Transversus Abdominis Plane with Rectus Sheath Blocks Versus Port Site Infiltration of Local Anaesthesia in Emergency Laparoscopic Cholecystectomy—Does It Reduce Postoperative Opiate Requirement? A Pilot Study

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Abstract: Laparoscopic cholecystectomy (LC) is the gold standard of treatments for symptomatic gallstone disease. The aim of this study is to determine if postoperative opiate use is reduced with transversus abdominis plane (TAP) and rectus sheath (RS) regional anaesthetic blocks compared to port site local anaesthetic (LA) infiltration. A prospective, randomised cohort study was conducted of adult patients who underwent an emergency LC between 25 April 2022 and 25 May 2023. An amount of 40 mL of 0.375% ropivacaine was infiltrated as either TAP and RS blocks or to port sites. Patient demographics, operative data, and postoperative opioid use were collected from the medical record. In total, 138 patients were enrolled in this study: 73 patients allocated to the LA to port sites cohort (52.9%) and 65 patients in the TAP and RS cohort (43.5%). The most common indication for surgery was acute cholecystitis. The average amount of opiate analgesia use was 115.2 mg in the LA group compared to 61.2 mg in the TAP and RS group (p < 0.05). Optimisation of postoperative pain allows for early recovery, improved patient satisfaction, and improved cost-effectiveness for the health service. With a trend towards multimodal analgesia, the uptake of TAP and RS regional anaesthesia may help to achieve this goal.

Keywords: laparoscopic cholecystectomy; regional anaesthesia; general surgery

1. Introduction
1.1. Laparoscopic Cholecystectomy

Emergency laparoscopic cholecystectomy (LC) is a common surgical procedure [1]. The Acute Surgical Unit (ASU) performs approximately 20 LCs per month between Monday and Friday, as the primary treatment for symptomatic gallstone disease. Though LC is a minimally invasive surgery, postoperative pain and nausea are the main symptoms experienced by patients. Therefore, early management of postoperative symptoms is important as this can optimise quality of life, reduce hospital length of stay, improve clinical outcomes and patient satisfaction, and reduce the burden of cost on the health service by shortening the postoperative length of stay and postoperative opioid analgesic requirement [2].

Opioid analgesia is associated with side effects of nausea, vomiting, constipation, ileus, and urinary retention [3]. The concept of enhanced recovery after surgery (ERAS) programs has led to the increased awareness and uptake of multimodal analgesia such as local anaesthetic or regional blocks, with the aim of reducing the amount of postoperative enteral opiate analgesia requirements. This has led to an increasing interest in introducing transversus abdominus plane (TAP) and rectus sheath (RS) regional anaesthetic blocks to
add to the multimodal postoperative analgesia regime. Comparatively, intraoperative local anaesthetic (LA) to laparoscopic port sites has been widely used to augment postoperative opiate analgesia use by reducing pain locally associated with the incision sites. There are two aspects in which there is a significant paucity of data relevant to our study. Firstly, the literature to date describes TAP blocks usually performed by the anaesthetist under ultrasound guidance, as opposed to being performed laparoscopically during the LC. Secondly, there is a paucity of data comparing outcomes from TAP and RS regional blocks compared to the direct infiltration of LA to port sites.

1.2. TAP and RS Blocks

The TAP block was first described by Rafi in 2001, by using a landmark-based approach through the triangle of Petit [4], and was predominantly performed by anaesthetists under ultrasound guidance. It involves the delivery of regional anaesthesia to thoracolumbar nerves originating from T6-T12 and L1 spinal roots. A local anaesthetic agent is infiltrated in the fascial plane between the transversus abdominis and internal oblique muscles (Figure 1) [5]. The propagation of LA in this plane blocks neurological afferents and provides analgesia to the anterolateral abdominal cavity. Ultrasound-guided techniques have traditionally been used to improve the accuracy, safety, and ease of administration; however, they can significantly extend operative time. The infiltration of TAP blocks laparoscopically has the advantage of efficiency, as delivery can be completed in as little as 30 s [6], and identification and confirmation of the correct plane of infiltration is visualised under vision (Doyle’s bulge) (Figure 2). The goal of the TAP block is to provide analgesia to the skin, muscles, and parietal peritoneum.

