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Kalça Artroskopisi Sırasında Karın İçi Basıncı ve Ayak Perfüzyonunu Etkileyen Faktörlerin Değerlendirilmesi

Evaluation of Factors Affecting Intra-Abdominal Pressure and Foot Perfusion During Hip Arthroscopy

Ali İhsan Kılıç[1], Ortaç Güran[2], Ramadan Özmanevra[3], Onur Hapa[4]

1Siirt Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, Siirt, Türkiye

2Sancaktepe Şehit Prof.Dr. İlhan Varank Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, İstanbul, Türkiye

3Girne Üniversitesi Dr. Suat Günsel Hastanesi, Ortopedi ve Travmatoloji Ana Bilim Dalı, Girne, Kuzey Kıbrıs Türk Cumhuriyeti

4Dokuz Eylül Üniversitesi Hastanesi, Ortopedi ve Travmatoloji Ana Bilim Dalı, İzmir, Türkiye

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Özet

GİRİŞ ve AMAÇ: Bu çalışmanın amacı, kalça artroskopisi operasyonun farklı evrelerinde karın içi basınç ile ayak baş parmağı perfüzyon basıncı ve satürasyon düzeyi parametreleri arasındaki korelasyonu irdelemektir.
YÖNTEM ve GEREÇLER: Femoroasetabular sıkışma tanısıyla kalça artroskopisi yapılan 8 hasta çalışmaya dahil edildi. Karın içi basınç, ayak baş parmağı perfüzyon basıncı, satürasyon indeksi, ayak sıcaklığı, vücut sıcaklığı, kan basıncı, kalp hızı, operasyon süresi, traksiyon mesafeleri gibi parametreler sırasıyla ameliyat başlangıcında (AB), traksiyon uygulaması başlangıcında (TB), traksiyon uygulamasının sonlandığı anda (TSON), traksiyon serbestlendiğinde (TS), kalça fleksiyona alındığında (Flex), kalça ekstansiyona alındığında (Ext) ve ameliyat sonunda (AS) değerlendirildi.
BULGULAR: Ameliyat süresi AS perfüzyon ile ters korelasyon gösterdi (r: -0.729, p = 0.04). TSON karın içi basınç ile TSON satürasyon negatif korelasyon gösterdi (r: -0.84, p = 0.009). TB karın-içi basınç, TB vücut-sıcaklığı ile pozitif korelasyon gösterdi (r: 0.85, p = 0.007). Traksiyon sonunda intraabdominal basınç, operasyon başlangıcı değerden daha düşük ölçüldü (p = 0.02). Traksiyon sonu ayak perfüzyonu ve satürasyon seviyeleri operasyon başlangıcına kıyasla daha düşük ölçüldü (p = 0.001 ve p = 0.002, sırasıyla).
TARTIŞMA ve SONUÇ: Kalça artroskopisi sırasında uygulanan traksiyonun karın içi basıcı, ayak perfüzyon basıncı ve satürasyon değerlerinde düşüşe sebebiyet verdiği sonucuna ulaşılmıştır. Ameliyat süresi ile ayak perfüzyon basıncının negatif korelasyon gösterdiği tespit edilmiştir.
Anahtar Kelimeler: kalça, artroskopi, intraabdominal hipertansiyon, ayak, perfüzyon.

Abstract

INTRODUCTION: The purpose of the present study was to investigate the correlation between intra-abdominal pressure and great toe perfusion pressure and saturation level at different stages of the hip arthroscopy surgery.
METHODS: Eight patients whom were elected to undergo hip arthroscopy for femoroacetabular impingement were included in the study. Intra-abdominal pressure, great toe perfusion pressure, saturation, foot temperature, body temperature, blood pressure, heart rate, operation time, mean traction time were measured at the beginning of surgery (BS), beginning of traction (BT), end of the traction (ET), after releasing of the traction (RT), at hip flexion position(Flex), at hip extension position (Ext) and end of the surgery (End).
RESULTS: The operation time was negatively correlated with End perfusion(r: -0.729, p=0.04). ET Intraabdpress was negatively correlated with ETSaturation (r: -0.84,p=0.009). BT Intraabd press was positively correlated with BT body temp (r: 0.85, p=0.007). Intra-abdominal pressure at the end of traction was lower than that at the beginning of operation (p=0.02). Foot perfusion and saturation level at the end of traction was lower than that at the beginning of the operation (p=0.001 and p=0.002, respectively).
DISCUSSION AND CONCLUSION: As a conclusion, traction during hip arthroscopy decreases intra-abdominal pressure, foot perfusion pressures and saturation. The operation time negatively correlated with foot perfusion pressure.
Keywords: hip,arthroscopy,intra-abdominalhypertension,foot,perfusion.

