Comparative Study Between Systemic Balanced Analgesia, Continuous Femoral Perineural Analgesia and Continuous Intra-Articular Analgesia for Primary Reconstruction Surgery of The Anterior Cruciate Ligament of The Knee

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Abstract:

Introduction. The aim of this prospective study was to compare the analgesic efficacy of three techniques for knee ligamentoplasty and quadricipital deficit with a view to early physiotherapy.

Hypothesis. Continuous intra-articular analgesia and well-managed systemic analgesia could replace continuous femoral peri-nerve analgesia in resource-limited countries.

Material. - We included 165 patients undergoing primary reconstruction of the anterior cruciate ligament of the knee. All patients underwent spinal anaesthesia. The first group, systemic analgesia (SA), received balanced systemic analgesia postoperatively for a minimum of five days, based on Paracetamol, Diclofenac and a morphine PCA. In addition to the systemic analgesia already described, the second group, femoral analgesia (FA), will benefit from a femoral peri-nervous catheter in the crural position. 20 ml of bupivacaine at 0.125% concentration is injected; maintenance is set up immediately with a continuous flow of 8 ml/h for 36 h. The third intra-articular analgesia (IAA) group received, in addition to the same systemic analgesia, an infusion through an epidural catheter of 20 ml of 0.125% bupivacaine, followed by maintenance with 8 ml/h of the same local anesthetic via an electric syringe pump for 36 h. Cumulative morphine consumption, pain estimation at rest and on mobilization using a numerical scale (EN) from 1 to 10, and quadriceps deficit were evaluated.

Results. - Morphine consumption was lower in the AF group and the difference was statistically significant with an F = 3.539(2) and a p = 0.031. A mean difference of 6.12 ± 2.41 between the AS and AF groups with a significant p = 0.012, a mean difference of 1.67 ± 2.41 with a non-significant p = 0.49 between the AF and AIA groups and a mean difference of 4.45 ± 2.31 with a p = 0.056 at the limit of significance between the AS and AIA groups. Analgesia in the femoral peri-nerve group was more effective, with a reduction in mean EN compared with the other two groups. Efficacy was statistically significant at H4, then from H24 to H36 compared with systemic analgesia, but not significant compared with intra-articular analgesia. Intra-articular analgesia was only significantly effective compared with systemic analgesia at H36. Quadriceps muscle deficit is an incident specific to femoral blocks.

Discussion. - This study suggests that a continuous intra-articular or even a well-conducted systemic analgesia provides satisfactory analgesia for knee ligamentoplasty, compared with a more effective

femoral peri-nerve. The quadricipital lock absent in intra-articular treatment could be an advantage in speeding up functional recovery.

Introduction:

Considered one of the most painful, anterior knee ligament reconstruction surgery requires an effective, optimal and well thought-out postoperative analgesic strategy, depending on the means available.

For our purposes, the most commonly used open technique is the Kenneth Jones (K J), which consists of a free bone-tendon-bone transplant using the middle third of the patellar tendon. (1).

Pain management in the immediate post-operative period and during rehabilitation sessions is therefore a key to success, not forgetting patient comfort and satisfaction, which are increasingly important.

Several classic and conventional analgesic techniques were discussed and compared, taking into account the evolution of technical and pharmacological means in anesthesia and analgesia.

The aim of analgesia is twofold: on the one hand, to improve patient comfort, and on the other, to accelerate postoperative functional recovery. (2)

Peripheral regional anesthesia and analgesia of the lower limb is currently the gold standard in knee surgery (3). Several analgesic techniques and procedures are compared, including femoral nerve block and intra-articular analgesia.

Femoral nerve block, as an analgesia technique, has proved its effectiveness in general knee surgery and has become the gold standard (3, 4) .

Continuous administration via catheter in major knee surgery is justified on two grounds: the deep branches (nerves of the quadriceps femoris and saphenous vein) are involved in the innervation of the knee joints (5) and the reflex contracture of the quadriceps muscle, which is extremely painful and limits post-operative rehabilitation. This explains the interest of the femoral catheter for analgesia and rehabilitation in this context (6). The usual basic flow rate is 0.1 ml/kg/h. It can be modulated secondarily according to the quality of analgesia obtained (3).