![Figure 1. Schematic diagram of the intraoperative TAP blockade under ultrasound guidance. The block is infiltrated into the TAP plane midway between the costal margin and iliac crest [5].](image)
Figure 2. Laparoscopic view of Doyle’s bulge, demonstrating the infiltration of local anaesthetic into the plane between the transversus abdominus and internal oblique [6].

However, the literature has suggested that postoperative pain experienced by patients can be attributed to visceral pain which is more pronounced after the LC. Although the TAP block is effective in blocking T6-T9 intercostal nerves, this often does not provide adequate coverage for the umbilical port, which is the extraction port for the gallbladder and the main major source of pain [7]. Therefore, the addition of the RS block to the posterior rectus sheath is a useful adjunct in blocking spinal dermatomes 9, 10, and 11, providing analgesic coverage to the periumbilical area. The RS block is placed at the same time the TAP block is administered, under direct vision along the rectus plane. When used in combination, it is hypothesised that the TAP and RS blocks provide superior analgesic coverage for visceral pain sensation over the anterior abdominal wall at the incision site(s) and area of maximum pain sensation.

1.3. Choice of Local Anaesthetic for Infiltration

A systematic review and meta-analysis by Alsharari et al. compared four different local anaesthetics (bupivacaine, ropivacaine, lidocaine, and levobupivacaine) of varying concentrations used in LC [8]. It was important to consider the potential adverse effects of the administration of TAP and RS blocks. In particular, the laparoscopic placement of TAP and RS blocks was hypothesised to reduce the risk of visceral injury, haematomas, incorrect placement, and local toxicity. A meta-analysis and systematic review demonstrated that TAP blocks provided superior postoperative analgesia for up to 24 h when compared to port site wound infiltration of local anaesthetic used alone. It is important to note that for most straightforward LCs, patients can be discharged on the day of surgery. Therefore, a significant reduction in the use or need for strong opioid analgesia would facilitate an early discharge home and reduce costs and the burden to the health service.

1.4. Aims

The primary aim of this study is to determine if postoperative opiate use is reduced with TAP and RS blocks after LC compared to port site LA infiltration alone. Secondary aims are to determine if complications related to opiate use are reduced in the TAP and RS blocks cohort compared to the LA to port sites alone group.
2. Methods

2.1. Study Design and Methodology

A prospective, randomised, single-blinded, single-centre cohort study was conducted of adult patients who underwent an emergency LC between 25 April 2022 and 25 May 2023. Patients were allocated to the TAP and RS blocks cohort or the LA to port sites cohort at the time of the emergency LC. A standard LC set up was consistently used for all patients, positioned supine with both arms out and with four working ports. An umbilical entry (supra-, infra-, or transumbilical) allowed a 12 mm Hasson entry. The choice of entry was determined by body habitus and the presence of an umbilical hernia.

The TAP and RS blocks were performed by a single surgeon. An amount of 20 mL of 0.75% ropivacaine was diluted with 20 mL of 0.9% sodium chloride (for a total of 40 mL volume of 0.375% concentration). The TAP and RS blocks were infiltrated between the transversus abdominus and internal oblique planes after the camera port was inserted, whereas LA alone was infiltrated in the subcutaneous tissue of the port site entries at the end of the procedure. The total concentration of LA used was the same in both groups.

2.2. Inclusion and Exclusion Criteria

The inclusion criteria were patients over 18 years of age who presented through the emergency department and underwent an emergency LC. The exclusion criteria were patients under 18 years old, pregnant patients, patients that declined inclusion into the study, patients who were unable to provide consent for themselves, patients with documented hypersensitivity to LA, and any laparoscopic converted to open cholecystectomies.

