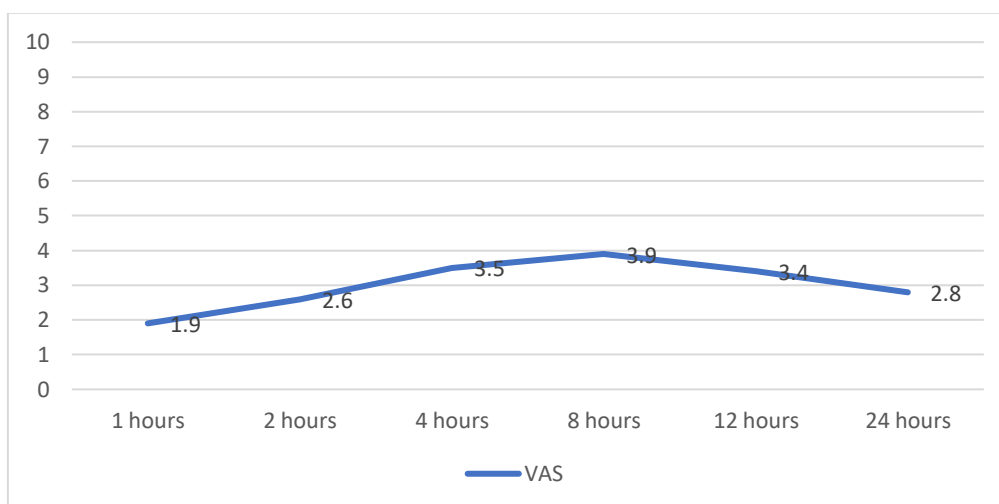
### Ethical considerations

**The Institutional Ethics Committee of the study institution reviewed and approved the project before it was carried out.**

All of the participants were informed in their own language about the study and their rights for participation before providing data for the researcher-administered questionnaire. The participants were informed about the participant's role and rights, to clarify that their participation was voluntary and they voluntarily signed the consent form. The information was treated confidentially, and they could withdraw from the study at any time.

## OBSERVATIONS





## DISCUSSION

The primary aim of this study was to evaluate the postoperative analgesic effectiveness and opioid-sparing effect of ultrasound-guided transversus abdominis plane (TAP) block in patients undergoing lower abdominal surgeries. A prospective observational design was employed, and the study was conducted at the Department of Anaesthesiology Government Medical College Baramullah. The study population included patients aged over 18 years who underwent lower abdominal surgeries under general anesthesia. Ultrasound-guided TAP block with Ropivacaine was administered postoperatively, and pain intensity was assessed using the Visual Analog Scale (VAS) over 24 hours. The requirement for rescue analgesia, incidence of adverse events, and hemodynamic stability were also evaluated.

The distribution of surgical procedures in this study was primarily composed of inguinal hernia repairs (40%), followed by Lower Segment Caesarean Sections (LSCS) at 25.7%, appendectomies at 22.9%, and total abdominal hysterectomies at 11.4%. These types of lower abdominal surgeries typically involve significant postoperative pain, primarily of somatic origin, which is effectively managed by TAP block. The high representation of inguinal hernia repairs corresponds with findings from Parikh et al. (2013), where TAP block significantly reduced postoperative pain and opioid consumption in patients undergoing hernia repairs.<sup>19</sup> Inguinal hernia repairs often involve substantial incision-related pain, which is well-targeted by TAP block due to its action on the sensory nerves of the anterior abdominal wall.

For LSCS procedures, TAP block has been widely studied and validated as an effective method for reducing postoperative pain. D'mello et al. (2019) demonstrated that TAP block significantly decreased opioid consumption and delayed the time to first analgesic request in women undergoing cesarean sections.<sup>25</sup> The block's ability to provide long-lasting analgesia with minimal systemic involvement makes it particularly suitable for obstetric populations where opioid minimization is crucial for maternal and neonatal safety. The findings in the present study reflect these observations, with patients undergoing LSCS reporting effective pain control and reduced reliance on systemic opioids. Appendectomies and total abdominal hysterectomies also benefit from TAP block's targeted analgesia. Tubog et al. (2018) observed reduced pain scores and opioid consumption in patients undergoing hysterectomy when TAP block was included as part of multimodal analgesia.<sup>23</sup>

Postoperative pain assessment in this study was measured using the Visual Analog Scale (VAS) at multiple time intervals—1, 2, 4, 8, 12, and 24 hours postoperatively. The VAS scores indicate that pain intensity was well-managed during the initial postoperative hours, with the mean VAS score starting at 1.9 at 1 hour and gradually increasing to a peak of 3.9 at 8 hours. This gradual rise and subsequent decline to 2.8 at 24 hours reflect the effective analgesic properties of the TAP block, particularly its action on the sensory nerves of the anterior abdominal wall.

