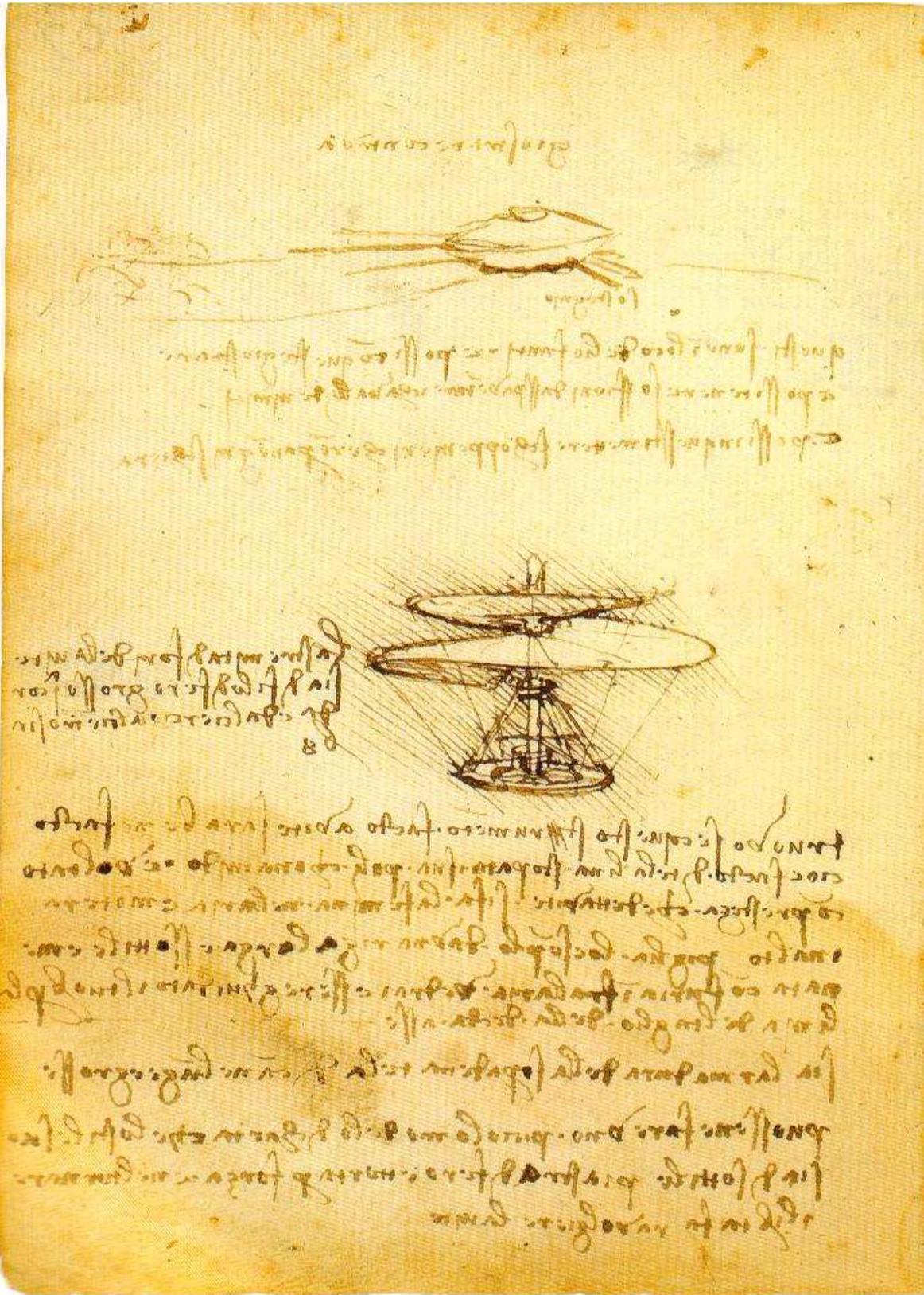


**BIER'S BLOCK- (INTRAVENOUS REGIONAL ANAESTHESIA OF THE
UPPER LIMB)**



"Areal Screw", c.1493, Codex Atlanticus, Leonardo da Vinci.

“What was, will be again, what has been done will be done again, and there is nothing new under the sun. Take anything which people acclaim as being new: it existed in the centuries before us. No memory remains of the past, and so it will be for the centuries to come, they will not be remembered by their successors”.