2.3. Data Collection

Patient demographics from the electronic medical record included patient age, sex, body mass index (BMI), diabetes status, smoking status, history of ischaemic heart disease (IHD), immunosuppression or steroid use, or pre-existing long-term analgesia use, and American Society of Anaesthesiologists (ASA) status. Operative data were collected from the perioperative record including the type of umbilical entry, drain insertion, subtotal LC, and time of surgery. In addition, the following data were collected at the two-week post-discharge review in the surgical outpatients department: postoperative length of stay, cumulative dose of opiate use, length of hospital stay, analgesia requirement in the post-anaesthesia care unit (PACU), ward, and throughout the discharge period. Data were stored on a secure and encrypted password-protected drive.

2.4. Data Analysis

Data were analysed with the aim of determining a statistical significance for the presence of a reduced opiate analgesia requirement post-LC and improved patient satisfaction with pain scores. To consistently compare opiate analgesia use across the two cohorts, equianalgesic dosing was calculated for oxycodone, fentanyl, tramadol, tapentadol, and codeine use via conversion to their morphine equivalent(s) using the Opioid Calculator app (Faculty of Pain Medicine, ANZCA, Version 3.1.2, 2023). Statistical analysis was performed using SPSS Version 12.1.0 and Microsoft Excel Version 7.3. A \( p \) value of <0.05 was used as a marker of statistical significance.

Ethics approval was obtained through the GCHHS human and research ethics committee (HREC). Written informed consent was obtained from all patients for enrolment in this study.

3. Results

3.1. Patient Demographics

A total of 138 patients were enrolled in this study, with 73 patients allocated to the LA to port sites cohort (52.9%) and 65 patients in the TAP and RS cohort (43.5%). Overall, there were 57 male patients (41.3%) compared to 81 female patients (58.7%), consistent with a male-to-female ratio of 5:7. The average BMI of the cohort was 31.1, and the median
ASA was 2. Overall, 23 patients (16.7%) were current smokers, six vaped (4.3%), nine patients had IHD (10.1%), five patients had concurrent steroid use (3.6%), and 14 patients (10.1%) had a history of long-term analgesia use. Patient demographics are demonstrated in Table 1.

Table 1. Patient demographics.

<table>
<thead>
<tr>
<th></th>
<th>LA to Port Sites</th>
<th>TAP and RS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 73 ) (52.9%)</td>
<td>( n = 65 ) (43.5%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>44</td>
<td>47</td>
</tr>
<tr>
<td>Range</td>
<td>20–93</td>
<td>24–80</td>
</tr>
<tr>
<td>Average BMI</td>
<td>30.4</td>
<td>31.9</td>
</tr>
<tr>
<td>Average ASA</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoker</td>
<td>12 (16.4%)</td>
<td>12 (18.5%)</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>10 (13.6%)</td>
<td>9 (13.8%)</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>51 (69.7%)</td>
<td>44 (67.7%)</td>
</tr>
<tr>
<td>IHD</td>
<td>3 (4.1%)</td>
<td>6 (9.2%)</td>
</tr>
<tr>
<td>Immunosuppression/steroid use</td>
<td>4 (5.5%)</td>
<td>1 (1.5%)</td>
</tr>
<tr>
<td>Long-term analgesia use</td>
<td>9 (12.3%)</td>
<td>5 (7.7%)</td>
</tr>
<tr>
<td>Diabetes status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>5 (6.8%)</td>
<td>9 (13.8%)</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>68 (93.2%)</td>
<td>56 (86.2%)</td>
</tr>
</tbody>
</table>

LA: local anaesthetic; TAP: transversus abdominus plane; RS: rectus sheath; BMI: body mass index. ASA = American Society of Anaesthesiologists physical status classification system; IHD: ischaemic heart disease.

3.2. Operative Data

The most common indication for an emergency LC was acute cholecystitis (\( n = 92 \), 66.7%), followed by symptomatic recurrent biliary colic (\( n = 20 \), 14.5%), and the least common indication was cholangitis, with one patient (0.72%) undergoing an LC. Figure 3 demonstrates all indications for surgery. An infraumbilical 12 mm port entry was the most common approach used (\( n = 90 \), 65.2%); two patients had a 5 mm optical entry due to prior surgery (1.4%), and one had an open cutdown to the right paramedian also due to prior surgery (0.72%). The average time from ED presentation to theatre (surgical start time) was 46 h (1.9 days). These patients were triaged as “Category C” on the emergency board to be completed within 24 h. Average postoperative length of stay (LOS) in the LA group was 1.26 days, compared to an LOS in the TAP/RS group of 1.08 days (\( p = 0.11 \)). Ten patients in the LA cohort raised concerns at the time of their postoperative phone call regarding postoperative wound issues, compared to four patients in the TAP/RS cohort. Of the whole cohort, 18 patients (13.0%) were lost to follow-up. The operative data within each cohort are demonstrated in Table 2.

