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Nonopioid Therapies for The Management of Postoperative Knee Pain

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March 29, 2020

PERMISSION

Title

Department Nursing

Degree Master of Science

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Abstract

The U.S. Department of Health and Human Services reports an average of 130 opioid related deaths a year. With the estimated increase in knee arthroplasty procedures, there could be a growth of 250,000 new chronic opioid users from knee procedures alone. This increases the risk for more opioid misuse. Pain Society guidelines encourage nonopioid pain management to support reducing opioid consumption for all patients. Intraoperative treatments including nerve blocks and injections as multimodal analgesia. Both of these treatments have been found to be effective in postoperative pain management. Several other nonopioid prescription options include nonsteroidal anti-inflammatory medications, Cox-2 inhibitors, acetaminophen and gabapentinoids. There is conflicting information on the effectiveness of medications such as gabapentinoids. The decision on how to treat postoperative pain is multifactorial and consideration must include risk versus benefit of each option. Nonpharmacologic therapies include physical therapy, acupuncture, compression devices and music therapy. All of the above therapies have been shown to decrease postoperative opioid use. A literature review was completed using CINAHL complete and PubMed. The search was limited to within the last five years. Completed research revealed a total number of 38 relevant articles, fourteen were used for this paper. The literature analyzed was congruent with current guidelines as recommendations for alternatives to effective opioid pain management. More research is needed into the effectiveness of specific nonopioid pain management therapies, and what patient populations they would best serve.

Keywords: Alternative pain management, nonopioid pain management, postoperative knee arthroplasty, pain control

Nonopioid Therapies for The Management of Postoperative Knee Pain

Background

In the 1990s, healthcare providers began prescribing opioids at an increased rate. This was done after reassurance from the pharmaceutical companies that the pain relievers were low risk for addiction. According to the U.S. Department of Health and Human Services (2019), since then there has been an increase in misuse of both prescription and non-prescription opioid use resulting in over 130 opioid-related overdoses a day, and an estimated 10.3 million people misusing prescription opioids in 2018. The number of overdose deaths has been decreasing since 2017 but was still four times higher in 2018 than it was in 1999 with nearly 70% of overdose related deaths in 2018 related to opioids (Centers for Disease Control and Prevention [CDC], 2020). Of the adults who misused pain medications at least once in the last year, 63.4 percent did so to relieve physical pain (Lipari et al., 2017). Although 87.2 percent of the 91.8 million people who were prescribed prescription opioids in 2015 did not misuse them, there are still a significant amount of deaths as well as increase in healthcare costs from the misuse (Lipari et al., 2017).

Opioid side effects can include immunosuppression, depression, increased pain sensitivity, ileus, respiratory depression, and an increase in morbidity and mortality, and long-term use is associated with an increased risk of knee revision when used after a total knee arthroplasty (Hah et al., 2017). Even with these known side effects, opioids are effective in relieving pain, thus influencing why they are the primary treatment for acute postoperative pain. It is estimated that 51 million Americans undergo inpatient surgery annually, and over 80% of patients receive opioids after low-risk procedures; most of these prescriptions include oxycodone or hydrocodone, the most common opioids in overdose deaths (Hah et al., 2017). With opioids

known risks, and evidence demonstrating the misuse of these drugs, it is important to find alternatives in pain management.

This literature review will coincide with a case report based on the OSCE of 46-year-old women who will undergo an elective knee procedure after a meniscus injury. During her preoperative exam she was unaware of what her postoperative recovery, including pain management would look like. This patient will most likely be given opioid treatment to manage her acute postoperative pain. She does not have a history of opioid use, and it is estimated that only 4.3%-8.2% of patients with no history of preoperative opioid use will become long-term opioid users. While this does not seem significant, it is estimated that there will be around 3.48 million knee arthroplasty procedures by the year 2030, this could potentially create more than 250,000 new chronic opioid users each year in the US (Goesling et al., 2016). This literature review will focus on nonopioid ways to reduce postoperative knee pain in hopes of slowing the opioid misuse in the United States.