Ecclesiastes 1: 9-11, 3rd Century B.C.E

As much pressure is exerted by the object against the air as by the air against the body. And see how the wings, striking against the air, bear up the heavy eagle in the thin air on high. And see the air as it moves over the sea strike against the swelling sails to make the loaded heavy ship run; so that for those demonstrative reasons that have been given, you may know that man, with great contrived wings, exerting effort against the resisting air, may conquer and subject it, and so rise above it....

...A bird is a machine working according to mathematical laws. It lies within the power of man to reproduce this machine with all its motions, but not with as much power....Such a machine constructed by man lacks only the spirit of the bird, and this spirit must be counterfeited by the spirit of man.....

Study me reader, if you find delight in me, because on very few occasions shall I return to the world, and because the patience for this profession is found in very few, and only in those who wish to compose things anew. Come humanity, to see the miracles that such studies will disclose in nature.....

*The notebooks of Leonardo da Vinci, Codex Atlanticus, fol. 161 r-a.
Biblioteca Ambrosiana, Milan.*

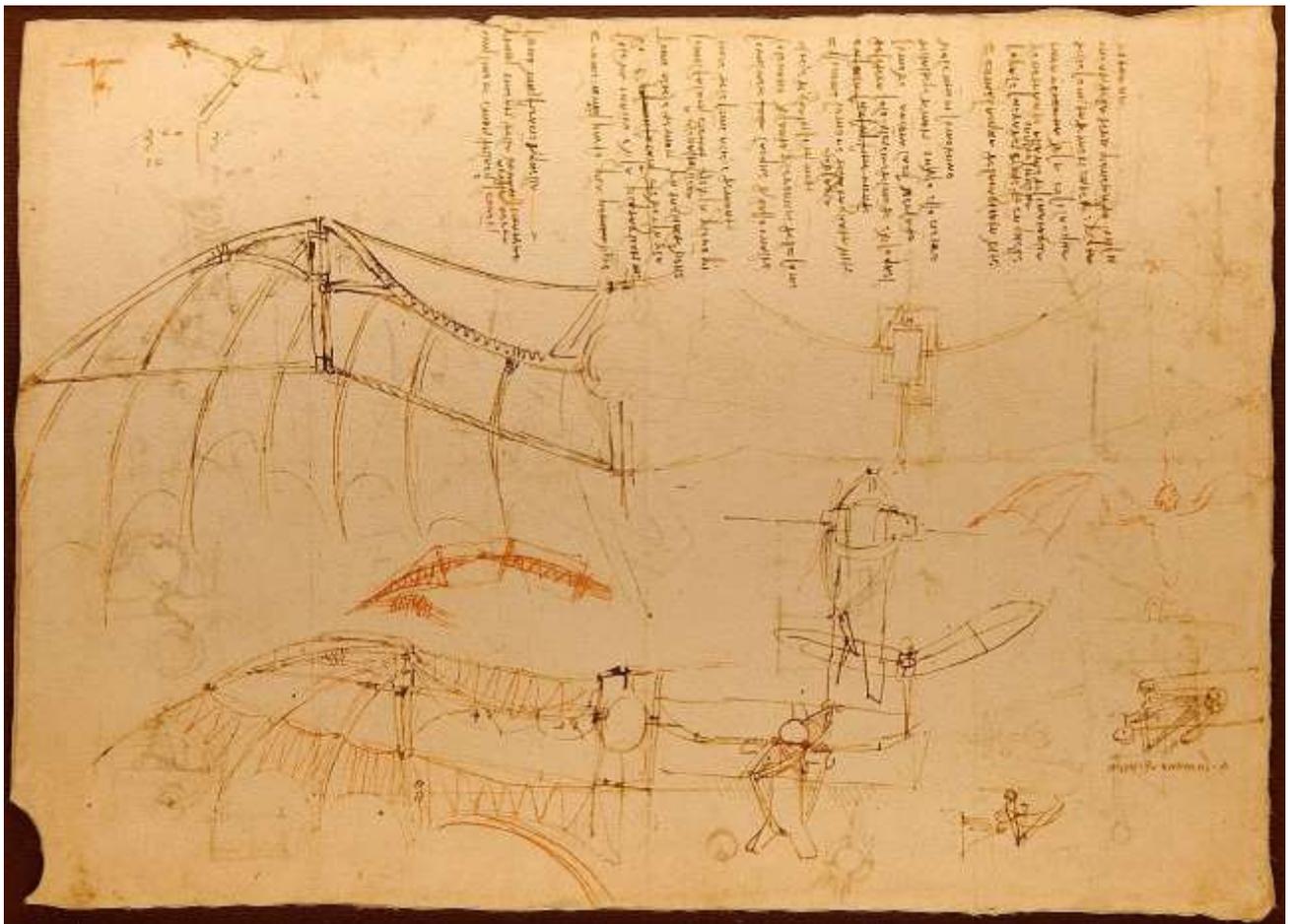
Leonardo da Vinci was fascinated by flight. He spent many hours studying birds soaring over the Tuscan landscape. Legend had it that an eagle hovered over his cradle when he was a baby, a supposed omen of his future genius in the study of aeronautical engineering, (...though perhaps in reality the eagle was merely spying a potential meal). Among the hundreds of stunning drawings of Leonardo, collected together in the so called Codex Atlanticus now kept in the Biblioteca Ambrosiana, Milan, is an astonishing sketch of the first known concept of flight by means of a rotating wing. Leonardo was convinced that a machine could by this means raise a person into the air and that human flight by means of a machine was possible. His prescient genius was over four centuries ahead of the Wright brothers and over four and a half centuries ahead of the development of the first helicopter. The statement, written in his brilliant coded mirror imaged, left handed writing, “As much pressure is exerted by the object against the air as by the air against the body”, has a spine chilling resonance with Isaac Newton’s third law of motion, developed well over two centuries later, that “for every action there is an equal and opposite reaction”.