Table 2. Operative data. There was no statistically significant difference in average OT time or postoperative LOS between each cohort.

<table>
<thead>
<tr>
<th>Entry technique</th>
<th>LA to Port Sites ( n = 73 ) (52.9%)</th>
<th>TAP/RS ( n = 65 ) (43.5%)</th>
<th>( p ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraumbilical</td>
<td>52 (71.2%)</td>
<td>38 (58.5%)</td>
<td></td>
</tr>
<tr>
<td>Transumbilical</td>
<td>7 (9.6%)</td>
<td>16 (24.6%)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Cont.

<table>
<thead>
<tr>
<th>Entry Technique</th>
<th>LA to Port Sites n = 73 (52.9%)</th>
<th>TAP/RS n = 65 (43.5%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraumbilical</td>
<td>10 (13.7%)</td>
<td>11 (16.9%)</td>
<td></td>
</tr>
<tr>
<td>Optical</td>
<td>2 (2.7%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Open cutdown to right paramedian</td>
<td>1 (1.4%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Unknown (not documented)</td>
<td>1 (1.4%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Average postoperative LOS (days)</td>
<td>1.26</td>
<td>1.08</td>
<td>0.096</td>
</tr>
<tr>
<td>Drain</td>
<td>14 (19.2%)</td>
<td>10 (15.4%)</td>
<td></td>
</tr>
<tr>
<td>Subtotal LC</td>
<td>4 (5.5%)</td>
<td>4 (6.2%)</td>
<td></td>
</tr>
<tr>
<td>OT time (min)</td>
<td>100.6</td>
<td>97.8</td>
<td></td>
</tr>
<tr>
<td>Postoperative wound concerns</td>
<td>11 (15.1%)</td>
<td>4 (6.2%)</td>
<td></td>
</tr>
</tbody>
</table>

LA: local anaesthetic; TAP: transversus abdominus plane; RS: rectus sheath; OT: operating theatre; LOS: length of stay; LC: laparoscopic cholecystectomy; OT: operating theatre.

Figure 3. Indications for emergency LC.

3.3. Postoperative Opiate Analgesia Use

Figure 4 demonstrates the average amounts of opiate analgesia use in PACU, in the ward, at the time of the postoperative phone call in the clinic, and overall (total) opiate analgesia use.
Figure 4. The amount of postoperative opiate analgesia use (morphine equivalent) in LA versus TAP and RS patients post emergency laparoscopic cholecystectomy. There was a statistically significant reduction in the amount of postoperative opiate analgesia use in the ward, and in total, in TAP and RS patients compared to the LA cohort ($p < 0.05$).

3.3.1. PACU Results

The average amount of time spent in PACU for the LA group was 71 min, compared to 76 min in the TAP and RS group. The average total opiate analgesia used in PACU was 9.5 mg (morphine equivalent) in the LA group, compared to 11.8 mg (morphine equivalent) in the TAP and RS group ($p = 0.28$). The time to rescue opiate in the LA group was 76.5 min, compared to 102.3 min in the TAP and RS group.

3.3.2. Ward Results

There was less opiate analgesia use in patients in the ward who had received a TAP and RS block, with an average of 29 mg (morphine equivalent), compared to 77.7 mg (morphine equivalent) in the LA group; however, this difference was not statistically significant ($p = 0.13$).

3.3.3. Outpatient Department (OPD) Results

There was no significant difference between the average amount of opiate analgesia (morphine equivalent) used in the LA group of 33.2 mg and the TAP and RS group of 29.3 mg ($p = 0.32$) at the time of the OPD follow-up phone call.