Case Report

T.S. is a pleasant 46-year-old female whom presented in clinic on February 27th 2020 for preoperative exam clearance. She reported that she had fallen about six months prior and injured her right knee, she had not injured her knee prior to this. At that time, she reports she did not hit her head or lose consciousness. She was now planning on having a right knee arthroscopy in about one month. She was unsure of the location, date/time, surgeon, and type of anesthesia that will be used. She did continue to have a constant aching pain in her knee that was mildly relieved with the use of Tylenol and Ibuprofen once daily as needed. During her appointment she continued to have moderate pain. She had not used physical therapy, ice, heat, elevation and rest or other nonpharmacological sources of pain relief. She had not been educated on pre or

postsurgical care instructions including pain management. She denies having taken opioid pain medications in the past.

A complete review of the patient's personal medical, social and surgical history as well as a family history was completed during the appointment. A full 12-point review of systems and head to toe physical assessment was conducted along with an EKG, comprehensive metabolic panel, TSH, and CBC with differential, no imaging was needed at this time (Appendix B). It was determined that T.S. was non high risk for her planned procedure. Instructions on medication management and follow up were discussed with the patient. (Please see Appendix A for the full clinic note).

Literature Review

Current Guidelines

With the anticipated increase in elective knee surgeries, and the continued risk of opioid abuse within our nation it is important to find effective alternatives in postoperative pain management for patients with limited side effects. The American Pain Society (APS) along with the American Society of Anesthesiologists (ASA) recommended guidelines for the management of postoperative pain that were later reviewed and approved by The American Society of Regional anesthesia and Pain Medicine (Chou et al., 2016). These guidelines were intended for the use of any provider who manages postoperative, chronic, acute, dental and trauma related pain.

The APA and ASA panel created 32 recommendations in total. Recommendations related to postoperative adults include:

Preoperative, family-centered education should be completed for patients, including perioperative pain management planning. Preoperative evaluations of comorbidities,

substance abuse risk, psychiatric risk, history should be completed for all patients. Plans should be adjusted based off of pain relief and presence of adverse events and other individualized factors. Validated pain assessment tools and tracking tools need to be used. Patients should be offered multimodal analgesia and a variety of analgesic medications and techniques including nonpharmacological interventions such as nerve stimulation, acupuncture, massage, cold therapy. Providers should prescribe the use of oral over intravenous opioids for postoperative analgesia and avoiding intramuscular administration. The use of acetaminophen and /or nonsteroidal anti-inflammatory (NSAIDs) drugs as well as gabapentin and ketamine should be used as multimodal analgesia (Chou et al., 2016, pp. 133–144).

Standardized post-arthroplasty pain control has not yet been identified because reported pain is subjective. Influences on pain include patient threshold, the use and duration of tourniquet, pre-operative pain level, anesthetic technique, surgical trauma involved, sex of the patient and experience of the surgeon as well as postoperative activity level (Anaesth, 2020). This makes determining a standardized treatment difficult as patient's all have unique pain factors. It is important to instead identify multiple different treatment options that could work for different patient populations.

Intraoperative Treatments

Procedures performed immediately prior to or during surgery can have significant effects on postoperative pain. Two techniques used are injections and nerve blocks. The objective of postoperative nerve blocks is the help reduce postoperative pain and opioid use. This can include blocks at the femoral region as well as the sciatic nerve or common peroneal branches. It has been found to have fewer side effects than most analgesia and is associated with improved

analgesic effects (Anaesth, 2020). Femoral nerve block is currently recommended and is one of the oldest blocks used, however it does have a high risk of falls linked to weakness in the quadriceps muscles (Anaesth, 2020). A literature search of 58 studies found that nerve blocks can be beneficial but given the technical difficulty and narrow time frame to complete it is not practical for all patients (Derogatis et al., 2019). Therefore, while proven to be beneficial, it is unknown which patients benefit from a nerve block the most, and if they should be utilized as a standard in pain management.

Another study conducted by Aso et al, (2018) measured the total amount of fentanyl consumed via PCA pump post-surgery in those that had a femoral nerve block, or a femoral nerve block combined with a local infiltration of analgesia as a multimodal treatment plan. Total consumption in the group with the femoral nerve block combined with the infiltration was significantly less than those who just had a nerve block. In addition, the group also had increased range of motion in the knee. Patients also had less complaints of nausea and vomiting postoperatively, this could be related to less use of opioids as a side effect of opioids include nausea and vomiting (Aso et al., 2018).

