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Original Article

Intravenous Infusion of Acetaminophen Versus Nalbuphine as a Post-operative Pain Relief After lower Abdominal Surgery

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ARTICLE INFO	ABSTRACT

Objective: The aim of this study is to make an assessment for Intravenous Acetaminophen against Nalbuphine intravenous injection after a single dose in relieving post-operative pain after lower abdominal surgeries.

Experimental approach: One hundred patients were categorized into two groups, each group of 50 patients suspected to lower abdominal surgery, the first group received Acetaminophen 1000 mg intravenous infusion as a single dose. While the Second group received Nalbuphine 10 mg intravenous injection as a single dose.

For each group Visual Analogue Scale (VAS) was measured for each patient before taking drugs (T0), after 15 min (T1), 1hr (T2), 2hrs (T3), 3hrs (T4) and 4hrs (T5) from taking drugs. Blood glucose level, heart rate and arterial blood pressure were recorded before taking drugs (T0), after 1hr (T1), 2hrs (T2), 3hrs (T3) and 4hrs (T4) from taking drugs.

Need for any additional analgesia was recorded in both groups.

Any adverse events were recorded.

Findings and discussion: Regarding (VAS) there was no significant differences between both groups at T0, T1, T2, althoughthere were a significant difference between both groups at T3, T4 and T5.

By measuring the differences between both groups regarding blood glucose level, heart rate, arterial blood pressure. The study showed that there is no significant differences between both groups at (T0), (T1), (T2), (T3) and (T4).

Conclusion: Nalbuphine iv injection is preferable than IV Acetaminophen infusion in relieving mild to moderate pain after lower abdominal surgeries **as it** lasts for four hours after administering it with significantly no adverse events.

Key words: Acetaminophen infusion, Perfalgan, Nalbuphine, Post-operative pain, Visual analogue scale VAS.

1. INTRODUCTION

Pain often is so subjective, however, that many clinicians define pain as whatever the patient says it is, and the perception of pain (pain threshold) can be influenced by

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affective (emotional), behavior, cognitive (beliefs and attitudes), sensory (perceptual), and physiologic factors" [1]

Pain after surgery is common, often severe and largely unnecessary. Effective relief of post –operative pain is vital and not just humanitarian reasons. Such pain probably prolongs hospital stay, as it can affect all organ systems, including: respiratory (e.g. reduced cough, sputum retention, hypoxaemia); cardiovascular (e.g. increased myocardial oxygen consumption, ischaemia); gastrointestinal (e.g. decreased gastric emptying, reduced gut motility, constipation); genitourinary (e.g. urinary retention); neuroendocrine (e.g. hyperglycemia, protein catabolism, sodium retention); musculoskeletal (e.g. reduced mobility, pressure sores, increased risk of DVT); and psychological (e.g. anxiety, fatigue). There is now evidence that post-operative pain relief has significant physiological benefit. [2]

Intravenous acetaminophen was approved for use by the US Food and Drug Administration in November 2010 for treatment of mild to moderate pain, treatment of moderate to severe pain with adjunctive opioid analgesics, and reduction of fever, Aalsoan IV preparation of acetaminophen, Perfalgan®, was approved in 2001 for use outside the U.S., in nearly 80 countries. [3]

IV Acetaminophen is relatively safe and does not produce the unwanted side effects of opioids (respiratory depression, decreased gastric motility, and increased risk of substance abuse) or non-steroidal anti-inflammatory drugs (NSAIDs) (impair platelet function or impaired renal function) [4] Acetaminophen, both in general and in the infusible formulation, has a very good safety profile at therapeutic doses. In clinical trials, Intravenous Acetaminophen has shown a safety index similar to placebo. [5] Combination studies have shown that Intravenous Acetaminophen has an opioid-sparing effect, and that it can reduce the patient's total opioid requirement by 24-46%. [6]

This study was concerned in comparing the effectiveness of Intravenous Acetaminophen against Nalbuphine IV injection in relieving post-operative pain after lower abdominal pain surgeries by using VAS, which is ungraded scale of 10 cm long, the patient mark at a point on this scale that he thought it expresses his pain sensation.

In addition, the study records the effect of pain stress on blood glucose level, heart rate, systolic blood pressure and diastolic blood pressure.

2. MATERIALS AND METHODS

Study design:
This is a prospective, randomized, double blinded study.

Setting:
These cases selected from surgery units in soldiers Police hospital in Cairo, Egypt, during the period from January 2014 to November 2014.

