Introduction:

“The state should, I think, be called ‘anesthesia’ this signifies insensibility” – William Morton (1819–1868) 1

“The only weapon with which the unconscious patient can immediately retaliate upon the incompetent surgeon is hemorrhage” – William Stewart Halsted (1852–1922) 1

It sounds like a story of three Williams. Shakespeare’s observation (Cymbeline: Act 5, Scene 4) explains why attempts to alleviate the pain of disease, injury or simple surgical procedures by producing unconsciousness are almost as old as civilization, although the techniques were crude. 1 William Morton, credited as the pioneer of general anesthesia, successfully demonstrated the effect of ether anesthesia in 1846. 2 The enormous potential of wider use in surgery was recognized at once. 2 Subsequent developments culminated in widespread use of anesthesia that saw a meteoric rise in surgical procedures at the end of 19th Century. Amongst the first to seize the opportunity was William Halsted, who introduced radical approach to the breast cancer surgery in 19th century and is widely considered as founder of modern surgery. 3,4 The focus was strictly on radical surgery, which relied profoundly on development in the fields of anesthesia and asepsis. 5

Fast forward to 21st century, the approach to breast cancer has seen fundamental changes. In recent years, controversy has centered on whether breast cancer is a systemic or local disease at inception. 6 Surgery remains the first-line treatment for early, localized, or operable breast cancer, is performed in...
The site of the current study is a 760-bedded district general hospital with teaching and research affiliations to neighboring universities, catering approximately 440,000 population in the North West of England. The breast unit deals with approximately 300 new cancers every year. All breast surgery take place on site, led by a team of three consultant breast and oncoplastic surgeons. The procedures that entail regional anesthesia involve a few dedicated consultant anesthetists with special interest and experience in regional anesthesia in breast surgery. Limited human resource allocation, time constraints, potential complications have all raised question about the need for providing regional anesthesia in all cases of breast surgery.

When it comes to anesthetic analgesia in elective breast surgery, often the choice remains between regional anesthesia and rather traditional local anesthetic (LA) wound infiltration. Whilst some studies have attempted to explore the effect of regional anesthesia on survival of breast cancer, others have looked mostly at suitability of a specific type of regional anesthesia in a specific breast surgical procedure by focusing mostly on pain control and post-operative nausea and vomiting (PONV). None of the studies actually explored the short-term outcomes of regional anesthesia as well as LA wound infiltration in breast surgery as a whole, in the context of potential biases and physiological changes. Current literature does not provide a clear answer whether all patients undergoing breast surgery would be benefitted by regional anesthesia, or should a ‘selective’ approach be more productive?

Aims:

The primary aim of the study was to assess and compare short term outcomes (such as changes in blood pressure, nausea & vomiting, pain control, requirement of analgesia, length of stay and complications) between local anesthetic wound infiltration and regional anesthesia in breast surgery, in the context of various past medical histories, type of surgery and confounding factors. The secondary aim was to identify any practices or subgroups, where regional anesthesia would be better suited than local anaesthesia.

Materials and methods:

Patients were listed and consented for relevant procedures, once the decision was made in the breast clinic, with involvement of multidisciplinary team and breast care specialist nurses, as appropriate. Patients were routinely assessed in the pre-operative clinic and their conditions were optimized, if and when necessary, and given a planned date for surgery. On the day of operation, patients were reviewed by the anesthetists and surgeons, and options of anesthetic analgesia were discussed in full.

Setting: District General Hospital in the North-west of England, UK

Study period: Between 1st June 2018 and 28th February 2019

Inclusion criteria: All successive patients undergoing elective breast surgery above the age of 18.

Exclusion criteria: i) Patients below the age of 18; ii) Refusal to have regional anesthesia or LA wound infiltration; iii) those who concomitantly received both regional anesthesia and local anesthetic infiltrations and iv) emergency procedures such as drainage of abscess or evacuation of haematoma.

Type of study: Prospective observational study involving data collection of two groups, namely regional anesthesia and local anesthetic wound infiltration.

Consent: There was no requirement for ethical approval or informed consent.

Randomization: There was no randomization. The decision of regional anesthesia or LA wound infiltration was taken on the day as per the routine practice of the relevant anesthetist following discussion with the patient, without any prior randomization. However, the allocation of anesthetists to breast surgery lists was random, and purely dependent on the anesthetic rota.

