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RESEARCH ARTICLE

Use of Warmed Irrigation Solution in Arthroscopy: a Systematic Literature Review and a Perspective of Ten Years of Experience in Hip Arthroscopy

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ABSTRACT

The number of hip arthroscopies has rapidly increased worldwide due to the new knowledge of intraarticular hip pathology. This procedure is successful with a low rate of complications but severe. One of the most important, from the anesthetic point of view, is hypothermia, carrying out a physiological response that could be dangerous for the patients. In hip arthroscopies, a warmed irrigation solution has been implemented as a simple, low-cost, and effective method for preventing hypothermia. There is limited literature on hip arthroscopy; therefore, much of the literature is focused on shoulder and knee arthroscopy.

This systematic review of the literature aims to analyze the current evidence of warmed irrigation solutions in hip, shoulder, and knee arthroscopy.

One reviewer searched the following databases: PubMed, Embase, and Cochrane Library. Level I to level IV studies involving hip, shoulder, or knee arthroscopy were included. The results found in the databases were compared, duplicate records were eliminated, and the rest were reviewed for their inclusion by title and abstract. A full-text review of the manuscripts was performed to ensure that all relevant articles, as well as cross-referenced articles, were included.

Eight studies of patients undergoing arthroscopy were included in the qualitative synthesis (6 shoulder studies, 1 hip study, and 1 knee study; 526 patients). Warm irrigation fluid reduced the degree of core body temperature drop and the incidence of hypothermia in 6 studies (5 shoulder studies and 1 hip study).

In conclusion, warming irrigation fluids for shoulder and hip arthroscopy significantly decreased the risk of hypothermia, increased the lowest mean temperature, decreased the maximum temperature drop, and decreased the risk of shivering and hypothermia.

Introduction

In the last two decades, hip arthroscopy has emerged as a less invasive tool to manage intraarticular, and extraarticular pathology, such as femoroacetabular impingement (FAI), labral and chondral injuries, ligamentum teres injuries, iliopsoas impingement, sub-spinous impingement, and the indications continue to expand[1], such as the endoscopic release of the sciatic nerve, a technique which we have implemented as a working group in recent years.

Hip arthroscopy causes less soft-tissue damage, fewer complications, less scarring, a lower risk of infection, and faster recovery time.[2] Still, it also has a complication rate of 0.5% to 5%,[3] and hypothermia is one of them, defined as a decline in core body temperature below 35°C (95°F).[4]

Many anesthesiology publications have described potential surgery-related hypothermia complications, and recent information about this complication related to shoulder arthroscopies has been published.[5] Nevertheless, our publication in 2012 about the incidence of hypothermia in hip arthroscopy is the first description of this problem related to hip surgery,[6] posteriorly performed a prospective cohort using the warmed solution to decrease the incidence of hypothermia.[7]

It is known that hypothermia decreases oxygen supply by peripheral vasoconstriction, impairing both the oxidative and phagocytic capacity of neutrophils[8,9,10,11] and altering tissue regeneration ability, predisposing to infections and limiting the tissue regeneration capacity. It promotes bleeding by affecting platelet activity and the coagulation cascade. Furthermore, it can also raise the risk of cardiovascular events by increasing the adrenergic response.[4,8,9,12,13]

Managing the patient's temperature during shoulder and hip arthroscopy poses unique challenges. Extravasation of irrigation fluid is common and is not just limited to the capsule of a joint,[1,4,15,16] but extravasation of fluid is minimal during knee arthroscopy because the surgical site is distal to the body core. Therefore, warming irrigation fluids during knee arthroscopy may not minimize the risk of hypothermia, decrease the drop in temperature, increase the lowest temperature, or reduce the risk of shivering. [5]

This systematic review of the literature aims to analyze the current evidence of warmed irrigation solutions in hip, shoulder, and knee arthroscopy.

Methods

Literature search strategy:

A systematic review of the literature regarding warmed irrigation solutions in hip, shoulder, and knee arthroscopy was carried out. We searched PubMed.gov (http://www.ncbi.nlm.nih.gov/pubmed), Embase (https://www.embase.com), and Cochrane Library (https://www.cochranelibrary.com/search) from 1990 until December 2022.

