

# Failed Nerve Blocks: Prevention and Management

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**“The secret of success is constancy of purpose” - Benjamin Disraeli, British politician**

Success and failure go side by side in regional anesthesia. No anesthesiologist can claim a 100% success record while giving nerve blocks. So, it is always better to focus on how to prevent causes of block failure rather than focusing on managing a failed block. Faraj W. Abdallah et al. did a comprehensive literature hunt to find out the meaning of block “success” which were used by various authors in their studies and found that it was highly variable and there was lack of consensus regarding its meaning[1]. The most common definition of block success was an achievement of a surgical block within a designated period. There are essentially four stake holders for defining success criteria: namely the patient, the anesthesiologist, the surgeon and the hospital administrator. The various parameters of success for a patient which

included postoperative pain and patient satisfaction were evaluated in 4 trials only. The anaesthesiologist-related indicators like block onset time & complications were reported most frequently. The surgeon and hospital administrator-related indicators were not collected in any trial. For all practical purposes, especially from our perspective a block failure may be accepted when complying with any one of the following after giving an adequate time of approximately 30 minutes: Conversion to general anaesthesia (GA) after surgical incision. Use of Intravenous (IV) opioid analgesics  $\geq 100 \mu\text{g}$  fentanyl or equivalent after incision. Rescue peripheral nerve block given (a second block after completion of initial block). Infiltration of local anaesthetic agent (LA) into the surgical site. The above four criteria are routinely recorded in medical records and have also been accepted in previous research papers. We may have a) atotal failure which is defined as block where bolus of LA completely misses its target and surgery cannot proceed, b) an incomplete block where patient has numbness in the area of nerve distribution but not adequate for incision, c) a patchy block in which some areas in distribution of plexus usually have escaped, d) a wear off block or secondary failure seen when surgery outlasts the duration of block and e) amis directed block is when part or whole of the drug is injected into the neighbouring structures e.g. into a different fascial or muscular plane or a vessel. M. Morgan had stated that “Regional anaesthesia always works—provided you put the right

dose of the right drug in the right place”. Failure occurs due to blocking the wrong nerve or not blocking all the nerves for a planned surgery.

**Three primary keys to successful regional anesthesia are therefore nerve location, nerve location and nerve location! - N.M. Denny.**

Every anesthesiologist must “pause” just before placing the needle at the site of nerve block. While doing so he re-confirms the patient’s identity, the intended procedure and the correct side of the intended nerve block. There are numerous factors which play a crucial role in the success or failure of a peripheral nerve block. The operator’s technical skills and experience play a substantial role. An unskilled anaesthesiologist is perhaps the biggest cause of failure. It has been found that exposure to multiple techniques at the same time is confusing for the beginner. A pearl of wisdom is that one should avoid “over-selling” regional anesthesia (RA) techniques in the initial days of their independent practice. Dr. Gaston Labatin 1924 had wisely sermoned that “A thorough knowledge of the descriptive and topographic anatomy with regards to nerve distribution is a condition which anyone desirous of attempting to study regional anesthesia should fulfil”. If ultrasound is being used then knowledge of sono-anatomy is equally essential. Gross anatomic distortion will however remain a challenge to the success of nerve blocks. It is essential to give appropriate blocks for appropriate surgery. According to

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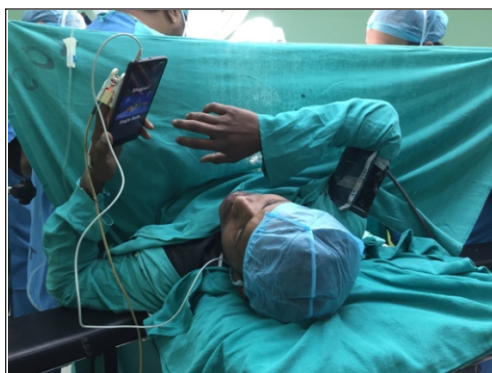
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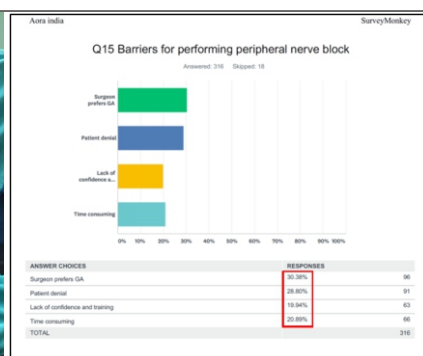
Hilton's Law, the nerve trunk innervating a joint also supplies the overlying skin and the muscles that move that joint, and one must block all the nerves for a successful block. On the contrary one must also understand the limitations of a particular nerve plexus block and the commonest nerves that may be spared in a plexus block. It is better to choose one technique, become familiar, confident and comfortable with it and stay with the technique for a reasonable time, rather than trying unfamiliar nerve block techniques at the first go. Sub-optimal placement of LA in landmark-based technique leads to highly variable success rate of these blocks. Using proper equipments is always advisable and both peripheral nerve stimulator (PNS) and ultrasound (US) have been validated to increase success rates in multiple studies. Block success rates are similar between US and PNS when the block was performed by experts[2]. Whatever the equipment, knowing and familiarising with it is a bare minimum requirement. While using a nerve stimulator the current intensity is essentially the most important factor. An evoked motor response at a current of  $\leq 0.5$  mA (0.3-0.5 mA) ensures a successful nerve block. Knowledge of an appropriate motor response of the innervating nerve is crucial for the success of the nerve block and any non-ideal motor responses will increase the failure rates. In recent times everybody is laying emphasis in US-guided blocks and the target nerve is no longer invisible. Does US-guided blocks lead to a 100% success? Sites et al. identified 398 of 520 peripheral nerve block errors committed by US novices during their performance[3]. The crux is