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Sorumlu Yazar/Corresponding Author:
Ali İhsan Kılıç
Siirt Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Kliniği, Siirt, Türkiye
ali.ihsan.88@gmail.com
ORCID: 0000-0001-7491-6044

O.Güran 0000-0001-6485-5807
R.Özmanevra 0000-0003-0515-4001
O.Hapa 0000-0001-8154-658X

INTRODUCTION

Hip arthroscopy has become increasingly preferred in the treatment of hip diseases due to its successful results (1–4). However, hip arthroscopy has a steep learning curve and is open to some intraoperative complications. Some of these complications are traction-related injuries, iatrogenic chondrolabral injuries, instrumentation breakage and intra-abdominal fluid extravasation (3). Specifically, intra-abdominal fluid extravasation (IAFE) and vascular obstruction at the level of ankle are two devastating major complications of hip arthroscopy (5,6).

The former IAFE has been reported as case series or reports until now, and its symptoms may be so severe that it may lead to cardiac arrest and death due to venous compression with decreased venous return to heart (7). Possible risk factors related with IAFE were reported as higher arthroscopic fluid pump pressure, concomitant iliopsoas tenotomy, normal variant communication between hip capsule and iliopsoas bursa, longer operation time especially in the peripheral compartment (5,8–10). The second devastating major complication is vascular obstruction at the level of the ankle joint. A reported case was treated conservatively and authors supposed the possible mechanism was due to position of the foot and ankle during the time without traction that while hip and knee flexed to 300 to 400, foot has been forced into the dorsiflexion leading to vascular compromise. The authors also stated that the main reason was the compression caused by insufficient padding and fixation with leather boots. They did not correlate this complication with traction or operation time (6).

It has been shown that intra-abdominal fluid extravasation (IAFE) can elevate the intra-abdominal pressure and cause intra-abdominal compartment syndrome in patients who undergo hip arthroscopy (5,11). Increased IAP is related with systemic hypoperfusion, organ failure and death that occur due to cardiopulmonary dysfunction (12). Intraoperative measurements such as oxygen saturation, temperature, blood pressure, peak inspiratory pressure (PIP), pulmonary compliance, and end-tidal carbon dioxide have been studied to detect cardiorespiratory dysfunction during surgery (13,14).

The purpose of the present study was to investigate the correlation between intra-abdominal pressure and great toe perfusion with using saturation level at different stages of the hip arthroscopy surgery. The hypotheses were that traction would increase the intra-abdominal pressure, decrease great toe perfusion, and that flexion during hip arthroscopy would increase the intra-abdominal pressure and decrease great toe perfusion pressure.

MATERIALS and METHODS

Participants

Eight patients who were underwent hip arthroscopy with a femoroacetabular impingement diagnosis between January 2015 and August 2015 were included in this study. Local ethical committee approval was taken before initiation of the study (IRB No: 2015/17-41). Data were collected prospectively while the study was conducted retrospectively. The exclusion criteria were smoking, diabetes mellitus, inflammatory arthropathies, peripheral vascular disease, previously deep venous thrombosis and previous abdominal surgery. Patients did not have any systemic disease or history of medication.

Surgical Technique & Measured Parameters

Hip arthroscopies were performed under general anesthesia with endotracheal intubation in supine position on a formal traction table in a standardized fashion by a single surgeon. Standard anterolateral and anterior portals were created and interportal capsulotomy was performed. Iliopsoas tendon release was not required in any patient. Decompression of impingement was performed and capsulotomy was left open. Arthroscopic pump pressure was maintained at 40 - 60 mm Hg during the entirety of surgery.

Intra-abdominal pressure was measured by transducers (Pressure Monitoring Kit, Bıçakçılar, İstanbul/Turkey) connected to monitors after injection of 50 cc saline through a Foley catheter followed by clamping the drainage line of a urinary bag, as previously described (15). Great toe oxygen saturation, perfusion pressure, and temperature were measured by a pulse oximeter (Covidien Nellcor TM, N-560, Korea). Other parameters, the body temperature, blood pressure, heart rate, operation time and traction time were measured as well. The measurements were performed by an anesthetist.

Each parameter was measured at the beginning of surgery (BS), beginning of traction (BT), end of the traction (ET), after releasing of the traction (RT), at hip flexion (Flex), at hip extension (Ext) and end of the surgery (End). The definitions of these stages are provided in Table 1.