The search strategy in Pubmed was as follows:

((((((((((”Therapeutic Irrigation”[Mesh]) OR Therapeutic Irrigation[Title/Abstract]) OR Irrigation, Therapeutic[Title/Abstract]) OR Irrigations, Therapeutic[Title/Abstract]) OR Therapeutic Irrigations[Title/Abstract]) OR Lavage[Title/ Abstract]) OR Lavages[Title/ Abstract]) OR Douching[Title/Abstract])) AND ((((((((((Surgeries, Arthroscopic[Title/ Abstract]) OR Arthroscopic Surgeries[Title/ Abstract]) OR Arthroscopic Surgery [Title/Abstract]) OR Surgical Procedures, Arthroscopic[Title/Abstract]) OR Surgical Procedure, Arthroscopic[Title/Abstract]) OR Procedures, Arthroscopic Surgical[Title/ Abstract]) OR Procedure, Arthroscopic Surgical[Title/Abstract]) OR Arthroscopic Surgical Procedure[Title/Abstract]) OR Arthroscopic Surgical Procedures[Title/ Abstract]) OR Arthroscopies[Title/ Abstract]) OR Arthroscopy[Title/Abstract]) OR “Arthroscopy”[Mesh])))) AND ((”Temperature” [Mesh]) OR Temperatures[Title/Abstract]).

Selection Criteria and Process:

The present study followed preferred reporting items for systematic reviews (PRISMA) guidelines.[17,18] Randomized controlled trials or nonrandomized controlled trials in which the use of room temperature irrigation fluid was compared with warm irrigation fluid in the arthroscopic hip, shoulder, and knee surgery in terms of core body temperature and adverse effects were included. One author (JB) independently selected studies with inclusion criteria by screening the titles and abstracts. The author reviewed the full texts of the selected studies to determine the inclusion articles. Disagreements were resolved by consulting with the principal author.

Eligibility criteria for study selection:

The inclusion criteria were established as follows:

- Article published in English
- Article in which the safety of the procedures has been analyzed.

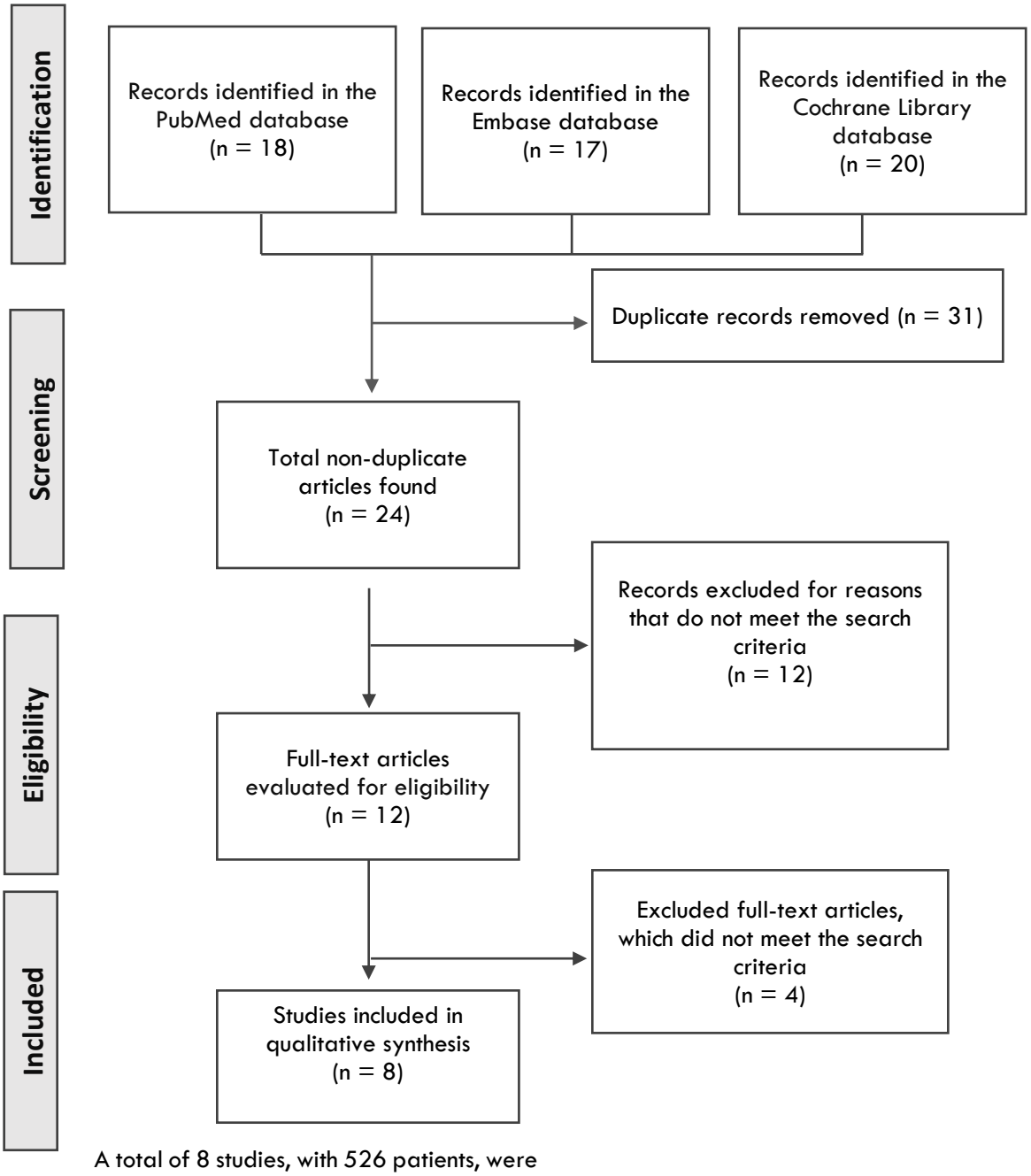
- Article published in a peer-reviewed journal.
- Prospective or retrospective clinical studies.