In a double-blind study of 120 individuals undergoing total knee arthroscopy, those who had pre-procedure injections of bupivacaine (local anesthetic), morphine, and ketorolac into the joint were found to have improved Knee Society Scores. Knee Society Scores are an evaluation of function, at six weeks compared to those in the control group (Motififard et al., 2017). Those who had the injection also needed less IV analgesia within 24 hours after surgery. Previous studies have shown that injections with steroids resulted in faster rehabilitation, less nonsteroidal anti-inflammatory consumption, and decreased hospitalization stays; these studies had no effect on pain relief compared to those who did not have steroid injections (Motififard et al., 2017).

Derogatis et al. (2019) also reported local infiltrating analgesia are helpful in improving immediate pain relief postoperatively.

In an additional study, patients who received peri-articular injections required more narcotics on the day of surgery than those who received nerve blocks (Gustke, 2015). The type of nerve block and injection should be individualized depending upon the patient and their circumstances. More research is needed on the effects of nerve blocks and injections for postoperative pain management.

Nonopioid Pharmacological Treatment

Nonopioid medications can include acetaminophen, ibuprofen and other nonsteroidal anti-inflammatory drugs as well as gabapentin and cyclooxygenase-2 inhibitors (Cox-2), dexmedetomidine and others as this is not an all-inclusive list. A literature review of 58 studies found incompatible information with the use of acetaminophen and gabapentinoids in the reduction of opioid use (Derogatis et al., 2019). Cox-2 inhibitors have been found to reduce opioid requirements but have increased severe side effects making them an ineffective alternative for most patients (Derogatis et al., 2019).

A study by Uribe et al (2018) “Comparing the Efficacy of IV Ibuprofen and Ketorolac in the Management of Postoperative Pain Following Arthroscopic Knee Surgery.” The study placed individuals into groups, one that received standard care, one that received Ibuprofen and one that received Ketorolac immediately after surgery. The study concluded that opioid consumption post-surgery was decreased in the group that received Ibuprofen as well as the group that received Ketorolac. Opioids were still utilized as rescue medications for all patients, but the number of total opioids used was decreased, with a more significant decrease in the group that received ibuprofen (Uribe et al., 2018).

Another alternative medication is Gabapentoids. With the cause of postoperative pain involving more than just tissue injury and inflammation, Gabapentoids help to act on the neuropathic and visceral pain that is also present (Axelby & Kurmis, 2020). These medications have been used to help with diabetic neuropathy, anxiety, pain and sleep disturbances in patients with fibromyalgia, and have now been considered for peri-operative adjectve medications to reduce post-operative pain and opioid use (Axelby & Kurmis, 2020). A meta-analysis concluded that while there was a reduction in opioid consumption, there was an increase in side effects including sedation and dizziness and Gabapentoids were most effective in those that had chronic pain conditions such as spinal surgeries, only 20 percent of total knee arthroscopy are estimated chronic conditions (Axelby & Kurmis, 2020). Preliminary studies still suggest there could be benefit to Gabapentoid use in helping to reduce opioid consumption postoperatively, but more research is needed.

Nonpharmacological Treatment

Nonpharmacological treatments can include music therapy, physical therapy, cognitive-behavior therapy, and massage or acupuncture, this not all-inclusive lists. Komann et al. (2019) found that women were more likely than men to use nonpharmacological methods for pain management, as well as those who are younger than age 56. Those that used acupuncture, cold packs, increased activity sch as walking, and continued education from medical staff were less likely to wish for additional pain management options (Komann et al., 2019). Patients who are less likely to want additional pain management are more likely to be satisfied with their pain control. A connection could then be made that those who used nonpharmacological treatments are more likely to be satisfied with their pain control and less likely to need opioid pain treatment.

Derogatis et. al (2019) found knee braces to be safe for most patients and the most commonly recommend treatments postoperatively with the least likelihood to have side effects. The STICKS study conducted by Brock, Sprowson, Muller and Reed (2015) was conducted to assess the effectiveness of elastic compression on postoperative knee swelling and bleeding, quadricep strength, as well as range of motion and pain control. The study was a randomized control trial where patients were educated with training videos for how to apply the bandages for adequate compression. Patients would then trial bandage application under supervision to assess for understanding of education. The groups were assessed at day one, day two, six weeks as well as at six months. The study concluded improvements for those that wore compression devices in both range of motion and pain control postoperatively (Brock et al., 2015).