Type of the procedure: surgical procedures were divided into two groups-

i) Minor or moderate, such as excision biopsy of breast or axillary lump, wide local excision (with or without wire guidance) of carcinoma breast, mammary duct excision and lymph node biopsy; and

ii) Major, such as simple mastectomy, axillary node clearance, therapeutic mammoplasty, augmentation and reduction (with or without mastopexy), and reconstruction (immediate or delayed).

Regional anesthesia (RA): Regional anesthesia involved thoracic paravertebral (PVB), intercostal, pectoral and serratus blocks (either in isolation or combination). PVB was usually reserved for major cases entailing long duration. Selection of the rest of the RA technique dependent on the type (minor/ moderate vs. major) of surgery and location of incision/ site of dissection. The regional anesthesia was performed by the anesthesiologist under real time ultrasound guidance in the anesthetic room, usually after induction of anesthesia. Multiple injections were usually given without insertion of any indwelling catheter for infusion. Asepsis was maintained during infiltration and 18G-22G needles were used for block.

i) PVB was performed, as described by O’Riain et al (2010).

Paravertebral block typically involved targeting the paravertebral space (PVS), which has been classically described as a triangular-shaped area bounded medially by the vertebral bodies, intervertebral discs and intervertebral foramina; anteriorly by the parietal pleura and posteriorly by the superior costotransverse ligaments, ribs and transverse processes.

ii) Intercostal block involved infiltration around intercostal neurovascular bundle at the upper part of intercostal space, as described by Bonica et al (1990).

iii) Pectoral blocks (Pecs-I and Pecs-II) are superficial interfascial plane blocks, which grant access to the branches of the brachial plexus that supply the pectoral muscles and upper anterior thoracic wall, and were performed as described by Blanco et al (2011). Pec-1 involved injecting LA in the fascial plane between pectoralis major and minor muscles (performed with the patient supine, either with the arm next to the chest or abducted at 90 degrees), adjacent to the pectoral branch of the thoracoacromial artery. A Pecs-2 block consisted of a Pec-1 injection, plus a
second injection made under pectoralis minor muscle in the anterior axillary line at the level of the fourth rib.\textsuperscript{9,10}

iv) Serratus anterior block involved in-line needling and placement of local anesthetic solution either superficial or deep to the serratus anterior muscle in the midaxillary line at the level of the fifth rib, also as described by Blanco et al (2013).\textsuperscript{21}

**Local anesthetic (LA) wound infiltration:** The infiltration was performed by the surgeon during operation using a 18G or 20G needle.

**Local anesthetic agent:**

i) Types- Bupivacaine and Levo-Bupivacaine; patients with higher risk profile usually received Levo-Bupivacaine.

ii) Dosage- 3 mg/kg of Bupivacaine or Levo-Bupivacaine, up to a maximum of 150 mg.

iii) Strengths- 0.5%, 0.25% and 0.375% (Bupivacaine); and 0.25% and 0.375% (Levo-Bupivacaine). Appropriate strength was selected to match the required volume that would deliver maximum allowed dosage without compromising safety.

iv) Anesthetic induction time-The actual period of time that the patient stayed in the anesthetic room, which included time for induction and regional block, where applicable.

**Blood pressure (BP):** Both systolic and mean BP were recorded (on admission and during the procedure) in mm of Hg.

**Pain score:** A 11-point verbal numerical rating scale was used to assess intensity of pain (no pain = 0; mild, moderate, severe, and very severe pain = 1-10).\textsuperscript{22} The maximum single most pain score during post-operative period was recorded.

**PONV:** PONV intensity scale was used (significant PONV; none/ no significant PONV).\textsuperscript{23} The maximum PONV scale during post-operative period was recorded.

**Analgesia:** Analgesia administered in the ward during post-operative period was recorded as simple analgesia (such as Paracetamol and/or Ibuprofen), weak opioid (such as Codeine, Dihydrocodeine and Tramadol), and strong opioid (morphine). Pain score guided the type of post-operative analgesia required in the ward, namely simple analgesia for mild pain, mild opioid for moderate pain and morphine for severe or very severe pain. The dispensation of analgesia dependent on the discretion of the nursing staff in the ward, with guidance from the anesthetist, if necessary. In case of more than one type of analgesia being dispensed to the patient over a course of time, the most potent analgesia was recorded for the purpose of the study.

**Complications:** Both LA (such as allergy, neurovascular damage, pneumothorax, local bruise) and surgical (haematoma) complications were recorded.