Intra-articular analgesia is an analgesia technique mainly developed for endoscopic knee surgery, but with indications for all joints (2, 3). It represents an alternative to femoral peri-nervous block for analgesia during knee surgery. Defined as the injection of analgesic molecules into the joint capsule to treat acute pain, and conceptually based on the presence of receptors or axonal endings of nociceptive neurons (2) sensitive to various stimuli, tension, traction, and particularly to inflammatory mediators.

Intra-articular injection of bupivacaine at the end of the procedure has been shown to be beneficial, both in terms of pain reduction in the first 6 hours, and in terms of sparing associated analgesics (7-9).

The extension of intra-articular analgesia by means of a catheter, positioned by the surgeon at the end of the operation, is a simple technique that has proved effective (10).

Several recent studies have compared postoperative analgesia by continuous intra-articular injection to continuous femoral block (11-13) and other techniques, as well as the influence on discharge ability (14) feasibility in the outpatient setting (15, 16) and the frequency of postoperative discomfort symptoms (17).

Intra-articular analgesia of the knee remains a dreaded technique, despite its many advantages.

The aim of our work is to compare it with peri-nervous femoral analgesia, and with systemic balanced analgesia. The objectives of this prospective randomized study are:

- The analgesic efficacy of each technique.

- Degree of quadriceps deficit

Materials and methods:

This was a prospective, comparative, randomized, single-center study conducted over three years in the orthopedics and traumatology unit of the Sétif hospital.

Population:
A population of adults admitted during the study period for primary reconstruction surgery of the anterior cruciate ligament of the knee.

Inclusion criteria:
- Consenting patients.
- Admitted for rupture of the anterior cruciate ligament of the knee.

Exclusion criteria :
- Patient refusal
- Surgical revision
- Alternative indications for ALR
  - Local or systemic infection,
  - Patient on anticoagulants,
  - Allergy to local anaesthetics...
- Contraindications to non-steroidal anti-inflammatory drugs

Population size :
During the study period, 173 patients were admitted for knee ligamentoplasty, of whom eight were excluded: five refused spinal anaesthesia, two repeat surgeries and one contraindication to diclofenac.
The minimum number of cases required for each group was 33.

Methods :
A total of 165 cases were included, divided into three study groups by drawing lots:
- 1st group (AS): patients receiving systemically balanced analgesia (paracetamol + diclofenac + PCA morphine)
- The 2nd group (AF): patients receiving, in addition to "paracetamol, Diclofenac and PCA morphine", continuous femoral peri-nervous analgesia.
- The 3rd group (AIA): patients receiving, in addition to "paracetamol, diclofenac and morphine PCA", continuous intra-articular analgesia.

Study protocols :
Intra-anaesthetic stage :
All patients underwent spinal anesthesia with 12.5 mg bupivacaine 0.5% + 25 δ clonidine.
Antibiotic prophylaxis with 2g cefacidal is administered.

Procedures :

After surgery, patients were clearly informed of the three analgesic procedures, and informed consent was obtained:

- The first group (AS) will receive systemically balanced analgesia postoperatively for a minimum of five days, based on :
- Paracetamol at a dose of 1g every 6h per os.
- Diclofenac 50 mg every 12 hours per os.
- And a morphine PCA with a concentration of 1mg /ml and a refractory period of 7 min.
- In addition to the systemic analgesia already described, the second group (AF) will benefit from a femoral peri-nervous catheter in the crural position for a minimum of five days, with the same dosage:

After locating the femoral nerve by ultrasound, and dilating the space with a few milliliters of saline, a 5-8 cm catheter is inserted.

20 ml of bupivacaine at a concentration of 0.125% is injected fractionally through the anti-bacterial filter;

Maintenance is started immediately with a continuous flow of 8 ml/h of the same anesthetic via an electric thumb syringe, for 36 h.

- The third group (AIA) will receive, again in addition to the same systemic analgesia already described, through an epidural-type catheter placed intra-articularly by the surgeon at the end of the procedure after closure of the joint capsule and mounted 5 to 8 cm and securely fastened.

20 ml bupivacaine 0.125% is injected through the antibacterial filter 10 to 15 min before deflating the pneumatic tourniquet, with the Redon drain still clamped. Maintenance is also started immediately with 8 ml/h of the same local anesthetic via an electric syringe pump for 36 hours.

Intra-articular catheters are practically removed at the same time as the Redon drain at D2 post-op, as are peri-nerve catheters.