A systemic review by Gatewood et al. (2017), found that cryocompression therapy is more effective than traditional icing and can reduce hospital stay and opioid consumption yet is not more than compression alone. Liu et al. (2020), completed a meta-analysis of randomized controlled trials and concluded that compression bandages after a total knee arthroplasty showed slightly greater pain with ambulation during the first four-to-eight hours after surgery and no difference in pain scores at later times. However, the study did find that those who did not use compression had greater increase in swelling postoperatively which can cause pain for patients. Limitations to the meta-analysis include small sample sizes limiting the accuracy of the data. This demonstrates that cryocompression can improve pain scores, while compression alone needs more research.

Additional treatments as part of physical therapy and compression include continuous passive range of motion, NMES and sEMG which induce muscle activity. Gatewood et al. (2017), NMES and sEMG application during therapy found increase in muscle strength,

especially in quadricep strength improving range of motion and pain control. Shockwave therapy following arthroscopic surgery was found in only one study with inconclusive results on pain management. This is consistent with the research from Komann et al. (2019), that concluded inconsistent results with the use of TENS units. The study does not that there is consistent research show that TENS units can help with pain management, and that limited sample size along with correct usage could play a factor in their results.

Additional nonpharmacological therapies can include music therapy and meditation for relaxation and distraction. This could include the patient's favorite music, relaxing and soothing music, nature sounds, piano or violin music. According to Santhna, Norhamda, and Damrudi (2015) music therapy has been shown to decrease narcotic use post total knee arthroscopy by helping with relaxation and distraction.

Jung, Cho and Chung, (2015) completed a systemic review evaluating the effects of acupuncture for postoperative pain in total knee arthroplasty. Acupuncture was defined as all types of needle stimulation, but laser acupuncture was included in the study. After evaluating 10 databases they concluded there are multiple sources supporting acupuncture for postoperative pain management. However, the research did find discrepancies in the best types of acupuncture postoperatively. Research also stated various type of adverse reactions depending upon they type of acupuncture completed (Jung et al., 2015). This indicates that more research is needed to identify the type of acupuncture with the least amount of side effects that would be most beneficial for total knee arthroplasty patients.

Future Research

While these methods of treatment are in line with current American Pain Society and American Society of Anesthesiologists guidelines the extent to which they should be used and at

what stage of the recovery phase is not always specific. Multiple modalities of nonopioid treatment are available for patients post total knee arthroplasty. It is important to consider each patient's pain factors into future research such as tolerance, pre procedure pain, surgery and anesthesia technique, mental health, as well as other individual factors. These factors can guide a provider in estimating the amount of pain a patient may have after procedure, as well as the best treatment options for that individual. This can also help the provider and patient have a conversation about what a realistic pain goal after a procedure should be. Each patient is unique in their needs, so it is important to keep an individualized plan of care for patients regarding their postoperative pain.

While the effectiveness of some therapies has been proven beneficial in controlling pain and reducing opioid use, not enough individual therapies have not been studied against each other to see what is more beneficial and for what type of patient. Larger sample sizes are needed during studies to achieve more accurate information. Combining a standard for pain management with individualized pain perceptions is difficult and reflected in the literature.

Learning Points

- Current American Pain Society guidelines encourage the use of nonopioid pain management techniques, individualized care plans, and support reducing opioid consumption.
- Intraoperative nerve blocks as well as injections as multimodal therapies have supporting evidence for relieving postoperative knee arthroplasty pain. Which type of nerve block and what kind of injections are most effective has yet to be determined.
- Multiple nonopioid medications are available for treatment of pain and have shown to decrease the need for opioids postoperatively, however, which medications are the most

effective for individualized patients, and in what combination is the most effective is unknown at this time. It is also important to take into consideration all medications have their own side effects.

- Nonpharmacological therapies are vast, and include physical therapy, acupuncture, compression devices and braces, music therapy, ice and many more. These treatments have been shown to help control pain but is not clear as to what patients benefit the most from what type of treatment.