**Discharge and Follow-up:** Patients were reviewed post-operatively and discharged as per pre-operative plan, subject to acceptable control of PONV, pain, stable states of observations and wounds, and satisfactory social circumstances. All patients were routinely followed-up in the surgical clinic in 2-4 weeks' time.

**Histology:** Type of histology was grouped as i) benign (diagnostic excision showing a benign condition) or not applicable (aesthetic procedure) and ii) malignancy.

**Source of data collection:** Case notes, digital archives and Operating Room Management Information System (ORMIS\textsuperscript{©}).

**Data collected:**

i) 20-point past medical conditions and various relevant factors

ii) (Age, concerned Anesthetists and Surgeons; Diabetes, Hypertension, Cardiac condition, Chronic pain, Connective tissue disorder, Immune-modulator, Antiplatelet/ anticoagulant, Neo-adjuvant chemotherapy, Prior breast surgery, Prior radiotherapy, Active smoking, BMI, Type, Strength & Volume of LA, Pre-operative BP).

iii) 18-point procedural and outcome measures

iv) (Anesthetic induction time, Breast procedure, Reconstruction, Axillary procedure, Verbal numerical rating pain scale, PONV score, Simple analgesia, Weak opioid, Strong opioid, Average & Lowest systolic per-operative BP, Average & Lowest mean per-operative BE Length of stay, Haematoma formation, Complications of regional block & LA wound infiltration and Histology).

**Statistical analysis:** Chi-square, Fisher's Exact test, Student’s t-test, One-way ANOVA and Kaplan-Meier tests were performed using SPSS V26 (IBM® corporation, New York, USA). A p-value of <0.05 was considered to be statistically significant.

**Results:**

A total of 137 patients were identified and 143 events were analysed. Fifty-eight patients received regional anesthesia and eighty-five patients received LA wound infiltration. Figure 1 depicts distribution of all patients.

**Figure 1.** Flow diagram of distribution and record of events.

![Flow diagram of distribution and record of events](image)

There was no significant difference amongst most of the demographics (patient and procedure), past medical histories and various confounding factors (Table 1). The areas where statistical significances were noted were age; type, strength, and volume of LA; anesthetic time for induction and histology. A separate sub-group analysis showed that those with malignant conditions were older (62.0± SD 13.0), compared to those who had benign (50.6± SD 17.7) conditions (p<0.001).

**Table 1.** Distribution of patient and procedure demographics, past medical histories and various confounding factors as per the type of intervention (n=143). All ordinal and ratio data have been expressed as ± SD, where applicable.

<table>
<thead>
<tr>
<th></th>
<th>LA wound infiltration</th>
<th>Regional anaesthesia</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age at diagnosis</td>
<td>38 (range 21-94)</td>
<td>61 (range 41-89)</td>
<td>0.002</td>
</tr>
<tr>
<td>Diabetes</td>
<td>No</td>
<td>Yes</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>82</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>No</td>
<td>Yes</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>48</td>
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<tr>
<td></td>
<td>Yes</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Cardiac condition</td>
<td>No</td>
<td>Yes</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>52</td>
<td></td>
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<tr>
<td></td>
<td>Yes</td>
<td>07</td>
<td></td>
</tr>
<tr>
<td>Chronic pain</td>
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<td>Yes</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>05</td>
<td></td>
</tr>
<tr>
<td>Connective tissue disorder</td>
<td>No</td>
<td>Yes</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>82</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td>Immune-modulator drug</td>
<td>No</td>
<td>Yes</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>Antiplatelet/ anticoagulant</td>
<td>No</td>
<td>Yes</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>05</td>
<td></td>
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</tbody>
</table>
Table 2 shows associations between type of the procedure and pain score as well as PONV scale. Statistically significant higher occurrence of pain score was noted following major surgery, in both LA and RA groups. However, relatively lower incidences of severe and very severe pain were noted in the group of patients who underwent major surgery and received regional anesthesia, compared to those who received LA. Similarly, PONV scale was higher in the major surgery groups, significantly so in the LA group (p<0.001). Also, the relative incidence of significant PONV in the major surgery group was lower (2.7%) amongst patient who received regional (2.7%), than local anaesthesia (12.7%).

Table 3. Procedure specific morphine requirement as per the type of intervention (LA= Local anaesthesia; RA= Regional anaesthesia).