Intravenous analgesia (paracetamol + diclofenac) is continued for a minimum of five days, beyond which the continuation of analgesic treatment is self-controlled.

Surgical technique :

the Kenneth Jones (K J) open technique is the most widely used, involving a free bone-tendon-bone transplant using the middle third of the patellar tendon (1) A pneumatic tourniquet was routinely used.

Data from :

The following criteria were collected prospectively during hospitalization and after discharge home:

- Immediately postoperative and until catheter removal:
  - Quantitative: cumulative morphine consumption
  - Qualitative: estimation of pain at rest and on mobilization using a numerical scale (EN) from 1 to 10
- Remotely, up to the 5th day (by telephone):
  - Estimation of pain by EN at rest and on mobilization

- quadriceps deficit.

Data were collected on a data sheet at h2, h4, h6, h8, h12, h16, h20, h24, h28, h36, h2, h3, h4 and h5. (T0: injection of local anesthetic for both the AF and AIA groups, and the patient's installation at the post-operative level for the AS group).

Statistical analysis :

Results are analyzed using SPSS statistics 26 software. We use both descriptive and analytical statistical techniques.

Descriptive statistics :

- Tabular and graphical presentation.
- Reduction parameters (mean and standard deviation).
- Frequency and percentage for qualitative variables

Analytical techniques :

Statistical significance tests for the comparative study :

- Reduced deviation test for comparing proportions and means.
- ANOVA variance test for comparison of more than two groups, completed by post-hoc tests.
- Chi-square test for repetition comparison.

Results:

Population :

Over the study period, 165 patients were included in the study protocol, divided by random selection into three groups of 55 patients. Their characteristics are reported in Table 1

The average age of our patients was 30.00 ± 7.30 years , with extremes ranging from 17 to 52 years. There was a clear male predominance, with 97.6% men (n= 161) and 2.4% women.There was no significant difference between the three groups for the initial criteria

Table : Demographic data by study group.

Groups	Total (N = 165)	Systemic balanced analgesia(n =55)	Femoral peri-nerve (n=55)	Continuous intra-articular (n=55)	P
Age	30,00 ± 7,30	29.36 ± 6.745	30.16 ± 7.932	30.47 ± 7.280	0.716
Gender : Male : Female :	 (161) 97,6% (04) 2,4%	 33,5% (54) 25% (01)	 32,9% (53) 50% (02)	 33,5% (54) 25% (01)	0,774
ASA : ASA 1 : ASA 2 :	 (158) 95,8% (07) 4,2%	 (54) (01)	 (52) (03)	 (52) (03)	0,551

Pain assessment :

Postoperative pain assessment, at rest and during movement, using a numerical scale from 0 to 10, was collected repeatedly from the second hour to the fifth day .

Assessment of pain at rest:

From H2 to D5 post-op, the means with standard deviations of the EN are summarized in Table 2 with comparisons by study group and statistical significance. An illustration is shown in Figure 1.

Figure : Average EN at rest by group
(*): $p < 0.05$ between AS and AF groups
(†): $p < 0.05$ between AS and AIA groups

Table : Means with standard deviations of EN at rest by group

	Total	AS Group	AF Group	AIA Group	p
H2	0,72(1,66)	0,67(1,41)	1,08(2,31)	0,44(0,99)	NS
H4	2,19(2,10)	2,45(2,21)	1,65(1,89)	2,42(2,12)	**NS 0.084**
H6	3,52(2,32)	3,50(2,39)	3,12(2,38)	3,91(2,16)	NS
H8	3,54(2,49)	3,52(2,47)	3,16(2,39)	3,91(2,59)	NS
H12	2,29(2,26)	2,58(2,36)	2,27(2,35)	2,04(2,26)	NS
H16	1,63(1,92)	1,98(2,11)	1,49(1,95)	1,42(1,68)	NS
H20	1,38(1,79)	1,60(1,79)	1,18(1,64)	1,35(1,93)	NS
H24	1,11(1,55)	1,49(1,64)	0,69(1,30)	1,11(1,59)	**0,034**
H28	0,90(1,36)	1,24(1,52)	0,59(1,08)	0,85(1,36)	**NS 0.063**
H36	0,80(1,56)	1,26(2,04)	0,46(1,22)	0,61(1,13)	**0,03**
J2	0,87(1,43)	1,06(1,53)	0,75(1,41)	0,78(1,36)	NS
J3	0,61(1,29)	0,62(0,86)	0,45(1,13)	0,72(1,72)	NS
J4	0,57(1,38)	0,60(1,25)	0,20(0,56)	0,84(1,85)	NS
J5	0,57(1,48)	0,69(1,36)	0,41(1,33)	0,58(1,72)	NS

Assessment of pain on movement:

The averages of EN to movement (small thigh flexions and external or internal rotation) from H2 to D5 postoperatively are summarized in the Table 3 These averages, compared by group, are shown schematically in Figure 2.