Leonardo did not have the benefit of centuries of scientific and aeronautical engineering enlightenment that we have today. Though knowledge of the physics behind powered flight and the necessary power to weight ratios required for it, did not exist in the Fifteenth century, Leonardo understood that by a certain “spirit” of nature flight was possible - and that this spirit was no mystical divine force, but rather a natural phenomenon that with time, and study, could be understood by humanity, and by this understanding human flight would one day be possible. Newton himself acknowledged that he could only have seen further than others by standing on the shoulders of the giants of centuries past. Indeed did Leonardo himself stand on the shoulders of giants that preceded him?

Archimedes of Syracuse, in the Third century B.C designed a water pump that lifted water against gravity by means of a pipe with a screw shaped internal surface, operated by hand. We know that the Italian Renaissance was a time of intense interest and study in long lost knowledge of the ancient world. Had Leonardo had access to the writings of Archimedes, and thus gain some measure of inspiration from Archimedes' screw?

It is a truism that virtually every human idea has been thought of before in some form or another, "there is nothing new under the sun". The preservation of human "memes" is imperfect indeed. Knowledge is not always relentlessly progressive. It can be won and then lost again, only to be rediscovered in a later age, "What was, will be again, what has been done will be done again".

The clever commonly used intravenous regional anaesthetic technique, known as the "Bier's Block" might be considered a relatively recent invention. Surprisingly however this technique is well over a century old! It was first carried out by the German surgeon Dr August Karl Bier in 1908. It rapidly gained widespread popularity at the beginning of the 20th century, before falling into a long period of disuse. The technique was briefly "rediscovered" by Holmes in the early 1960s, but by the 1970s had again faded in popularity, and memory, before being "rediscovered" yet again in a 1994 study by Lowen and Taylor. No doubt the technique will again lose favour at some point in the distant future, only to be rediscovered all over again.



*Studies for human powered flight, c. 1488, Leonardo da Vinci,
Codex Atlanticus Biblioteca Ambrosiana, Milan*

BIER'S BLOCK- (INTRAVENOUS REGIONAL ANAESTHESIA OF THE UPPER LIMB)

Introduction

Bier's Block (or intravenous regional anaesthesia) is a local anaesthetic technique for surgical procedures on the upper limb where a local anaesthetic agent is injected intravenously proximal to a double inflated blood pressure cuff.

Prilocaine is the referred anaesthetic agent.

The cuff should remain inflated for a **minimum of 20 minutes** from the time of injection of the prilocaine.