Exclusion criteria were systematic reviews or meta-analyses, letters to the editor, case reports, expert opinions, comments, and articles that did not involve the study's purpose.

Results

Using the search strategy, 55 articles were identified, and duplicate records were removed, leaving 24 unique records. The titles, and abstracts were screened by two investigators (J.B., I.G.). Twelve records did not meet the inclusion criteria, then these investigators (J.B., I.G.) assessed the full text of the remaining 12 records. Four of these records were excluded. Therefore, 8 met the inclusion criteria. The search process is displayed in Figure 1.

Figure 1: PRISMA flow diagram demonstrating trial inclusion criteria. PRISMA preferred reporting items for systematic reviews.



A total of 8 studies, with 526 patients, were included in the systematic review. The

studies included patients undergoing arthroscopy of the shoulder (n = 6),[19,20,21,22,23,24] hip (n = 1),[7] and knee (n = 1)[25] (Table 1).

Table 1: Study Characteristics.

Author, Year	Level of Evidence	Sample	Treatment Group	Comparison Group	Active Skin Warming	Measures, Outcomes, and Results
Board et al., 2008.[21]	II	N = 24 Inclusion: shoulder arthroscopy	Warmed irrigation fluids (36°C); n = 12	Room-temp irrigation fluids (22°C); n = 12	Intraoperative FAW used for all patients	TTM; temperature measured every 10 min intraoperatively and every 30 min postoperatively; shivering. The mean maximum drop in the room temperature group was 1.67°C (95% CI 1.33–1.97) and 0.33°C (95% CI 0.17–0.49) in the warmed fluid group (P < 0.001). Further to this the drop in core temperature in the room temperature group was maintained throughout surgery whereas normothermia resumed by 30 min in the warmed fluid group.
Duff et al., 2012.[22] Part A	I	N = 52 Inclusion: elective shoulder arthroscopy; age >18 yr; ASA I-III; BMI of 18.5-40 Exclusion: preoperative temp >37.5°C; unable to speak or understand English	Group 1: warmed irrigation fluids (37°C); n = 25	Group 3: room-temp irrigation fluids; n = 27	Preoperative and intraoperative FAW used for all patients	TTM; temp measured (1) immediately before induction, (2) on arrival in PACU, (3) 20 min after PACU arrival, and (4) on discharge from PACU; shivering.
Part B	I	N = 55 Inclusion: elective shoulder arthroscopy; age >18 yr; ASA I-III; BMI of 18.5-40 Exclusion: preoperative temp >37.5C; unable to speak or understand English	Group 2: warmed irrigation fluids (37°C); n = 29	Group 4: room-temp irrigation fluids; n = 26	Intraoperative FAW used for all patients	TTM; temp measured (1) immediately before induction, (2) on arrival in PACU, (3) 20 min after PACU arrival, and (4) on discharge from PACU; shivering
Kelly et al., 2000.[25]	I	N = 20 Inclusion: knee arthroscopy. ASA I-II; spinal anesthesia Exclusion: age <18 or >65 yr; contraindication or unwillingness to undergo spinal anesthesia; disease potentially affecting thermoregulation; antipyretic drugs; tourniquet; requirement for use of external warming device before or during surgery for patient's comfort or safety	Warmed irrigation fluids (40°C); n = 9	Room-temp irrigation fluids (20.75°C); n = 11	Not used	TTM; temp measured every 15 min. Statistical comparison of the mean percent temperature decreases from preoperative baseline between the 2 groups did not support the hypothesis that patients receiving warmed irrigation solution would maintain a higher core body temperature than those receiving room temperature solution.
Kim et al., 2009.[19]	I	N = 46 Inclusion: shoulder arthroscopy; ASA I-II	Warmed irrigation fluids (37°C-39°C); n = 23	Room-temp irrigation fluids (20°C-22°C); n = 23	Not used	TTM; temp measured every 15 min for 1 hour and then every 30 min until surgery completed; shivering. The final core body temperature was