Table1: Definition of hip arthroscopy stages which measurements were recorded.

Stage	Definition
Beginning Of Surgery (BS)	The period between general anesthesia was performed and placing the patient on the traction table
Beginning Of Traction (BT)	The period between the patient is prepared as sterile for the operation and placed on the traction table
End Of The Traction (ET)	The period when the traction was completed and remained at a constant traction power
Release Of The Traction (RT)	Period after the traction is completely released in operation
At Hip Flexion (Flex)	The hip flexion position when the measurements were made during the operation
At Hip Extension (Ext)	The hip extension position when the measurements were made during the operation
End Of The Surgery (End).	The period when the operation is complete and the patient left the traction table

Statistical analysis

Relations between variables were explored by Spearman correlation analysis. Friedman test was used to compare intra-abdominal pressure, toe perfusion, saturation levels at

different time periods of the surgery. If a significant difference was found ($p<0.05$), Bonferroni corrected one on one comparisons were made to find the source of the difference. Data analysis was performed using SPSS (Statistical Package for the Social Sciences) for Windows, version 22.0 (IBM, SPSS statistics). A value of $p<0.05$ was considered as statistically significant.

RESULTS

There were 7 males and one female patients. The mean age of the patients was 27±6 (18-37). Mean operation time and traction time were 162±44 (105-240) min and 103±40 (55-170) min, respectively.

The operation time was negatively correlated with End perfusion (r:-0.729, p=0.04). ET Intraabd press was negatively correlated with ET Saturation (r: -0.84,p=0.009). BT Intraabd pres was positively correlated with BT body temp (r:0.85, p=0.007). Intra-abdominal pressure, foot perfusion, saturation values were compared with each other for different stages of the operation. Intra-abdominal pressure at the end of traction was lower than that at the beginning of operation (adjusted p=0.02). Foot perfusion and saturation level at the beginning of the operation was greater than that at the end of traction (p=0.001 and p=0.002, respectively). Saturation level at hip extension stage was lower than that at the beginning of the surgery (p=0.02).

Results with all parameters were summarized at Table 2.

Table 2: The results regarding all parameters at different stages of performed hip arthroscopies.

Stages of surgery	Perfusion (mmHg)	O_2 Saturation (%)	Intra-abdominal pressure (mmHg)	Body temperature (^{0}C)	Foot temperature (^{0}C)	Blood pressure (systolic/diastolic)	Heart rate (/min)
*BS	0.47±0.2 (0.3-0.6)	97±2 (95-100)	6±1 (5-8)	34±0.8 (34-35)	30±2 (28-32)	102/56±14/13 (89-114/44-67)	79±17 (64-94)
*BT	0.3±0.2 (0.1-0.5)	91±10 (82-100)	6±2 (4-8)	34±0.5 (34-35)	28±2 (27-30)	101/58±17/11 (87-116/48-68)	71±12 (60-81)
*ET	0.1 (0.0-0.1)	78±14 (66-90)	3±1 (2-4)	34±1 (33-34)	27±2 (25-28)	105/54±13/9 (93-117/46-62)	74±7 (68-80)
*RT	0.2±0.2 (0.0-0.4)	86±9 (78-94)	4±2 (2-6)	34±1 (33-34)	26±2 (24-28)	96/48±2/7 (94-99/42-54)	70±10 (62-79)
*Flex	0.2±0.1 (0.1-0.2)	83±9 (75-91)	4±2 (2-6)	34±1 (33-34)	26±2 (24-28)	96/46±9/7 (88-103/40-52)	71±9 (63-79)
*Ext	0.2±0.2 (0.0-0.4)	83±9 (74-91)	3±1 (2-5)	33±1 (32-34)	26±2 (24-28)	97/49±13/14 (85-108/37-61)	68±8 (61-75)
*End	0.2±0.2 (0.0-0.4)	87±11 (77-96)	5±2 (3-7)	33±1 (32-34)	26±3 (23-29)	98/51±13/14 (86-109/39-64)	67±9 (59-74)