3.3.4. Total Results

There was significantly less use of opiate analgesia in the TAP and RS groups compared to LA to port sites, with the average amount of opiate analgesia (morphine equivalent) used in the LA group of 115.2 mg compared to the TAP and RS group of 61.2 mg ($p < 0.05$).
4. Discussion

Symptomatic gallstone disease is one of the most common ED presentations, to which emergency LC is the gold-standard treatment. TAP blocks have consistently shown to provide superior pain relief compared to wound infiltration, with reduced pain scores at various time points and during movement. Additionally, TAP blocks have been associated with lower opioid consumption and fewer instances of postoperative nausea and vomiting, indicating a potential for improved patient outcomes. Therefore, the optimisation of these patient outcomes, particularly postoperative pain and opiate analgesia requirements, allows for early recovery, improved patient satisfaction, and improved cost-effectiveness for the health service. With the advent of ERAS and a trend towards multimodal analgesia, the uptake of TAP and RS regional anaesthesia may help to achieve this goal.

4.1. Local Anaesthetic

Surgical incision results in an activation of nociceptors found in the skin, muscle, and viscera. Stimulation of nociceptors causes depolarisation which activates voltage-gated sodium channels [9]. Ropivacaine is a long-acting regional anaesthetic which causes reversible inhibition of sodium ion influx, subsequently blocking impulse conduction in nerve fibres. Given its reduced lipophilic properties, it is less likely to penetrate large myelinated motor fibres and has selective action on pain-transmitting A, B, and C nerve conduction pathways [10]. It is the anaesthetic agent of choice in epidurals for postoperative pain control or, commonly, labour control [11].

As a structural amide, it has a moderate onset and an elimination half-life of 120 min [9]. There are many studies that have compared the efficacy of local anaesthetics (bupivacaine, levobupivacaine, and lidocaine), and ropivacaine was chosen as the local anaesthetic choice in this study due to its superior effectiveness [8,12]. Ropivacaine is generally well-tolerated, and a pooled analysis from controlled clinical trials of patients receiving ropivacaine concentrations from 0.125 to 1% for nerve blocks indicated that common adverse reactions included hypotension (32%), nausea or vomiting (7–17%), bradycardia (6%), and headache (7%) [11]. None of these side effects were specifically recorded in our study.

4.2. Delivery of the Regional Block

The accuracy and efficiency of the delivery of the TAP block is improved laparoscopically compared to under ultrasound guidance. A randomised controlled trial by Siriwardana et al. demonstrated LA was only delivered correctly 23% of the time, with 18% of cases delivered intraperitoneally [13]. A meta-analysis by Hamid et al. indicated that a RS block provides the greatest pain relief in the first two hours post-operation and a reduction in 24 h morphine-equivalent consumption compared to port site infiltration of LA [14]. However, this difference is no longer significant after the first 24 h, with the reason suggested as the RS blocking only the anterior rami of the ventral branches of the spinal nerves, but not sufficient to address the visceral pain experienced from the port site incisions in the anterior abdominal wall.

4.3. Postoperative Pain Relief

A study by Grape et al. reported improved patient outcomes in the TAP/RS cohort compared to the wound infiltration/LA cohort [15]. The results of our study demonstrate no significant difference between the amount of time spent in PACU postoperatively either in the TAP and RS group or the LA group. Interestingly, the time to rescue opiate in the LA group was 76.5 min, compared to 102.3 min in the TAP and RS group; however, the average amount of opiate analgesia used in PACU was 9.5 mg (morphine equivalent) in the LA group, compared to 11.8 mg (morphine equivalent) in the TAP and RS group. Although this difference was not statistically significant, it is hypothesised that this is related to the delayed effects of the regional blocks on anaesthetising spinal nerves; therefore, comparatively it appears that more opiate analgesia is required in PACU in the TAP and RS group.
There was significantly less overall opiate analgesia use in patients who had received a TAP and RS block, with an average of 61.2 mg (morphine equivalent), compared to 115.2 mg (morphine equivalent) in the LA group \( (p < 0.05) \). Interestingly, although the outcomes for opiate use in PACU and on discharge from the ward were similar, there was significantly less opiate analgesia use in patients in the ward who received a TAP and RS block compared to the LA group. This may be due to a number of factors, some which include patient demographics (results were not controlled for opiate-naivety versus opiate-tolerant patients) and the fact that analgesia administered in PACU or the ward are PRN dosages, whereas on discharge, patients are able to self-administer from their own supply once provided a discharge script. It is important to also note patients’ ability to accurately recall the amount of opiate analgesia use on discharge. To mitigate this issue, further studies have introduced a standardised template to be used by all patients to allow them to record the amount of postoperative analgesia used.