Cuff inflation time should not exceed **60 minutes**.

The procedure should only be undertaken by suitably trained and experienced staff, including appropriate numbers of staff.

Advantages:

Advantages include:

1. Reliable
2. Cost effective
3. Safe (provided it is administered by appropriately trained and experienced staff)
4. Simple to administer
5. Avoids the need for a general anaesthetic

Disadvantages:

Disadvantages include:

1. Limb ischemia:
 - This limits the duration of the procedure to around 1 hour.
2. Pain at the tourniquet application site, (again limits procedure to around 1 hour).
3. Not suitable for young children (< 5 years of age)
4. Requires good patient cooperation:
 - Unsuitable for very anxious/ uncooperative/ confused patients

See also separate documents on:

- **Prilocaine (in Drugs folder)**

- **Intralipid Therapy (in Toxicology folder)**
- **Methemoglobinemia (in Toxicology folder)**

History

Somewhat surprisingly the technique of intravenous regional anaesthesia is not new.

In fact it was first carried out by the German surgeon **August Karl Bier** (1861 -1949) using procaine in 1908 and became popular around this time, before falling into a long period of disuse.

The technique was briefly “rediscovered” by Holmes in the early 1960s, who used lignocaine but by the 1970s had again faded in popularity, before becoming popular again in the 1990s.

Indications

Bier’s block is suitable for **short painful procedures** of the upper limb, such as:

1. Closed reduction of forearm or hand fractures.
2. Some minor operative procedures.

Contra-indications / Precautions

These include:

1. Significantly anxious / confused / uncooperative patients.
2. Children < 5 years of age
3. Neurovascular compromise
4. Risk from the use of IV local anaesthetic agents, such as:
 - Allergy to local anaesthetic agents
 - Unstable epilepsy
 - Severe liver disease
 - Significant heart block (2nd or 3rd degree)
 - Sickle cell disease
5. Severe vascular disease
6. Supracondylar fractures:

- These are **not** suitable for Bier's block due to their proximity to the tourniquet and the inability to assess neurovascular status following manipulation.

Complications

These include:

1. Limb ischemia:
 - If cuff remains inflated for longer than recommended times.
2. Adverse reactions to prilocaine:

This will usually only be seen in cases of **inadvertent cuff failure/ deflation** in particular before 20 minutes.

CNS toxicity usually precedes CVS toxicity for prilocaine and lignocaine.

(CVS toxicity may precede neurological toxicity with bupivacaine, which should never be used for a Bier's block).

Systemic effects of prilocaine toxicity include:

- **Neurological:**
 - ♥ Restlessness
 - ♥ Paraesthesia, especially circumorally.
 - ♥ Tinnitus
 - ♥ Seizures
 - ♥ Reparatory arrest
- **Cardiovascular:**
 - ♥ Hypotension
 - ♥ Bradycardia.
 - ♥ Conduction delays
 - ♥ Cardiac arrest
- **Methemoglobinemia**

Preparation

The procedure should be done in an appropriately monitored and equipped resuscitation room.

1. Consent:
 - All patients require informed consent for this procedure.
For children, informed consent should be obtained from the parents.
2. Baseline routine observations:
 - Include a **weight** (actual or at least best estimate) on an observation chart, (needed to calculate the dose of prilocaine).
3. Ensure there are no **contraindications** to the procedure, (as listed above)
4. Fasting:
 - Ideally there should be 4 hours prior to the procedure, though this is not essential.
5. Staff requirements:

Minimum requirements include:

 - **Two doctors**
 - ♥ One doctor is required to perform the procedure and another to perform/ supervise the Bier's anaesthetic.
 - **One nursing staff**
 - ♥ To record, give anesthetic solution, assist as required
6. Bier's machine check:
 - Test the valves and gauges.
 - Check all cuff connections and manometer for leaks.
7. Pre-medication:
 - This is useful (especially in children) to alleviate anxiety and provide some initial analgesia.
 - ♥ Titrate IV opioids in adults
 - ♥ Intranasal fentanyl is a good option in children.
8. **Prilocaine:**

Use prilocaine ("Citanest") 0.5 % solution.

Prilocaine has a longer duration of action and lower systemic toxicity than lignocaine

Calculate the appropriate prilocaine dose, and draw up in a syringe ready to deliver.