Table : Means with standard deviations for EN in movements by group

	Total	AS Group	AF Group	AIA Group	P
H2	0,92 ± 1,97	0,95±1,67	1,30 ± 2,76	0,58 ± 1,30	NS
H4	2,78 ± 2,44	2,87 ± 2,546	2,19 ± 2,20	3,20 ± 2,49	NS
H6	4,35 ± 2,37	4,26 ± 2,459	4,08 ± 2,50	4,69 ± 2,16	NS

H8	4,15 ± 2,58	4,00 ± 2,584	3,80 ± 2,44	4,60 ± 2,70	NS
H12	2,90 ± 2,33	3,26 ± 2,48	2,53 ± 2,07	2,87 ± 2,39	NS
H16	2,22 ± 2,25	2,62 ± 2,45	1,98 ± 2,12	2,05 ± 2,16	NS
H20	2,14 ± 2,17	2,38 ± 2,09	1,96 ± 2,20	2,05 ± 2,25	NS
H24	1,89 ± 1,98	2,34 ± 1,99	1,42 ± 1,84	1,87 ± 2,03	**NS 0.065**
H28	1,57 ± 1,80	1,84 ± 1,77	1,14 ± 1,40	1,69 ± 2,07	NS
H36	1,35 ± 1,95	1,76 ± 2,26	0,85 ± 1,52	1,35 ± 1,88	**NS 0.094**
J2	1,64 ± 2,09	1,85 ± 2,16	1,63 ± 2,22	1,44 ± 1,93	NS
J3	1,32 ± 1,90	1,38 ± 1,40	1,20 ± 2,15	1,34 ± 2,16	NS
J4	1,19± 1,72	1,23 ± 1,62	0,73 ± 1,11	1,52 ± 2,12	**NS 0.091**
J5	1,17 ± 1,89	1,40 ± 1,85	0,95 ± 1,83	1,10 ± 1,98	NS

Figure : EN averages for comparative movements by study group
(*) = p < 0.05 between AS and AF groups
(†) = p < 0.05 between AF and AIA groups.

Morphine consumption:

Morphine consumption according to the three study groups is shown in Table 4.
Consumption was lower in the AF (femoral peri-nerve) group and the difference was statistically significant with an F = 3.539(2) and a p = 0.031.
The post-hoc test shows a difference in mean of 6.12 ± 2.41 between the AS and AF groups with a significant p = 0.012, a difference in mean of 1.67 ± 2.41 with a non-significant p = 0.49 between the AF and AIA groups and a difference in mean of 4.45 ± 2.31 with a p = 0.056 at the limit of significance between the AS and AIA groups.

From H2 to H36, morphine consumption fluctuated between the three study groups with different degrees of significance. Figure 3.

Table : total morphine consumption

Groups	Average	N	Standard deviation
Systemic balanced analgesia group	18,52	55	14,42
Femoral peri-nerve	12,40	47	10,29
Continuous intra-articular	14,07	55	11,08

Total	15,13	157	12,34

Figure : Average morphine consumption by group
(*): $p < 0.05$ between AS and AF groups
(†): $p < 0.05$ between AF and AIA groups
(‡): $p < 0.05$ between AS and AIA groups

Quadriceps muscle deficit:
Of the 165 cases, 06 were missing.
20 cases of quadriceps deficit, i.e. 12.6%. All were observed in the AF group ($p = 0.000$) (incident specific to femoral blocks) ;

Discussion:
Pain assessment :
Assessment of postoperative pain, at rest and on movement, using a numerical scale from 0 to 10, was collected repeatedly from the second hour to the fifth day.
The results were stratified into three increasing grades of pain, as follows:
- From 0 to 3 on the EN was considered mild pain;
- From 4 to 6 on the EN was judged as moderate pain;
- And 7 to 10 on EN was considered severe pain.

