CONTROLLED HYPOTENSION and MINIMAL INFLATION PRESSURE: A NEW APPROACH FOR PNEUMATIC TOURNIQUET APPLICATION IN UPPER LIMB SURGERY



Tuncali B, Karci A, Bacakoglu A, Erdalkiran Tuncali B, Ekin A
Dokuz Eylül University İZMİR

INTRODUCTION

Pneumatic tourniquets are used :

- To reduce blood loss
- To provide optimal operating conditions

However, compression of the tissues under a tourniquet is associated :

- With soft tissue injuries involving muscle, artery, skin and, peripheral nerves

INTRODUCTION

To minimize the risk of complications from excessive inflation pressures :

- The use of wider tourniquet cuffs
- Use of minimal inflation pressures



AIM OF THE STUDY

- Apply "Controlled Hypotension" with a propofol-remifentanil to reach minimal tourniquet inflation pressures

- Compare the effectiveness of this technique with conventional tourniquet inflation pressures in patients scheduled for upper extremity surgery under general anesthesia

MATERIAL & METHOD

- After the Hospitals Ethic Committee approval
- Informed consent was obtained from 36 adult, ASA physical status I–II patients scheduled for upper extremity surgery

Exclusion criteria

- Cerebrovascular disease
- Hypertension
- Renal and/or hepatic insufficiency
- Peripheral claudication
- Severe anemia
- Hypovolemia

MATERIAL & METHOD

Patients were randomized :

- (Group 1, *n 18)*

  Normotensive anesthesia

  Conventional inflation pressures

- (Group 2, *n 18*

  Controlled hypotension

  Minimal inflation pressures (CHAMIP)

A pneumatic tourniquet, 11 cm width, was applied with a layer of "soft-roll" under wrap

MATERIAL & METHOD

- Anesthesia was induction :

  Propofol 1.5–2.5 mg/kg IV bolus

  Remifentanil 0.5 $\mu g \cdot kg^{-1} \cdot min^{-1}$ continous infusion

  Rocuronium (0.8 –1.2mg/kg for endotrach. Intubation

- Maintainance:

  Propofol (4 –5 $mg \cdot kg^{-1} \cdot h^{-1}$)

  Remifentanil (0.3–1$\mu g \cdot kg^{-1} \cdot min^{-1}$) continuous infusion to provide normotension in Group 1 and hypotension (SAP: 80–100 mmHg; MAP 60 mm Hg) in Group 2

MATERIAL & METHOD

- In Group 2, the digital plethysmograph was applied to the 2nd finger to determine the minimal inflation pressure
- The tourniquet was inflated until the arterial pulsations disappeared on the oscilloscope. This pressure was recorded as occlusion pressure
- The limb was exsanguinated with an elastic bandage before tourniquet inflation
- Group 1: Conventional P (250–300 mm Hg)
- Group 2: Min. inflation P (Occlusion P + 20 mm Hg)

MATERIAL & METHOD

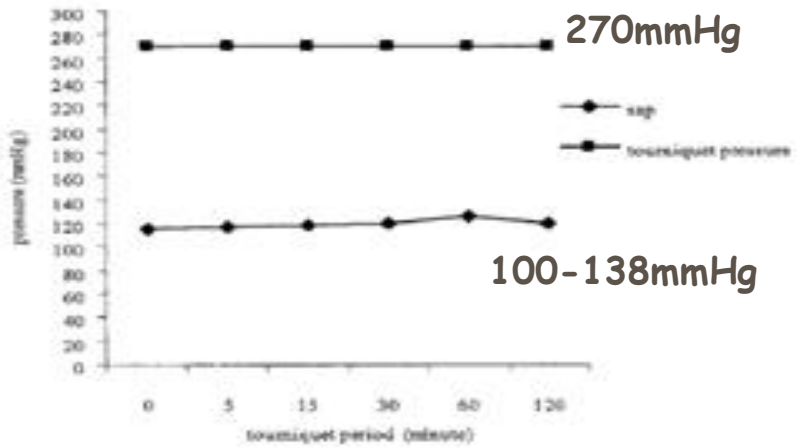
RECORDS

- The circumference of the upper extremity, tourniquet application times
- SAP & tourniquet inflation P at 0, 5, 15, 30, 60, 120 min
- Surgeon satisfaction of the surgical site
- On the day after surgery, the patients were examined for complications such as skin damage, nerve palsies, vascular; and asked whether or not they felt pain, burning, coldness, numbness, or paraesthesia on their hands