						35.5±0.3°C in the room-temperature fluid group and 36.2±0.3°C in the warmed fluid group (P < .001). The temperature drop was 0.86±0.2°C in the room-temperature fluid group and 0.28±0.2°C in the warmed fluid group (P < .001). Hypothermia occurred in 91.3% of patients in the room-temperature fluid group; the incidence of hypothermia was much lower in the warmed fluid group (17.4%; P < .001).
Oh et al., 2014.[23]	I	N = 72 Inclusion: shoulder arthroscopy, rotator cuff repair; ASA I-II Exclusion: large rotator cuff tear; isolated subscapularis tear; previous operation on same shoulder; requirement for use of external warming device before or during surgery for patient's comfort or safety	Warmed irrigation fluids (36°C); n = 36	Room-temp irrigation fluids (20°C); n = 36	Not used	ES; temperature measured every 15 min; shivering. The core body temperatures decreased throughout the surgery and increased linearly in the PACU, without any intergroup differences (P > .05). All patients were normothermic within 1 hour of arrival in the PACU.
Pan et al., 2015.[24]	I	N = 66 Inclusion: shoulder arthroscopy Exclusion: large rotator cuff tear; incomplete data; requirement for external warming device before or during surgery	Warmed irrigation fluids (36°C); n = 33	Room-temp irrigation fluids (21°C); n = 33	Not used	ES; temp measured every 15 min; shivering. After 15 minutes, the decreases in the room-temperature group were significantly greater after. The lowest temperature was 35.1±0.4°C in room-temperature group and 35.9±0.3°C in warmed irrigation group, the difference was statistically significant (P < .05). Hypothermia occurred in 94% in the room temperature group, significantly lower in warmed irrigation group (27 %; P < .05).
Parodi et al., 2014.[7]	II	N = 166 Inclusion: hip arthroscopy for FAI, same surgeon, and anesthesiologist; general anesthesia; upper body FAW at temp up to 43.3°C; use of irrigation infusion pump Exclusion: heart failure, kidney failure, b-blockers, technical difficulties in temp measurement.	Warmed irrigation fluids (32°C); n = 83	Room-temp irrigation fluids (median, 21.46°C); n = 83	Upper body FAW used for all patients	ES; temp measured every 15 min; shivering. A decrease in core body temperature by 0.5 C or greater occurred during surgery in 66% of patients in the control group versus 28% in the warmed solution group (P < .001) At least 1 core body temperature measurement of less than 36°C was recorded in 48% of patients in the control group versus 14% in the warmed-solution group (P < .001). The trend toward a decrease in core body temperature was 4 times greater in the control

						group than in the warmed-solution group (P < .001).
Alston et al., 2020.[20]	IV	N = 20 Inclusion: elective shoulder arthroscopy in pediatric patients	Intervention -Warmed irrigation fluid, near 38°C-42°C -Forced-air warming blankets in the perioperative -Warmed intravenous fluid for anesthesia N= 20	Pre-intervention N = 5	Forced-air warming blankets in the perioperative in 20 patients	Nasopharyngeal probe monitor. Temperature measured at the start of the procedure, at the end of the procedure, and at PACU. Pre-intervention group: 5/5 patients had core temperature < 36°C at the start of the procedure, 5/5 at the end, and 3/5 in PACU. Intervention group: 5/20 patients had core temperature < 36°C at the start of the procedure, 4/20 at the end, and 1/20 in PACU.