The pain relief observed aligns with findings from Tubog et al. (2018), who demonstrated that TAP block significantly reduced pain scores up to 24 hours postoperatively in patients undergoing hysterectomy.<sup>23</sup> The block's efficacy in mitigating both somatic and parietal pain, which are predominant after abdominal incisions, enhances patient comfort and reduces the need for systemic analgesics. D'mello et al. (2019) also noted similar VAS score reductions in cesarean section patients, where TAP block delayed the time to first analgesic request and reduced overall opioid consumption.<sup>25</sup>

The peak in VAS scores at 8 hours is consistent with the pharmacokinetic profile of Ropivacaine, which, although long-acting, gradually dissipates over time. This pattern was similarly reported by Mittal et al. (2018), where postoperative pain increased slightly towards the 8-hour mark but remained controlled without excessive opioid requirements.<sup>24</sup> The subsequent reduction in pain intensity at 12 and 24 hours suggests that the multimodal analgesic strategy, possibly combined with systemic analgesics, successfully bridged the gap as the TAP block's effect waned.

The sustained low VAS scores emphasize the role of TAP block in reducing breakthrough pain and minimizing the need for frequent rescue analgesia. This is crucial for patient recovery, as stable pain control facilitates early mobilization and enhances overall recovery outcomes in line with ERAS protocols.

In the present study, the mean total dose of rescue analgesia (Tramadol) required postoperatively was recorded as 147.9 mg with a standard deviation of 55.1 mg. This reduced consumption of opioid-based analgesia reflects the effectiveness of the ultrasound-guided TAP block in providing sustained postoperative pain relief. The delayed time to the first request for analgesia, averaging 2.8 hours, is indicative of the long-acting nature of Ropivacaine used in the TAP block. These findings align with those of Parikh et al. (2013), where patients receiving TAP block required significantly less Tramadol postoperatively compared to those who did not receive the block.<sup>19</sup>

The opioid-sparing effect of the TAP block is well-documented in literature. In a systematic review by Tubog et al. (2018), TAP block administration was associated with a marked reduction in perioperative morphine consumption across various types of abdominal surgeries.<sup>23</sup> The local anesthetic effectively blocks the sensory nerves in the anterior abdominal wall, providing direct analgesia to the site of incision and thus reducing the reliance on systemic analgesics. This mechanism not only minimizes opioid-related side effects like nausea, vomiting, and respiratory depression but also contributes to faster recovery times and enhanced patient satisfaction.

The current study's findings also resonate with those of Zhao et al. (2021), who reported that the inclusion of TAP block in postoperative pain management led to lower cumulative tramadol consumption in patients undergoing laparoscopic colorectal cancer surgery.<sup>29</sup> This reduction in opioid need is critical in enhancing recovery pathways and reducing hospital stays, aligning with Enhanced Recovery After Surgery (ERAS) principles.

Moreover, the application of ultrasound guidance for TAP block ensures precision in needle placement, reducing the risks of complications such as bowel perforation or vascular puncture. This was similarly emphasized in the study by Abdelsalam



et al. (2016), where ultrasound-guided TAP block resulted in enhanced safety and minimal adverse outcomes during major abdominal surgeries. The findings from the present study further substantiate the role of TAP block as a safe and effective analgesic technique, offering reliable pain relief with minimal side effects, thus supporting its integration into standard postoperative pain management protocols.

## RESULTS:

The study population had a mean age distribution concentrated between 40–49 years (57.1%), with a slight male predominance (54.3%). Most patients had a normal BMI (48.6%) and were classified as ASA I (57.1%). Surgeries included inguinal hernia repair (40%), LSCS (25.7%), appendectomy (22.9%), and total abdominal hysterectomy (11.4%).

Postoperative VAS scores showed a gradual increase from 1.9 at 1 hour to a peak of 3.9 at 8 hours, followed by a decline to 2.8 at 24 hours ( $p < 0.001$ ). The mean time to first analgesic request was  $2.8 \pm 1.1$  hours. The average total tramadol requirement over 24 hours was  $147.9 \pm 55.1$  mg.

Adverse effects were minimal: 82.9% of patients reported no complications, while nausea and vomiting each occurred in 8.6% of cases. No serious adverse events such as local anesthetic toxicity, intraperitoneal injection, or block failure were reported.

## CONCLUSIONS:

The USG-TAP block is an effective and safe regional anesthetic technique for postoperative pain management in lower abdominal surgeries. It significantly delays the need for rescue analgesia, reduces overall opioid consumption, and maintains hemodynamic stability, with minimal side effects. These findings support the integration of TAP block into enhanced recovery after surgery (ERAS) protocols to improve pain control and minimize opioid-related complications.

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