Mean length of stay (LoS) was 0.47 ± SD 0.77 (range 0 - 5) days. As far as LoS, and day case surgery were concerned, there was no significant association with either of the intervention group. (Table 4). A sub-group analysis showed a higher occurrence of major cases in the regional anesthesia group (n=36 out of 58; 62%), compared to LA infiltration (n=47 out of 85; 55.2%) group, although it was not statistically significant (p=0.42).

Table 4 Blood pressure recordings and length of stay as per the type of intervention.

Mean drop of systolic blood pressure (mm Hg) was significant [p=0.42].

Table 5 shows the association between type of LA agent and simple analgesia/opioid requirement. Levo-Bupivacaine was significantly associated with reduced post-operative overall opioid (both weak and strong) intake, in comparison to Bupivacaine. Strength (percentage) of LA had no significant impact on analgesia requirement.

Table 5. Association between type and concentration of Local Anaesthetic and analgesia requirement.
Higher volume of LA was associated with higher change of per-operative systolic BP (compared to pre-operative recordings) (p=0.29).

There was no documented complication related to regional block or LA wound infiltration. There was no record of failed block. A total of 8 wound hematomas took place, which required evacuation in 5 cases. Occurrence of haematoma was almost double in the regional anesthetic group (8.6%), compared to LA wound infiltration group (3.6%). However, the association was not statistically significant (p=0.20). A subgroup analysis showed that a significantly higher proportion of haematoma was encountered in the paravertebral block group (4 out of 21; 19%), compared to the rest (1 out of 37; 2.7%) of the regional anesthesia techniques (p=0.03) [Table 6]. There was no significant association between occurrence of haematoma and operating surgeon (p=0.42).

Table 6. Occurrence of haematoma formation according to intervention.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Haematoma formation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Paravertebral</td>
<td>17</td>
<td>04</td>
</tr>
<tr>
<td>Paravertebral &amp; Pectoral</td>
<td>02</td>
<td>00</td>
</tr>
<tr>
<td>Paravertebral &amp; Serratus</td>
<td>03</td>
<td>00</td>
</tr>
<tr>
<td>Pectoral</td>
<td>10</td>
<td>01</td>
</tr>
<tr>
<td>Pectoral &amp; Serratus</td>
<td>18</td>
<td>00</td>
</tr>
<tr>
<td>Serratus</td>
<td>01</td>
<td>00</td>
</tr>
<tr>
<td>Intercostal</td>
<td>02</td>
<td>00</td>
</tr>
<tr>
<td>LA wound infiltration</td>
<td>82</td>
<td>03</td>
</tr>
</tbody>
</table>

Table 4 also showed various BP recordings during surgery, showing a significant higher drop in systolic BP (compared to average per-operative systolic) in the regional anesthesia group (p<0.001). A separate regional anesthesia sub-group analysis showed a significant drop of systolic BP during operation (compared to preoperative systolic) amongst those who later developed haematoma (59.2 ± SD 3.9), compared to those who did not (55.0 ± SD 19.9), (p=0.015). Kaplan Meier graph also confirmed above findings [Figure 2].

Figure 2. Kaplan-Meier graph showing change of blood pressure as per haematoma formation according to intervention.

Discussion:
Incidence rates for breast cancer are projected to rise by 2% in the UK between 2014 and 2035, to 210 cases per 100,000 females by 2035. Surgical resection was one of the first effective treatments for breast cancer and continues to play a critical role in this regard. Carried out a detailed search of English literature using PubMed, Ovid MEDLINE®, Google Scholar, EMBASE, Cochrane Library, Cumulative Index to Nursing and Allied Health Literature databases, using the key words 'breast surgery', 'regional anesthesia', 'analgesia', 'complication', 'hypotension', 'PONV', 'haematoma' and 'length of stay'. Post-surgical pain following breast surgery came to light to be a common occurrence, with most studies reporting the incidence of moderate-to-severe postoperative pain reaching 25–30%. International Association for the Study of Pain (IASP) society defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. PONV is also a common distressing symptom or side effect after surgery and anesthesia. It can cause complications such as wound dehiscence, electrolyte imbalance, increased pain, dehydration and aspiration. Use of regional anesthesia has been associated with a lower incidence of PONV. Interestingly, the use of regional anesthesia techniques may modulate the immune system, likely via interleukins (IL). Increased IL-10 levels after propofol-paravertebral anesthesia for breast cancer has been reported, compared to sevoflurane/opioids. Preclinical and clinical studies suggest that the anesthetics and adjuvants given in the perioperative period can affect cancer recurrence and survival, perhaps tipping the balance in some instances to determine whether cancer progresses or regresses.