that US may not eliminate failures completely. The major limitation of US technology is the dependence on the operator. One needs adequate training and has a definite curve in honing the skills. The most common errors during US-guided blocks are too much of hand motions while holding the needle or probe, poor choice of needle-insertion site and angle, difficulty in aligning needle with the US-beam thus preventing needle visualization, failure to recognize needle tip before injection, anatomic artefacts (tissue resembling target nerve) and failure to recognize maldistribution of LA[4]. Combination of US and PNS (Dual guidance) for nerve identification and blockade have also been proposed. Using both facilitates learning, improve trainee performance and provide increased level of confidence and comfort. For superficial blocks, US alone is usually sufficient & PNS may be used to monitor for an overlooked intraneural placement. For deep or anatomically challenging US-guided blocks with inadequate images, PNS can be used to identify the nerve structures of interest. Multi-stimulation, a technique where each component of the nerve plexus is stimulated separately has been proved to increase the success rate and reduce the dose of LA. It however requires multiple passes or multiple skin punctures with the block needle. The best results are seen for infra-clavicular block, mid-humeral block, axillary block, popliteal or sciatic block and most US-guided nerve blocks. No additional risk of nerve injury during redirection of needle through partially anesthetized nerves has been reported. Excessively anxious or an uncooperative patient, patients with any

mental illness are not the ideal candidates for RA. The patient's anxiety may affect the anesthesiologist adversely making him anxious, denting his confidence and consequently ruining his chances of a successful nerve block (table 1)[5]. Underlying co-morbidities in the patient like obesity, arthritis, diabetes etc. may affect positioning, access, nerve localization and identification. A history of a good previous experience of anaesthesia or surgery is predictive of a more relaxed patient and a successful block. The management in such patients comprises of a good pre-operative counselling with a gentle, unhurried patient handling. Subsequent management may include usage of a light anxiolytic premedication, followed with lifting drapes off patient's eyes, shielding of the ears from noise and applying headphones with soft music in the operation theatres (figure 1). Patients may still claim that their block has failed due to the conscious awareness of operation theatre settings and 'sensations' transmitted through unblocked nerve fibres. Intravenous analgesia or sedation with appropriate monitoring for relieving anxiety and pain is essential and considered 'standard care' and should not be considered as a failure. Drugs are an important factor for the success of nerve blocks. Usage of a sufficient volume and appropriate concentration of LA solution is the key to a successful nerve block. Too much of volume or concentration of LA may lead to enhanced risk of side effects rather than increasing efficacy. Likewise, too less of volume or concentration of LA increase chances of failure. The anesthesiologist should always check for wrong dispensing and expiry date of drug personally, before proceeding with the nerve block. Mixing of LA is often misinterpreted to provide significant advantages like prolongation of the block duration and decreased toxicity, instead they provide effects which only mimic an intermediate-acting agent with higher chances of toxicity. Isolated case reports professing very low volumes of LA must be taken in the right context and should not be made the universal rule. Perineural opioid and non-opioid adjuvants prolong the duration of block, but none have prolonged duration more than 24 hours. Alkalinisation does not improve the block



**Figure 1:** Patient listening to soft music with headphones in the operation theater (picture taken with consent from the patient for publication).



**Figure 2:** Graph showing various reasons serving as barriers for performing nerve blocks in a survey conducted by AORA India (March-May, 2018) (permission taken from Dr. Vrushi Ponde et al.).

success rate. The adjuvants allow only dose reductions of LA, rather than really preventing block failure. The environment where anaesthesiologists who are in a hurry or work under undue pressure, often face higher failure rates. Organizational changes like instituting a 'block room' for RA will improve success. Indirectly it will lead to standardisation of block procedures in that institution as well. Additionally, an area separate from operation table allows adequate time to test and top up in effective blocks. Block rooms are a novel way of pooling of expertise, thus allowing excellent teaching opportunities for trainees. Poor ergonomics lead to increased fatigue and poor performance, especially among anaesthesia residents and novice operators using US-guided blocks[6]. Our team mates (specifically surgeon's) personality and their technical skills play a role in selection of type of anesthesia, nerve block technique, choice of drug and need of adjuvants. An uncooperative surgeon is a strong predictor of failure of nerve blocks. One should always discuss with surgeon about the surgical plan, site of incision, area to be operated and position of patient during surgery. A clinical pearl is not to allow surgeons & operation theatre (OT) staff to interrupt while one is giving the block as it will invariably increase the anxiety level. Once a patient is in the OT, the momentum shifts in favour of performing the surgery and only few surgeons (including mine) have the patience to wait for the block to work. Allowing adequate 'soak time' (time for a block to take effect) is mandatory for a block to be successful. Thirty minutes is considered the minimum waiting time before calling any block a failure. Once incomplete block has been diagnosed pre-operatively the management options are re-

block, additional injections or rescue blocks, a different nerve block, spinal or combined spinal epidural anesthesia (CSEA) in lower limb surgeries, systemic analgesia with opioids or adjuvants, local infiltration anaesthesia and general anaesthesia.