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Appendix A

ADULT PREOPERATIVE ASSESSMENT

T.S. is a 46-year-old female here today for pre op consultation and clearance for anesthesia and surgery. She is here alone and is her own historian. She had a fall about six months ago when she developed joint line tenderness in her right knee. She reports she did not hit her head or lose consciousness when she fell. She did not seek immediate care for her knee pain. The pain is worse with climbing stairs and ambulating. She describes it as a constant, aching pain. She has used Tylenol with no relief, and Ibuprofen once a day gives her mild relief.

Date of Surgery: Within one month Facility: Unknown Surgeon: Unknown

Procedure: Right Knee Arthroscopy

Prop Questionnaire

Do you ever have any pain or discomfort in your chest? no

Have you ever had a severe pain across the front of your chest lasting for half an hour or more?
no

Do you have swelling in your feet or ankles at times? no

Are you troubled by shortness of breath when:

Walking on the level? no

Walking up a slight hill? no

Sleeping at night? no

Do you sometimes get pains in the calves of your legs when you walk? no

Does your chest ever sound wheezy or whistling? no

Do you currently have a cold, bronchitis or other respiratory infection? no

Have you had a cold, bronchitis, or other respiratory infection within the last 2 weeks? no

Do you usually have a cough? no

Do you or does anyone in your family have serious bleeding problems such as prolonged bleeding following surgeries or cuts? no

Have you taken any aspirin, other blood thinners, or arthritis medicine in the last 2 weeks? Yes

Have you ever had problems with anemia or been told to take iron pills? no

Have you had any abnormal blood loss such as black, tarry or bloody stools, (for women) abnormal vaginal bleeding, etc? no

Have you or any of your relatives ever had problems with anesthesia? no

For Women: Is there any chance that you may be pregnant? no

Past Medical History:

Hypertension

Overweight

DM II

Hypothyroid

Squamous Cell Skin Cancer on Neck

Past Surgical History:

Hysterectomy

C-Section X 2

Biopsy of skin cancer on neck

Current Medications

Lisinopril 10mg Tablet once Daily

Metformin 1000mg Twice Daily

Rabelais 10 mcg Daily

Synthroid 125 mcg Daily

Aspirin 81 mg Daily

Ibuprofen PRN once Daily

Allergies: No known Drug or Environmental Allergies

Social History: Works in education, is married with 2 adult children

- Smoking status: 20 pack year history quite several years ago
- Smokeless tobacco: Never Used, no vaping
- Alcohol use: Yes 1-3 times a week

Drug Use Never

Family History

Father- Living- Hypertension, prostate cancer, hyperlipidemia, CAD with stenting at age 55

Mother-Living- Hypertension, breast cancer at age 60, obesity

Maternal grandparent- Hypertension, breast cancer

Paternal grandparent- Hypertension, Cardiac issue at age 80, melanoma

Review of Systems:

GENERAL: no fever, malaise or unexplained weight change

SKIN: has not had itching, rash, moles or lesions of concern

HEAD: no unusual headaches or recent head injury

EYES: denies loss of vision, redness or eye pain

EARS: no hearing loss, pain or tinnitus

NOSE: has not had nosebleeds, congestion or runny nose

OROPHARYNX: no sore throat, dry mouth or dental problems

NECK: no history of carotid, lymph node or thyroid disease

RESPIRATORY: denies shortness of breath, cough or wheezing

CARDIOVASCULAR: no chest pain, palpitations, swelling, orthopnea or PND
GASTROINTESTINAL: No abdominal pain, nausea, heartburn, anorexia or bowel problems
MUSCULOSKELETAL: no joint pains, arthritis, neck or back pain, myalgias or stiffness. Left foot pain unresolved, indication for surgery
ENDO/HEM/ALL: denies easy bruising or bleeding, excessive thirst or appetite, hay fever or other environmental allergies
NEUROLOGICAL: no muscle weakness, numbness, incoordination or tremor
PSYCHIATRIC: no problems with depression, anxiety, substance abuse or psychosis