4.4. Limitations

This study was set up as a pilot study and so is limited by its small sample size. Although patient factors such as preoperative long-term analgesia use, smoking status, diabetes, and immunocompromised were collected and identified, further subgroup analyses were not performed on the effect of these positive results on opiate analgesic requirements. For example, patient factors such as opiate naivety versus opiate tolerance, the use of other analgesics or long-term lyrica or pregabalin, BMI (a standardised concentration of 0.375% ropivacaine in a total of 40 mL volume of solution was used for all patients, as opposed to a strict mg/kg dosage), previous surgery, or the degree of difficulty of the procedure. The amount of opiate analgesia used in PACU was meant to be representative of the postoperative opiate requirements in the first 6 h, compared to the ward (12 h) and at the time of the clinic appointment post-discharge (>24 h); however, these times are used as estimates.

There were 14 patients overall with a documented history of long-term analgesia use, but there was no disproportion of patients who required significantly higher amounts of opiate analgesia (in either group); however, this may be attributed to the study’s small sample size, as it is well known that perioperative pain management for opioid-tolerant patients can be challenging, given the complex neurobiological interplay between opioid tolerance and opioid-induced hyperalgesia. The total amount of opiate analgesia use was not averaged over a specific timeframe; therefore, there may also have appeared to be a discordant use of opiate analgesia in patients who, for example, remained an inpatient for two days compared to a patient discharged on Day 0 of surgery.

Data were not standardised with regard to the intraoperative analgesia provided by the anaesthetic team, including the use of ketamine, ibuprofen, or parecoxib, or antiemetics, for example, droperidol. Further research should identify if there is a role for streamlining an intraoperative anaesthetic analgesic regime. Similarly, data were not standardised with regard to the dosing of opiates; future studies should look at all patients being prescribed the same regime of pro re nata (PRN) “as required” medications including oxycodone, fentanyl, tramadol, and so on. Similarly, regular versus PRN paracetamol and ibuprofen may have also affected the total amount provided to patients within their given timeframe. Lastly, a study by Aldohayan demonstrated that intraoperative preincisional laparoscopic preperitoneal local anaesthetic infiltration was significantly associated with reduced pain scores in the PACU [16]. This differs from our study in which LA was placed at port sites at the end of the case, prior to skin closure.

4.5. Future Studies

The results of this pilot study are currently being used to guide a larger cohort study, which has expanded with the addition of two other consultants within the ASU. Consistent data collection with the use of templates for both patients (self-recording of opiate analgesia
usage) and the ASU team to collate these data will allow more accurate documentation for data analysis.

5. Conclusions

The use of TAP and RS blocks has demonstrated a reduction in the use of postoperative opiate analgesia in emergency LC. Early results are promising and are currently being used to guide a larger cohort study in order to determine the significance of these results. These results should guide the implementation of a standardised protocol that encourages TAP and RS blocks compared to the conventional infiltration of LA to port sites, as this not only reduces the amount of opiates required but is also simple and efficient to perform and may reduce postoperative length of stay and improve cost effectiveness for the health service. In addition, the administration of TAP and RS blocks adds little to the surgical operative time, is administered under vision with direct visualisation, as opposed to being infiltrated separately by the anaesthetics team, and has already shown encouraging results as demonstrated in this study.

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Data Availability Statement: Due to privacy reasons, the datasets presented in this study are available on request from the corresponding author due to the raw data consisting of identifying patient hospital Unique Record Number (URN) and date of birth (DOB).

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References


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