Multimodal analgesia for breast surgery should include local or regional analgesic techniques. Regional anesthetic or analgesic blocks can be performed by either an anterior or posterior approach to achieve optimum analgesia. Anterior approach blocks include pectoral nerve, serratus anterior plane, interpleural, and intercostal nerve blocks. Posterior approach blocks include thoracic epidural and paravertebral blocks and newer approaches such as erector spinal plane blocks. The use of ultrasound in regional anesthesia has improved the safety of the various techniques and also broadened their scope. With recent development of oncoplastic procedures, more and more complex surgeries, including breast reconstructive surgeries, are now carried out routinely. These procedures are frequently associated with post-operative pain and prolonged hospital stays and related costs, and regional anesthesia may be helpful in these situations. Complications of regional anesthesia include LA intoxication, vasovagal reaction, vascular puncture, neural damage pneumothorax, intrathoracic or epidural spread and sympathetic block leading to hypotension and hemodynamic instability. The latter are complex, interactive, and as yet, the underlying mechanisms are not fully understood. However the complications don’t always get fully reported.

Needless to say, regional anesthesia has an important role to play in breast surgery and needs further evaluation. However, a short-term study would not be able to address a long-term effect such as disease recurrence or survival. Therefore, we focused in our study on short-term relevant aspects of the analgesic effect of regional anesthesia and LA wound infiltration in our study. Given the complex, sometimes inconclusive, if not contradictory findings, it is not unreasonable to consider the possibility of potential biases that would explain the differences in findings. Therefore, we aimed to assess the outcomes of both LA wound infiltration and regional blocks in breast surgery as a whole, in the context of 20-point past medical histories and relevant factors. We also measured 18-point outcome variables. This comprehensive evaluation was undertaken in order to address potential biases and confounding factors. A combination (n=7) of four different types of regional blocks (namely paravertebral, pectoral, intercostal and serratus
blocks), were included in the study. Selection of the type of block depended on nature and location of the procedure and anesthetist’s choice. We considered each simultaneous bilateral procedure as one case as it is not possible to distinguish effect of analgesia on each side separately in relation to PONV, pain score, and analgesia requirements. For this reason, we also excluded anyone who had LA wound infiltration on one side and regional block on the other, to save any confusion.

As far as the past medical histories/conditions and various confounding factors are concerned, no significant difference was noted in majority of the cases (Table 1). This is therefore reassuring that the choice of anesthetic analgesia can be made without the influence of common health conditions. Not surprisingly, anesthetic induction time was significantly higher in the regional anesthesia group, reflecting the extra time needed to undertake this additional step. A significant difference in use of LA was noted, perhaps echoing a heterogenous group of procedures performed, which warranted different volumes and strengths to provide a safe and efficacious dosage. This would explain the significant variations noted in the types, concentrations and volumes of LA in two groups of intervention (Table 1). A higher incidence of malignant histology was noted in the regional block group, reflecting perhaps choice of regional anaesthesia to provide a potential long-term survival benefit in cancer cases. This would also explain the higher age in the regional anesthesia group as those with malignant conditions were significantly older compared to those who had benign conditions.

A significantly lower pain score and a trend of reduced morphine requirement were noted amongst the patients who underwent major procedures in the regional anesthesia group, compared to LA wound infiltration group (Tables 2 and 3). Reduced pain score, noted in our study is in accordance with the findings noted by other studies. However, lack of statistical significance in reduced analgesia requirement amongst major procedures noted in our study could be a reflection of including unselected consecutive ‘all breast surgery and multiple types of block for providing regional anesthesia in the study, rather than a definitive procedure (such as mastectomy) and specific block (such as paravertebral block).

As such, we did note any such significant association between LoS and type of intervention. Interestingly, a subgroup analysis showed a higher occurrence of inpatients in regional anesthesia group (Table 4). This could be explained by the fact that major cases had a higher chance of staying overnight and a higher occurrence of major cases was noted in the regional anesthesia group.

Hypotension has been known to be associated with paravertebral, pectoral and intercostal blocks in patients who underwent mastectomy and thoracotomy34-36. Our study did not show any such association (Table 4). This could be due to our study population that comprised of ‘all breast surgical cases rather than specific procedures such as mastectomies or thoracotomies.