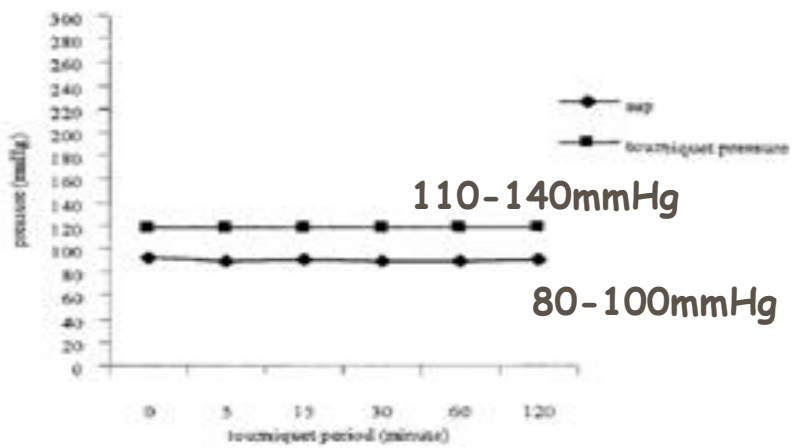
RESULTS

Demographic Data

	Group I (n=18)	Group II (n=18)
Age (yr)	30.2 ± 12.5	33.5 ± 14.2
Gender (M/F)	12/6	14/4
Extr. Circumf.(cm)	28.9 ± 1.7	29.3 ± 1.9
Tourniquet per. (min)	111.5 ± 10.3	116.2 ± ±20.7



Group 1



Group 2

RESULTS



Table 2. Surgeon's Opinion About the Performance of the Tourniquets and Tourniquet Inflation Pressures

	Group 1			Group 2		
	Start	Middle	End	Start	Middle	End
Surgeons opinion						
Satisfactory	18	18	18	18	17	18
Less than satisfactory	0	0	0	0	1	0
Unsatisfactory	0	0	0	0	0	0

Group 1 : 3 paresthesia & numbness (2nd post-op h)
Group II: No such complaint

DISCUSSION

- Cushing (1904) introduced the pneumatic tourniquet
- Safe limits for duration of tourniquet ischemia and inflation pressure are still discussed
- PT are associated with temporary or permanent damage to soft tissues, blood vessels
- So, it seems logical to limit the tourniquet pressure to a level that will provide hemostasis

DISCUSSION

What is done to determine minimal inflation P:

- Levy et al. & Reid at al. using Doppler technique, recommended 202.3 ± 34.2 and 190 mmHg
- Estebe et al. & Hagenouw et al. used pulse oximetry to confirm the absence of the arterial pulse to determine the minimum inflation P
- Newman and Muirhead used SBP ± 35mmHg [Satisfactory with 166 ± 19.6 mm Hg]
- Association of Operating Room Nurses recommended SBP ± 50–75 mmHg to obtain a bloodless field

AORN

DISCUSSION

- It is rational to relate the tourniquet pressure to the patient's blood pressure
- Studies recommending "Minimal Inflation Pressure" were performed with normotensive patients
- It is possible to reach smaller inflation pressures by decreasing the SBP
- Remifentanil offers superior intraop. hemodynamic stability and maintains intact CBF
- With propofol and remifentanil combination blood pressures were successfully maintained at 60mmHg to protect cerebral perfusion pressure

DISCUSSION

With this technique :

- Minimal inflation pressures ranged between 110-140mmHg (mean, 118.2mmHg)
- A bloodless surgical field was obtained almost in all cases
- The surgeon was satisfied with the performance of the tourniquet in almost all cases
- In the case which was rated as "less than satisfactory" oozing started after the 1st h and lasted approx. 15 min and disappeared spontaneously

DISCUSSION

- Paralysis after use of a tourniquet is a well-recognized complication
- Direct pressure of the pneumatic cuff is regarded as the main cause of nerve lesions; ischemic injury may also play a role
- In our study 3
- patients in Group 1 complained of paresthesia, that may have been related to high inflation pressures
- **CONCLUSION:** To reach real minimal inflation pressures with the pneumatic tourniquet we suggest the CHAMIP technique may be a good choice



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