**BS:Beginning of the surgery,*

**BT:Beginning of the traction,*

**ET:End of the traction,*

**RT:after releasing of the traction,*

**Flex:Hip flexion,*

**Ext:Hip extension,*

**End:End of the surgery*

DISCUSSION

The main finding of the present study was that the intra-abdominal pressure, foot perfusion pressure and saturation decrease at the end of traction compared with the beginning of the surgery. The risk factors for increased abdominal pressure and fluid extravasation include increased operation time, increased pump pressure and iliopsoas tenotomy during hip arthroscopy procedure (5,8–10). Main symptoms are abdominal pain, distention, hypothermia, shortness of the breath (5). Similarly, Hinzpeter et al. (16) reported that the operation time was positively correlated with the amount of fluid extravasation. Also although it was not statistically significant, the time in traction appears to be protective against fluid extravasation. They tried to explain this with associated ligamentotaxis impairing fluid migration toward the abdomen and relating time without traction and hip flexion are associated with increased fluid leakage. The present study failed to show the association of hip flexion and extension to the intra-abdominal pressures. However, pressure values started to increase while working at the peripheral compartment and came closer to values obtained at the beginning of the surgery. Also Hinzpeter et al. (16) mentioned that the extravasation risk was 6 fold greater in female patients in their study. In our study, we could not evaluate the parameters by gender, since only one of the eight patients was female. This can be considered as one of the limitations of our study.

We did not perform iliopsoas tenotomy to any patient. In addition to the contribution of traction, also not performing tenotomy may had caused a reduce in intra-abdominal pressure.

Regarding increased intra-abdominal pressure measurements; interestingly, a positive correlation was found between body temperature and intra-abdominal pressure at beginning of the traction in this study. Moreover, almost all patients were hypothermic throughout the surgery. Jaekers et al (7) proposed that monitoring of the body temperature is unspecific, because patients may exhibit certain degree of hypothermia due to intravenous infusion of fluid. Additionally, the decrease in body temperature is not always a reported finding (5,11). Intra-abdominal hypertension, which is called when pressure is 12 mmHg or above, is far above the levels that we observed at the present study (7). In another words, probably abdominal pressures did not increase enough to create hemodynamic instability at the present study.

Aguilera-Bohorquez et al (17) revealed that asymptomatic IAFE is not rare in patients who undergone hip arthroscopy. They also found PIP as a useful intraoperative parameter for early diagnosing IAFE during hip arthroscopy. PIP was not used as a parameter in our study.

The second major complication is the occlusion of the vessels at the level of the ankle after hip arthroscopy. Said et al (6) reported a case of occlusion of the tibial, peroneal arteries with presentation of cold foot with pain, paresthesia three days after the hip arthroscopy. Treatment was conservative. Authors proposed the mechanism was forced dorsiflexion of the foot while working at the peripheral compartment with the hip at the semi-flexed position. They did not relate this to traction or operation time, because both were short. In contrast, the present study showed a negative correlation with foot perfusion at the end of the procedure and the operation time, plus foot perfusion, saturation levels were decreased at the end of the traction compared with the beginning of the procedure, not changing at hip flexion stage. Foot and ankle problems developing after hip arthroscopy have been rarely reported in the literature. In the literature, apart from the case report in which vascular obstruction was reported (6), there is a questionnaire study involving 100 patients with complaints in the ankle area after hip arthroscopy (18), in addition to a study that mentions skin irritation and superficial paresthesia due to tight fixation of the foot (19).

Frandsen et al. (18) aimed to describe traction-related problems after hip arthroscopy in their study. They collected data from questionnaires and patient files. The questionnaire included questions that query traction-related problems in groin, at knee and ankle. A total of 100 patients who underwent hip arthroscopy filled out the questionnaire. The proportion of patients with ankle problems related to the traction boot was 37%. The problems in the ankle area included swelling, numbness and pressure spots. Thirty-seven patients stated that they remember the most painful period as the first 10 days after surgery. The authors conclude that well-padded boots are necessary to avoid pressure at ankle area. In addition, minimal amount of traction and total traction time must be kept (18).

In our study, we showed that the perfusion pressure and oxygen saturation in the foot decreased with traction. Considering this information, it should be kept in mind that traction-related perfusion may decrease in patients with vascular disease who will undergo hip arthroscopy. This approach can help prevent complications in this patient group. There are limitations of the present study; firstly, the number of patients is low and study has short-term follow-up, and probably significant correlations may be missed. But, in this study the preliminary results were demonstrated in a limited number of patients. Secondly, although intra-abdominal pressure estimation by bladder pressure measurement is a valid method, it may not still give intra-abdominal pressure, precisely. Thirdly, although we always tried to make the measurements at same stages and time intervals of the surgery with the same operating surgeon, there may still have been slight differences at time intervals of the measurements taken. In conclusion, traction during hip arthroscopy leads to a decrease intra-abdominal pressure, foot perfusion pressure and oxygen saturation. Operation time is negatively correlated with foot perfusion pressure. Intra-abdominal pressure is negatively correlated with foot saturation level. As a future prospect, the results of this study would constitute a basis for further relevant higher level of evidence studies.

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