From the overall analysis of the results, several strong points are worth discussing:

Degree of pain following knee ligamentoplasty:
In our series, postoperative pain following ACL repair of the knee is moderate, lasting 3 days.
The percentage of pain judged severe did not exceed 15.6% at rest and 22.20% with movement at H8, while the percentage of pain judged mild was in the majority, reaching 96.5% at rest and 90% with movement.
In the literature, pain following ligamentoplasty is classified as severe lasting more than 48 hours (2, 18, 19).

Pain kinetics :
From H0 to H36, pain kinetics in our series followed a similar pattern in both study groups compared to the AS group considered as control; with a higher fraction of mild pain in these groups but without statistical significance;
This may be due to the low concentration of the AL used, and/or the frequency of mechanical incidents encountered, a source of secondary failure.
At D2, an increase in moderate pain was observed in both the AF and AIA groups, testifying to even the slight contribution of ALR in our series.
From H0 to H8, the percentage of mild pain decreased and the mean EN increased. This is explained by the gradual lifting of the sensory block and the gradual reduction in the number of patients still blocked under spinal anesthesia.
Maximum pain was observed at H6 and H8, which may be explained by pain rebound after locoregional anaesthesia. In our series, this was probably due to pain rebound after lifting of the spinal

anesthesia sensory block. Similarly, the rebound observed at D2 in the AF and AIA groups after the scheduled cessation of continuous LA infusion.
In the literature, this rebound can increase EN by 2 [1.6-2.4] (20).

From H8 to D5, pain diminished progressively, reaching a minimal average at D4, D5 postoperatively; a reduction probably helped by the impregnation of pain receptors by analgesics and local anesthetics; but also, by a natural reduction in pain intensity, apart from the exacerbations that could appear during accelerated rehabilitation sessions, unfortunately not adopted by our orthopedic department.

The model adopted is classic, with immobilization in a Zimmer splint for 21 days; this immobilization is one of the analgesic means used in orthopedic surgery. (21).

Contribution of ALR procedures for pain:

Analgesia in the femoral peri-nerve group was more effective, with a reduction in mean EN compared with the other two groups.
Efficacy was statistically significant at H4, then from H24 to H36 compared with systemic analgesia, but not significant compared with intra-articular analgesia.
Intra-articular analgesia was only significantly more effective than systemic analgesia at H36 ; this may be due either to the low concentration of LA (0.125), or to the absence of morphine-type adjuvants that could potentiate analgesia, or to the absence of associated infiltration of the surgical site.
The efficacy of femoral block in knee surgery is indisputable in the literature, which still considers it the gold standard; this is the case of the Williams studies(22) and Frost(23) and many other studies (24-28).
Continuous block is more efficient than single or sequential injection(29, 30) .
In a meta-analysis of peripheral nerve blocks versus morphine consumption, the authors conclude that peri-nervous catheters provide superior analgesia to opiates for any location.(31) ;
In the Harris study, comparing a femoral nerve block group with a control group, pain scores were significantly reduced only at H24 post-operatively(24) ;
In Ren's 2015 study(32)comparing 280 patients in two study groups: continuous femoral block and morphine PCA, for knee arthroplasty, the effectiveness of continuous femoral block during the procedure was significantly superior in terms of pain score and morphine consumption.
But other studies also found no significant reduction in pain scores compared with control groups; such as the Matava study (33)and O'Leary(34).

In the literature, the efficacy of intra-articular knee analgesia also varies from one study to another.
In fact, several methods of administering LAs and adjuvants have been evaluated;
Infusion of AL solution alone into the joint cavity for analgesia is a rare procedure.
Infiltration of the surgical site and the addition of morphine or other substances to AL was the most debated technique.
In a study comparing the quality of analgesia from an intra-articular injection of 0.5% bupivacaine alone and pethidine alone and their combination, the EVS in the bupivacaine alone group was 20±8 mm at H6 and H12, and the quality and time of analgesia were better in the bupivacaine + pethidine group (35).
In Alford's study comparing a 0.25% bupivacaine infusion with placebo for ACL treatment (36) the median NE (at 2.5) was significantly reduced in both groups compared with a control group (at 4), and

was comparable between the two groups, while the maximum NE (4.5 vs. 6) was reduced in the bupivacaine group.

In the same study, Alford describes a rebound in pain after catheter removal in the bupivacaine group compared with the other two groups.