There was no procedural complication related to the LA infiltration of wound or regional anesthesia. There was no significant association between hematoma formation and the operating surgeon. A significant higher occurrence of haematoma in the paravertebral group was noted in the current study (4 out of 21; 19%) (Table 6). Hypotension in regional anesthesia has been thought to be due to sympathetic blockade. Richard et al has cited hypotension during last 30 min as a risk factor for post-operative bleeding. This observation certainly raises the question whether there is any correlation between regional anesthesia resulting in significant intra-operative hypotension due to sympathetic blockade and subsequent reversal of the block with return to normotension, that might lead to reactionary bleeding and formation of haematoma. Of course, we did not measure blood pressure changes specifically last 30 min of the procedure and therefore our study could not corroborate with the findings of Richard et al. However a significant drop in systolic blood pressure during surgery (average – lowest systolic BP) was noted in the group receiving regional block (Table 4). Furthermore, a similar significant drop in blood pressure was also noted amongst those who received regional block and subsequently developed haematoma (Figure 2). It could be argued that a wide variation in anesthetic practice (such as per-operative volume replacement) could have impacted on drop of BP. However only a small number (n=4) anesthetists were involved in providing most of the regional blocks, hence their practice is likely to be uniform and is unlikely to contribute to the variation in BP. Therefore, it would be worth exploring the clinical significance of haematoma in the paravertebral group, for which a larger study would be required.

In summary, regional anesthesia took longer time than LA wound infiltration, was associated with lower pain scale, and a trend of reduced morphine requirement. However, such improved patient experience has been shown to be associated with major breast procedures, rather than minor or moderate procedures. The outcomes were not impacted by common past medical conditions. Levo-Bupivacaine was noted to be associated with least post-operative opioid requirement (p=0.01). The study also highlighted a possible correlation between haematoma formation and paravertebral block, which would require larger studies to determine the cause-and-effect association.

We fully acknowledge the shortcomings of our study. Most importantly, this is not a randomized control trial. It is worth mentioning that observational studies can complement findings from randomized controlled trials by assessing treatment effectiveness in patients encountered in day-to-day clinical practice. Moreover, the decision to offer local or regional anesthesia depended on usual practice of the anesthetists. However, designation of anesthetists to the theatre lists was completely random. Hence it could be argued that the study entailed an in-built degree of randomization. On a positive note, the observational findings noted the study should help formulate hypotheses to be tested in future trials. Also, we admit that the relatively small numbers in the study could potentially give rise to statistical errors, which could be
The major strength of our study is its contribution to a relatively complex and yet under-addressed quandary whether one should opt for regional anaesthesia in all cases of breast surgery, or whether a ‘selective approach’ may be better. Furthermore, this database can be used to assess effect of regional anaesthesia on long-term recurrence and survival of breast cancer in future.

Recently issued guidelines support wider use and availability of regional anaesthesia. PROSPECT guidelines issued in January 2020 state ‘paravertebral blockade is recommended as the first line regional analgesic technique’. Pectoral nerves block may be used as an alternative to paravertebral block. Local anaesthetic wound infiltration may be added to regional analgesia techniques. Similarly, guideline from The Royal College of Anaesthetists recommend that there should be adequate supply of regional block devices. Ultrasound scanning, nerve stimulators and all equipment and drugs necessary to perform local and regional analgesia techniques should be available.

It appears that we have travelled a long way from the ‘Laughing Gas’ and routine ‘Radical Mastectomy’. Going back to where we left in the history, Imogen, the central character in Shakespeare’s Cymbeline, was noted to have had a mole in her left breast. If Imogen had to have an excisional breast surgery today, should we be (or not), based on the current evidence, offer her regional anaesthesia? To be, or not to be, that remains the dilemma. We believe that our study has contributed in addressing this dilemma.

Conclusions:
In conclusion, the option of regional anaesthesia should be available for all elective breast procedures. However increased theatre time should be taken into account to incorporate extra time required for regional anaesthesia.

A selective approach involving regional anaesthesia using Levo-Bupivacaine for major breast procedures would provide improved patient experience entailing lesser post-operative pain score and likely reduced post-operative morphine requirement. Common underlying health issues do not appear to have any significant impact on such an approach.

Potential association between post-operative haematoma formation in paravertebral space should be further evaluated.

Disclosure
The author reports no conflicts of interest in this work. Financial support: None

References:
21. Thakral L, Faber P. Pain management in day-case surgery. BA Education.