ASA, American Society of Anesthesiologists classification system; BMI, body mass index; ES, esophageal thermometer; FAI, femoroacetabular impingement; FAW, forced air warming; PACU, postanesthesia care unit; temp, temperature; TTM, tympanic thermometer.

Four used a randomized controlled trial design.[19,23,24,25] One used a randomized 2x2 factorial design[22], 1 used a quasi-experimental design with 1 consecutive group,[7,21] and 1 used a case series with a consecutive group.[20]

Warmed and operative room-temperature fluid temperature:

All 8 studies described the initial warmed irrigation fluid temperature. [7,19,20,21,22,23,24,25]

Kelly et al. used warmed irrigation solution between 39°C-40°C during arthroscopic knee surgery, compared to room-temperature irrigation (RTI) temperature of 20.75°C, with an operative room temperature between 20.5°C-21.5°C.[25]

In shoulder arthroscopy, Board et al. used a warmed irrigation (WI) fluid to 36°C group compared to an RTI group with a fluid temperature of 22°C, with a mean ambient temperature of 21.14°C (21.1°C –24.1°C).[21] Kim et al. compared a WI group with a mean temperature of 37.8°C (37°C-39°C) with an RTI group, only describing the room temperature (20°C-22°C).[19] Pan et al. compared an RTI group with a temperature maintained at 21°C and a WI group that received the fluid with a temperature of 36°C, describing a room temperature of 21.0±0.6°C and 20.8±0.5°C for each group respectively with no statistical difference.[24] Oh et al. compared a WI group with a fluid temperature set at 36°C and a room-temperature irrigation group without measuring it, describing a room temperature of 20.9 ± 1.1°C and a 21.2±0.9°C for each group respectively with no statistical difference[23]. Duff et al. described a protocol with the use of WI fluid at 37°C compared to an RTI group without describing the mean temperature of the fluid[22]. Alston et al. described a protocol with a WI solution between 38°C and 42°C without describing the RTI fluid and room temperature[20].

In hip arthroscopy, Parodi et al. compared a group in which an irrigation solution warmed up to 32.1°C (25°C-36.7°C) was used and a control RTI group with a fluid temperature of 21.4°C (17.5°C-24°C), describing a room temperature of 20.7°C (17°C-26°C) and 20.4°C (16.8°C-24.3°C) for each group respectively without statistical difference.[7]

Drop intraoperative temperature and lowest mean intraoperative temperature:

In 5 studies (4 shoulder and 1 hip), the mean drop intraoperative temperature and/or lowest mean intraoperative temperature was reported. [7, 19,21,23,24]

Board et al. described a mean temperature drop of 0.33°C (0°C-0.9°C) in the WI group and 1.67°C (0.9°C-2.4°C) in the RTI group; this difference was statistically significant.[21] Similarly, Kim et al. described a mean temperature drop of 0.28°C (0°C-0.8°C) in the WI group and 0.86°C (0.4°C-1.3°C) in the RTI group; this difference was statistically significant.[19]

Oh et al. described the last core body temperature between the WI group and the RTI group, 35.4±0.6°C and 35.5±0.6°C respectively, and the lowest core body temperature between groups, 35.4±0.5°C and 35.4±0.5°C respectively, the difference was not statistically significant.[23] Moreover, Pan et al. reported that the lowest temperature was 35.1±0.4°C in the RTI group and 35.9±0.3°C in the WI group; the difference was statistically significant.[24]

Parodi et al. reported a decrease in core body temperature by 0.5°C or greater during surgery occurred in 66% of patients in the RTI group versus 28% in the WI group. At least 1 core body temperature measurement of less than 36°C during surgery was recorded for 48% of patients in the control RTI group versus 14% in the WI group; this difference was statistically significant.[7]

Decrease in surgical time and core body temperature:

In 7 studies (5 shoulder, 1 knee and 1 hip), the decrease in surgical time and core body temperature was reported.[7,19,20,21,23,24,25]