- **Dose for arm blocks is 2.5 mg/kg = 0.5ml/kg of the 0.5 % solution.**
 - **Maximum dose= 5mg/ kg (=1ml/kg) up to 50 mls**
 - **Never use solutions containing adrenaline or bupivacaine.**
9. If planning on using an image intensifier or mobile/ gantry radiography:
- Ensure that the radiography equipment is available and set up
 - Ensure that a radiographer is available
 - Ensure that lead gowns are available for staff
10. Apply monitoring:
- Blood pressure, SaO₂ and consider ECG monitoring.

Procedure

1. Insert IV cannulae in the dorsum of **both hands**.
 - IV cannulae that are placed too proximal, e.g. in cubital fossa veins are less likely to be effective and more likely to cause systemic toxicity.
2. Velband padding:
 - Apply several layers of **Velband** around upper arm of the affected limb to provide padding under the tourniquet and reduce risk of tourniquet not transmitting the desired pressure to the arm
3. Secure the pneumatic cuff over the Velband.
4. Elevate the arm:
 - Elevate affected arm above the level of the heart for **2 minutes** to allow for **passive venous drainage** of blood under gravity.
5. Inflate **both** cuffs of the pneumatic tourniquet **100 mmHg** above the systolic blood pressure (but less than 300 mmHg).
 - **Confirm that the arterial pulse is absent.**
 - **Note the time that the cuffs were inflated.**

6. Inject the **0.5 % prilocaine** via the IV cannula in the affected limb slowly over **2 minutes**.
7. Remove the IV cannula on the injured side:

- Following administration of the prilocaine, remove the IV cannula on the injured side and apply **firm pressure** over IV site for 2 - 3 minutes until venous oozing ceases (it tends to ooze longer than normal).

There is little advantage of leaving this cannula in situ as it is rare to need a second dose of IV local anaesthetic, and the prolonged oozing may compromise timely plaster application.

Note that the **contralateral IV cannula must be left in-situ** until well after the Bier's block is finished to enable IV access should complications such as seizures or arrhythmias occur.

This IV access will also allow for additional doses of benzodiazepines or opioids to be given.

8. **Remain vigilant throughout the procedure for possible cuff failure.**

9. Assess for evidence of analgesia:

- **Maximum anaesthesia occurs in 5-10 minutes.**
- **The adequacy of analgesia should always be checked before commencing any manipulation or procedures.**

Look for:

- Mottled skin, (a normal response)
- Absence of pain on mobilization of the affected limb.

10. Perform the required procedure:

- For reduced fractures apply an initial plaster after reduction is deemed satisfactory.

11. Small additional doses of IV benzodiazepine for anxiolysis or small aliquots of opioids in case of pain may be administered

12. If immediate radiography is available re X-ray:

- If the position is unsatisfactory, remove the plaster and re-attempt reduction.

GAMP may be necessary if satisfactory reduction cannot be achieved.

13. The cuff should remain inflated for a **minimum** of **20 minutes** from the time of injection of the prilocaine.
14. When the manipulation and POP has been completed, the cuff can then be deflated as a “stat” manoeuvre.

It is not necessary to release and reinflate the cuff repeatedly.

15. Cuff inflation time should **not** exceed **60 minutes**.

Cuff deflation

In the event of inadvertent cuff deflation:

1. **Reinflate the cuff immediately.**
2. Observe the patient closely for possible signs of prilocaine toxicity.
3. In case of serious neurological and/ or CVS toxicity:
 - Follow standard resuscitation algorithms.
 - Consider **intralipid therapy** if standard algorithms are unsuccessful

For the treatment of **Methemoglobinemia** see **Toxicology folder**.

Post procedure care

1. Patients should be observed in the Emergency Department / SSU for at least **one hour** following completion of the procedure.
2. Prior to discharge, it must be demonstrated and documented that sensation and movement has returned to the affected limb (within the limits of the injury).

Disposition:

Elderly / debilitated patients may require admission for ongoing analgesia and allied health assessment, e.g. physiotherapy, occupational therapy.

Consider admitting elderly patients if the cause of the initial fall is unclear or requires further investigation.

AUGUST BIER



A. Bier

Dr August Karl Bier (1861-1949).

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