Exam

VS BP 136/88, P 78, T. 98.5 O2 95% wt 211lb Ht 5ft 6in BMI 34
 Physical Exam: **GENERAL:** vital signs reviewed, well developed and nourished, in no distress
SKIN: warm and dry, color normal
HEAD: normal
EYES: lids and conjunctivae normal, PERRLA, normal EOM's
EARS: hearing, external canals and TM's normal
NOSE: no congestion
OROPHARYNX: oral mucosa and pharynx normal
NECK: carotid pulses, thyroid and lymph nodes normal, trachea midline
CHEST: normal respiratory effort, breath sounds clear
CARDIOVASCULAR: normal rate and rhythm, no murmurs or gallops, no edema, peripheral pulses normal
ABDOMEN: no tenderness, masses or hepatosplenomegaly, bowel sounds normal
MUSCULOSKELETAL: joints and gait normal. Medial joint line tenderness of right knee. Normal Gait.
LYMPHATIC: no cervical, axillary or inguinal adenopathy.
NEUROLOGICAL: alert and oriented; cranial nerves intact; motor and sensory function normal; balance and coordination WNL
PSYCHIATRIC: normal mood, affect and insight

Assessment

Pre-op exam
 Hypothyroidism

Recommendations

Cleared for surgery? Yes
 Risk of surgery? Non high risk
 Pre-op Testing? Labs completed and normal. EKG without ectopy
 VT Prophylaxis? Per surgical protocol
 Pre-op antibiotic? Per surgical protocol
 If on beta-blocker, instructed to take AM of surgery? Not on a beta-blocker

Patient had laboratory studies completed with normal results. The patient has no known cardiopulmonary disease. The patient also is currently asymptomatic. Hold all medications the morning of the procedure aside from Synthroid. Do not take NSAIDs for pain relief, ok to use

Tylenol as needed but not to exceed 4000 mg per day. Do not use NSAIDS until after procedure and as recommended by the surgeon. Do not start any new diets or herbal supplements. Work restriction note given until date of surgery. Patient to get further instructions from the orthopedic team regarding follow-up. Patient is cleared for surgery.

Appendix B

Patient: T. S.

Labs:

TSH: 3.65(0.4-4.3 miu/L)

Test	Result	Units	Reference interval
Albumin	3.9	g/dL	3.5-5.0
ALT (SGPT)	19	IU/L	6-31
AST (SGOT)	21	IU/L	11-36
Alkaline phosphatase	57	mg/dL	38-126
Total bilirubin	0.8	mg/dL	0.2-1.3
BUN	11	mg/dL	7-17
Calcium	9.2	mg/dL	8.4-10.2
Chloride	101	mmol/L	98-107
Creatinine	0.8	mg/dL	0.7-1.2
Glucose	98	mg/dL	65-105
Lactate dehydrogenase (LDH)	149	IU/L	100-250
Magnesium	0.89	mmol/L	0.65-1.05
Potassium	4.0	mmol/L	3.6-5.0
Sodium	141	mmol/L	137-145
Total protein	7.0	g/dL	6.3-8.2
Uric Acid	301	mmol/L	227-367/467

Dr. Herbst

Component Results

CBC W/DIFF & PLT

Component	Your Value	Standard Range	Units
WBC	4.4	4.8 - 10.8	K/uL
RBC	4.49	4.70 - 6.10	M/uL
HEMOGLOBIN	14.6	12.6 - 17.4	g/dL
HEMATOCRIT	43.5	37.0 - 51.0	%
MCV	96.9	80.0 - 94.0	fl
MCH	32.5	27.0 - 31.0	pg
MCHC	33.5	33.0 - 37.0	g/dL
RDW	12.7	11.6 - 14.8	%
PLATELET COUNT	151	130 - 400	K/uL
SEGMENTED NEUTROPHILS #	1.60	2.40 - 7.60	K/uL
LYMPHOCYTE #	2.30	1.00 - 4.30	K/uL
MONOCYTES #	0.40	0.00 - 1.10	K/uL
EOSINOPHILS #	0.10	0.00 - 0.60	K/uL
BASOPHILS #	0.00	0.00 - 0.20	K/uL
SEGMENTED NEUTROPHIL %	36.6	50.0 - 70.0	%
LYMPHOCYTE %	52.0	20.0 - 40.0	%
MONOCYTES %	8.9	0.0 - 15.0	%
EOSINOPHILS %	1.9	0.0 - 6.0	%
BASOPHILS %	0.6	0.0 - 2.0	%