Parodi et al. used a multivariate analysis with the generalized estimating equation model for repeated measurements allowing to define the core body temperature decreased at a rate of 0.18°C/h during surgery in the control group versus 0.04°C/h in the WI group.[7] Board et al. also described that the drop in core temperature in the RTI group was present throughout surgery and only normalized postoperatively, but the drop in the WI group was transient, and core body temperature stabilized after 30 minutes in most cases.[21]

Kim et al. performed a statistical analysis, describing that after 30 minutes, core body temperature was maintained above 36°C in the WI group, but it dropped significantly in proportion to the length of anesthesia in the RTI group ($P = .001$).[19] With comparable results, Kelly et al. compared the percentage of decreased temperature from baseline between WI and RTI, resulting significant percent temperature decrease after placement of the spinal anesthetic to post-anesthesia care unit (PACU) within each group ($P < .05$).[25] Similar results were reported by Pan et al. presenting a decrease in core body temperature in both groups, significantly greater after the first 15 minutes in the RTI group, until reaching its lowest measurement at 90 minutes.[24]

Contrasting with previous studies, Oh et al. described that the core body temperatures decreased throughout the operation and linearly increased by warming in the PACU, but there were no intergroup differences in these temperature changes.[23]

Alston et al. presented a series of cases of shoulder arthroscopy in pediatric patients, measuring core body temperature at the start and end of the procedure and in PACU. In the RTI group, 5/5 patients had a core temperature < 36°C at the start of the procedure, 5/5 at the end, and 3/5 in PACU, whereas in the protocol of the WI group, 5/20 patients had a core temperature < 36°C at the start of the procedure, 4/20 at the end, and 1/20 in PACU. Non-statistical analysis was performed.[20]

Variables related to decrease core body temperature:

In 4 studies (3 shoulder and 1 hip), other variables related to decrease core body temperature were measured.[7,19,23,24]

Parodi et al. concluded that the factors contributing to the development of hypothermia during hip arthroscopy surgery were prolonged surgery time and low room temperature in both groups ($P < .01$). In the RTI group, low body mass index (BMI), and low temperature of the arthroscopic irrigation fluid was a significant variable that decreased the core temperature ($P < .01$).[7]

Kim et al. concluded there was a clear relationship between core body temperature and the age of the patient in the RTI group (linear regression; $r = 0.382$; $P = .079$). Core body temperature was also correlated with the amount of irrigation fluid used (linear regression; $r = 0.507$; $P = .016$). However, in the WI group, these relationships were not statistically significant.[19] Oh et al. also performed a linear regression analysis, obtaining a negative correlation between the last core body temperature and body weight gain in the RTI group ($r = 0.374$, $P = .038$) and a positive correlation between BMI with the last core body temperature in both RTI ($r = 0.313$, $P = .043$) and WI group ($r = 0.397$, $P = .016$).[23]

Pan et al. measured proinflammatory cytokines in drainage fluid at 0, 2, and 6 h after surgery and measured in serum at 6 h preoperatively and 6, 12, and 24 h postoperatively. In drainage fluid, levels of TNF-α,

IL-1, and IL-6 were significantly higher in the RTI group in all the time intervals of measure, whereas IL-10 levels were significantly higher in the RTI group at 2 and 6 h postoperatively. IL-6 serum levels were significantly higher in the WI group 6 h preoperatively, nevertheless, this difference was inverted, with significantly higher levels in the RTI group at 6, 12, and 24 h postoperatively.[24]

Shivering and hypothermia:

In 6 studies (5 shoulder and 1 hip), the decrease in surgical time and core body temperature was reported.[7,19,21,22,23,24]

Parodi et al. obtained no patients with a core body temperature lower than 35°C in the WI group versus 2.4% in the control group, and there were no cases of shivering versus 6% in the control group.[7] Kim et al. defined hypothermia as a core body temperature less than 36°C, which occurred in 91.3% of the patients in the RTI group, whereas the incidence of hypothermia was 17.4% in the WI group, giving a statistical difference (P = .001). Shivering in the recovery room was observed in 21.7% of the patients in the RTI group, and no patient experienced shivering in the WI group (P = .017).[19] Similarly, Board et al. reported that 16.66% of patients in the RTI group suffered from severe shivering during the immediate postoperative period, with no cases of shivering in the WI group.[21] Pan et al. also reported a significantly lower hypothermia rate in the WI group compared with the RTI group, 27% and 94%, respectively (P = .000), and a lower percentage of shivering, 3% and 42%, respectively (P = .000).[24]