In Parker's study (37)no significant difference in pain scores was found between the bupivacaine, placebo and control groups (3.33±1.96 vs. 2.93±1.93 vs. 3.93±2.04); apart from greater morphine consumption in the control group.

On the other hand, infiltration of the surgical site and the addition of morphinics to the LA solution gave better analgesia; this was the case in the studies by Imani (35)and HÖher(38)Hoenecke (39)by Karlsson(40)and Koh(41).

In comparison between femoral block and intra-articular infiltration of LA, the literature favors femoral block in terms of pain reduction and morphine sparing (e.g. Dauri studies with resting EN at H12 of 2.4 [SD, 2.2] vs 5.4 [SD, 3.1] and 3.1 [SD, 2.5] vs 6.3 [SD, 2.9] at movement (42)and Iskandar(43)); Or at the same rank with no significant difference (as in the case of Woods (44)Iamaroon(45)and Mehdi (with a median VAS of 20 vs 18 at H4)(46).)

Morphine consumption :

Morphine consumption kinetics :

The morphine consumption curve faithfully follows the two pain kinetics curves at rest and with movement, demonstrating the direct relationship between pain intensity and morphine consumption.

Chia's study showed the relationship between morphine consumption and movement pain (47). Ready's study showed the difference in consumption depending on the surgical procedure, with different mean EVS (48).

Contribution of ALR procedures to morphine consumption:

Femoral perianalgesia provided considerable morphine savings compared with systemic analgesia (6.12±2.41; p = 0.012).

An expected result that parallels the reduction in pain scores in this group.

This saving should perhaps have been greater with a higher concentration of bupivacaine, and with a lower fraction of mechanical incidents causing secondary failure.

In fact, all the studies mentioned above point to a reduction in the consumption of morphine and analgesics;

In a recent meta-analysis, comparing the association of femoral block with systemic analgesia to systemic analgesia alone, the authors conclude that femoral block decreases, but slightly, morphine consumption in the first 24 hours (49).

In a Cochrane database, a meta-analysis looked at femoral block in major knee surgery (50) In 12 studies comparing single-injection femoral block with PCA morphine, the reduction in consumption at 24 hours was -12.86 [-18.65, -7.08] ;

In 08 studies conducted to compare continuous femoral block vs PCA morphine at 24h, morphine consumption was reduced by -16.89 [-24.01, -9.77] ;

Citing Chan's 2013 study in detail (51)where the average difference in 24h consumption was -29.70 [-38.59, -20.81] and Kadic's 2009 study (52) with a mean difference of -13.00 [-20.16, -5.84] , and that of Baranovic in 2011 (53) with a mean difference of -25.00 [-28.68, -21.32].

For the comparison of single-injection femoral block vs PCA morphine at 48h, the total of 11 studies had shown a mean difference of -13.21 [-21.99, -4.44] and of which one study (Chan 2012) had shown a difference of 1.60 [-1.67, 4.87] in favor of the PCA group.

For the continuous block comparison, the total mean difference of the 08 included studies was -19.14 [-27.53, -10.76] ; including Chan's 2013 series where the difference was -36.20 [-48.60, -23.80] , Kadic's went down to -8.00 [-16.52, 0.52].

Intra-articular analgesia resulted in morphine savings of 4.45 ± 2.31 mg with a p = 0.056.
Consumption was lower, especially in the first 06 hours, and from H12 to H24 (especially H16).
Increasing the concentration of LA and/or adding morphine could reinforce this sparing.
Infiltration of the surgical site was often associated with intra-articular infusion, but is now thought to be an analgesia technique in its own right.
Few studies used intra-articular infusion alone as an analgesic technique,
In a meta-analysis of intra-articular analgesia in arthroscopic knee surgery including 20 studies (54)12 studies showed pain relief after intra-articular local anesthesia in at least one of the pain parameters considered, while the other eight studies showed no such improvement.
In 09 studies, morphine consumption was significantly reduced by 10-50% within 4 hours.
Morphine reduction in AIA is a reality. But in Parker's study (37)study, the authors did not find a statistically significant difference in overall morphine consumption between the continuous intra-articular group, the placebo with saline infusion group and the control group;
A single significant difference in morphine consumption with a p = 0.015 was found between the AIA group and the control group from 48 h to 72 h in the time-dependent analysis.
In Joshi's study (8) the analgesia provided by the injection of 20 ml of bupivacaine did not exceed 4 h, and gave a reduction in morphine consumption compared with a control group.
In the same study, morphine alone or combined with bupivacaine reduced morphine consumption and pain scores more, and for longer.
In Milligan's 1988 study (55)AIA with the same volume of 0.5% and 0.25% bupivacaine versus infusion of the same volume of saline showed no significant difference in pain or reduction in analgesic consumption.
Kaeding's 1990 study (56)showed the efficacy of intra-articular injection of bupivacaine in terms of analgesic consumption and pain scores compared with placebo, and a non-significant difference when combined with infiltration of the surgical site.
In Musil's study (57) on 85 ACLs divided into 05 study groups with and without intra-articular injection of a mixture combining bupivacaine + morphine + adrenaline, the authors reported a 29% reduction in morphine consumption compared with the control group.
In Guler's study (58)the authors used a mixture of bupivacaine and morphine intra-articularly and compared their efficacy according to the injection time before or after deflation of the pneumatic tourniquet, and concluded that the reduction in pain scores and morphine consumption was more pronounced in the group after deflation of the tourniquet.