**“It is not a failure to fail, it is a failure not to have a plan in case you fail” (unknown).**

The decision to re-block depends on the dose already administered and time allowed to initiate surgery. A lower volume of LA required in US-guided blocks allows for a repeat block to be performed within maximum permissible dose of LA. Once the surgical procedure has already begun, we are left with very limited options for management of a failed block. We may still be able to successfully conduct the surgery with analgesic supplementation in form of opioids and anesthetic drug supplementation like ketamine or propofol in incremental doses in situations where we face partial effect or are expecting the block to take its effect with time. Local infiltration anesthesia (LIA) must be considered as one of the options[7]. The volume of LA is dependent on the extent of incision and one should not exceed the upper dose limit. It may be noted that incisional infiltration comprises of not only a subcutaneous injection but also intramuscular, interfascial and as deep tissue injections. LIA is also an integral component of multimodal analgesia. If all feasible efforts have been unsuccessful and the patient continues to have persistent pain then general anesthesia is the last resort. Surgical manipulation should then be stopped momentarily and general anesthesia (GA) with rapid sequence induction and intubation is to be followed

without further delays. Alternatively GA may be continued with a face mask or a laryngeal mask airway and spontaneous ventilation. When patients having no or little pain during blocks starts having pain when the block has worn off is defined as Rebound pain[8]. Various interventions may be tried for preventing rebound failure[9]. During pre-anaesthetic check-up patients must be educated regarding what to expect when block wears off. This remains the most useful strategy. CPNB using perineural catheters (PNCs) is most efficacious. Other options are Wound catheter infusion (WCI), oral or IV multimodal analgesics and IV or perineural adjuvants. A Secondary failure is seen in continuous peripheral nerve block (CPNB), where repeat dose of LA fails to provide effective analgesia after initial primary block has resolved. If faced with perineural catheter failures it may be addressed by usage of US guidance which improves success of catheter insertion compared to NS. Sub-circumneural space is considered the ideal space for catheter placement. Tunnelling improves catheter security and prevents inadvertent misplacements. Tissue glue may be applied to puncture sites to stop leakage of LA. Intermittent bolus doses are better than continuous basal infusion. Stimulating catheters available in the market have been reported to decrease secondary failure rates. Multimodal analgesia should be provided in all cases, more so in case of a non-functioning catheter. There is an ongoing debate on whether blocks should be done after GA. Melissa M. et. al. have rightly questioned – “Nerve Blocks Under General Anesthesia: Time to liberalize Indications?”[10] Marhofer has tried to demystify the myths related to regional blocks carried out during general anesthesia or deep sedation[11]. So how ready are we to change the rules? Taking a lead from our past successful experiences in paediatric patients and truncal or chest blocks, it is advantageous to use a combination of GA with low-volume, low-concentration single-shot or continuous peripheral nerve block[12]. Thus there will be no risk of failure, no delays and all stakeholders (surgeon, anaesthesiologist, patient and hospital administrator) will be satisfied. As health care systems continue to move toward patient-centred parameters, the patient criteria for success

**Table 1: Anesthesiologists perception of patients' anxiety, its frequency and effects during regional anesthesia. (Adapted from JIala et al., Anaesthesiologists' perception of patients' anxiety under regional anesthesia. Local and Regional Anesthesia 2010**

	Agree n (%)	Disagree n (%)
Patients' anxiety is common during regional anesthesia	36 (33)	74 (67)
Anxiety is mostly pre-operative	69 (62)	41 (38)
Patients' anxiety concerns me a lot	25 (23)	85 (77)
I underestimate patients' anxiety	49 (44)	61 (55)
I am always prepared to manage patients' anxiety	66 (60)	44 (40)
Patients' anxiety may affect my anxiety	59 (53)	51 (46)
Patients' anxiety affects my confidence in performing regional anesthesia	39 (35)	71 (65)
Patients' anxiety may affect block success	63 (57)	47 (43)
Differing advice from surgeon and anesthesiologist increases patient anxiety	100 (90)	10 (9)

n: Number of respondents who agree/disagree with the statements; %: Percentages

of a nerve block will become foremost. Broader questions will emerge beyond mere pain relief. In the attainment of success, there will always remain barriers for nerve blocks (figure 2). All effort should

be made to encourage every anesthesiologist to practice RA and not utilising it is probably the biggest failure.

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