The results in Oh et al. study differs, reporting 91.6% of hypothermia in the RTI group and 94.4% in the WI group (P = .276); besides, shivering percentage were not statistically different between both groups, with 8% of the patients in RTI group and 3% in the WI group (P = .347). Duff et al. study results are consentient, in which the frequency of shivering was not significantly different when warmed fluids were used with or without preoperative forced-air warming (13.8% vs. 7.7% and 4% vs. 3.7%).[22]

Discussion:

In recent years, few new studies have been published on this topic. Most studies are related to shoulder arthroscopy, and only one remains in hip arthroscopy.[7]

All studies presented in this systematic revision, except Oh[23] and Kelly et al.[25], concluded that warmed irrigation fluid is a helpful tool to prevent hypothermia and shivering. Warming irrigation fluids during knee arthroscopy is not helpful for minimizing hypothermia because the surgical site is distal to the body core, and the minimal fluid extravasation limits this problem to shoulder and hip arthroscopy.[5]

This topic should get more attention in hip arthroscopy because the importance of using warmed irrigation is that the leakage of the irrigation fluid into anatomical spaces adjacent to the joint, such as into the abdominal cavity and retroperitoneum; most reported cases involve extra-capsular endoscopic procedures like the release of the psoas tendon.[26,27,28] Still, extravasation could escape through capsular incisions following large capsulotomies at intra-articular hip arthroscopy, decreasing body core temperature. If it is more than 2L, it can trigger serious consequences such as compartment syndrome.[29,30]

Our first study about this topic described the incidence of hypothermia in 2.73% of the patient, with an association when surgery time exceeded 120 minutes, and 68.22% of patients had a decrease in temperature of more than 0.5°C until the end of the surgery, leading to a mean drop in body temperature of 0.19°C/h. One of the most important findings of this study was the direct relation between esophageal temperature and saline solution temperature, which was a modifiable factor that could be used to decrease the rate of hypothermia. During the procedure, low BMI and low diastolic blood pressure are also hypothermia-related.[6] Later, we performed a prospective cohort divided into a group in which an irrigation solution warmed up to 32°C and a control group in which we used irrigation solution at room temperature.

Another interesting concern is what Pan et al. concluded about the local inflammatory response, as measured by TNF-a, IL-1, IL-6, and IL-10 responses, which was significantly reduced by using warm irrigation fluid.[24] Although the clinical significance is unknown, it is logical to consider lowering inflammation after any surgical procedure.

Most recently, a meta-analysis by Steelman et al.[5] and posteriorly by Lin et al.,[31] concluded that warming of irrigation fluids for shoulder or hip arthroscopy significantly decreased the risk of hypothermia increased the lowest mean temperature, reduced the maximum temperature drop, and decreased the risk of shivering.

Despite there being only one case series study on shoulder arthroscopy in pediatric patients after the latest reviews,[20], and despite all the studies being heterogeneous in their methodology, we believe that there is sufficient evidence to support the use of warmed solution in shoulder and hip arthroscopy.

According to this information, in the last decade, we implemented not only the use of warmed irrigation but also the improvement of the technique and the learning curve of an experienced surgeon that allows us to reduce surgical time, which is another modifiable factor that is related to hypothermia, small capsulotomies, inflow fluid pressure lower than 50 mmHg, and leaving for the end of the arthroscopy the release of the psoas tendon when is required, all this to reduce fluid extravasation that could cause hypothermia. We also use warming blankets to keep patients warm during hip arthroscopy[32].

Since 2012, the principal author has performed 526 hip arthroscopies; 63% were FAI, 20% hip dysplasia, 12% sciatic nerve release for deep gluteal pain syndrome, 2% gluteus medius tendon repair, and less than 3% were coxa saltans, septic arthritis, and pigmented villonodular synovitis. In all cases, we have implemented the interventions described above, which generate no extra cost for the surgery, helping us to discharge all patients in a protocol within 24 hours post-surgery without further complications related to hypothermia or other issue during surgery.

In conclusion, despite being limited, current literature and our experience in hip arthroscopy support that hypothermia and shivering could be prevented using a warmed solution. This is an easy-to-implement, low-cost, and effective method to avoid this complication.

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