Allen's 1993 study on AIA (59) compared bupivacaine injection alone with morphine alone and the combination of the two; and concluded that the combination was more effective in reducing pain scores and analgesic consumption.

Alford 's study (36) and Hoenecke's study (39)using continuous infiltration of the surgical site after intra-articular injection of AL, found a reduction in morphine consumption, but not significant in the Alford study, and 37%, p < 0.05 in the Hoenecke study.

In comparison between femoral peri-nerve analgesia and intra-articular analgesia, the difference in overall morphine consumption was not significant, except at H8 where the mean difference was 1.06 [0.125 - 1.99], p = 0.027.

Indeed, in our series, the AIA had the advantage in morphine consumption reduction over the peri-nerve, from H0 to H6, then from H16 to H24 but insignificantly, while the peri-nerve had the advantage from H6 to H 16 significantly, and from H24 to H36.

In this reflection, the shortcomings of either technique could perhaps make a difference, namely the improved secondary failure rate of the femoral peri-nerve, or the addition of morphinics to the local anesthetics of the AIA.

In Dauri's study (60)pain scores and analgesic consumption were significantly higher in the continuous intra-articular group than in the continuous femoral block and epidural groups.

In Iskandar's study(43) comparing two groups for femoral and intra-articular ACL, the femoral block provided significantly better analgesia and lower morphine consumption (4.7 ± 2 vs. 13.7 ± 4.5, p < 0.001).

In another study by Dauri in 2009(42)morphine consumption was 3.2 [SD, 2.2] in the continuous femoral block group vs. 6.2 [SD, 2.5]; P < 0.001 in the intra-articular group with surgical site infiltration.

But in Iamaroon's study (45)the difference between femoral block and intra-articular block was not significant in terms of morphine consumption and pain score.

Quadriceps muscle deficit:

The sustained post-operative decrease in quadriceps strength with locoregional analgesia procedures was found, subjectively, exclusively with the femoral peri-nerve, with a fraction of 40.8% in the p <0.0001 group.

This muscular deficit could hinder early physiotherapy.

The absence of this deficit in the AIA group could have been considered an advantage over crural femoral peri-nerve analgesia.

Moreover, femoral block in the adductor canal is beginning to replace the crural approach for the lesser incidence of quadricipital deficit with a view to early physiotherapy (61).

In Dauri's study (42)a statistically significant difference in muscle deficit between the femoral continuous block group and the intra-articular group was defined at H12, p< 0.001, and H 24, p < 0.02.

In Iamaroon's study(45)quadriceps strength in the femoral block group was reduced by 45% vs. 10% in the intra-articular group, with p = 0.013 at 24 hours.

Conclusion:

Peri-nerve AALR really does offer an added benefit in terms of analgesia and morphine sparing, and should therefore be preferred wherever possible.

The theoretical risk of infection and chondrotoxicity of the former, and the simplicity of the latter, make us lean towards systemic analgesia, unless AIA is optimized and supplemented by infiltration of the surgical site.

The choice of one technique or the other therefore depends on material and human resources, and on the risk/simplicity ratio.

In countries with limited resources, these three techniques, and many others, must remain part of the therapeutic arsenal of healthcare personnel, including anesthetists and surgeons.

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