Ethical and legal aspects:
- The procedures set out in this study were designed to be obeyed the principles of good clinical practice and the ethical principles laid down in the current revision of the declaration of Helsinki.
- The study protocol was revised and approved by the ethics committee of the Faculty of Pharmacy, Ain Shams University.
- We ensured that all persons involved in this study were adequately informed about the protocol, the study related duties and functions and the study treatments.
- The investigator ensured that all patients have been educated how to express their sensation of pain using VAS and the nature and scope of the study before admitted to the study.

Patients:
One hundred patients, all males, suspected to lower abdominal surgeries and divided in to two groups each group of 50 patients, group I received 1000 mg of Acetaminophen IV infusion as a single dose while group II received10 mg of Nalbuphine IVinjection as a single dose.

Inclusion criteria:
- Age: 21 years' old male.
- Gender: all are males.
- Types of surgeries: lower abdominal surgeries including Varicocele, Appendectomy, External inguinal hernia, internal inguinal hernia, Umbilical hernia.

Exclusion criteria:
- Not addicted patient to any narcotic drugs.
- History of complete non-responsiveness to acetaminophen.
- History of hypersensitivity or serious adverse reactions to acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), or opioids.
- Gastric or peptic ulcer disease.
- Blood coagulation abnormality.
- Diabetic patients.
- Impaired liver or kidney function patients
- Hypertensive patients.
- Analgesics 12 hours before and 6 hours after administration of the study drugs.
- History of chronic obstructive pulmonary disease, tuberculosis, or any other pulmonary diseases.
- History of administering of either monoamines oxidase inhibitors (MAO inhibitors), tricyclic anti-depressants, sedative-hypnotics and antipsychotic drugs.

Methods:
1) One hundred patients categorized into two equal groups, each group of 50 male patients scheduled for post-operative pain relief after lower abdominal surgeries using spinal anesthesia by Heavy Marcaine® ampule (0.5% W/V Bupivacaine hydrochloride).

i.   The first group received Acetaminophen 1000 mg intravenous infusion as a single dose over 5 minutes.

ii. The Second group received Nalbuphine 10 mg intravenousinjection as a single dose, and each patient would be the control of himself in the both groups.

2) Pain assessment:

i. By using Visual analogue scale (VAS), which is one of the most commonly used pain assessment instruments and it is regarded as the **gold** standard in researches and clinical practice. [7]

Reporting VAS readings will start after recovery from spinal anesthesia (4 to 6 hrs. after end of surgery) and immediately before receiving the drugs of study (T0) where pain is intense and this was considered as the base line for subsequent readings.

After 15 minutes from giving the drugs of study, that indicates the onset of analgesic effect of both drugs (T1) then after 1 hour (T2), 2 hours (T3), 3 hours (T4) and finally after 4 hours (T5) from drugs administration.

ii. Vital signs:

iia) Arterial blood pressure after recovery from spinal anesthesia (4 to 6 hrs. after end of surgery) and before giving the drugs of the study (T0) where pain is intense and it was considered as the base line for other readings, after 1 hr. from giving the drugs of study (T1) and then after 2 hrs. (T2), 3 hrs. (T3) and finally after 4 hrs. (T4).

iib) Heart rate after recovery from spinal anesthesia (4 to 6 hrs. after end of surgery) and before giving the drugs of the study (T0)and then after 1 hr. from giving the drugs of study (T1), after 2 hrs. (T2), 3 hrs. (T3) and finally after 4 hrs. (T4).

iic) Monitoring breathing rate for Nalbuphine group to avoid any respiratory depression that may happen is very important, fewer than 8 breaths/min. is often considered to be a sign of respiratory depression.

iii. Laboratory studies:

Blood glucose level as an indicator for stress of pain, and will measured after recovery from spinal anesthesia (4 to 6 hrs. after end of surgery) and before giving the drugs of study (T0), after 1 hr. from giving the drugs of study (T1), then after 2 hrs. (T2), 3 hrs. (T3) and 4 hrs. (T4).

iv. The need for rescue or additional analgesia during the study was recorded and expressed as positive (patient needs additional analgesia) and negative (patient does not need additional analgesia), and the additional analgesia was Voltaren® ampoule 75 mg (Diclofenac sodium) given by drip on saline solution.

3) Side effects assessment: like respiratory depression, nausea and vomiting were recorded.

Role of clinical pharmacist in the research:

After choosing the team participating in this research, the clinical pharmacist did several meetings to explain all about this study. Our time schedule for the study, the picked cases and how to choose the participants in a random way to ensure that neither the researcher nor the participants would interfere in the process, the way that data will be collected and analyzed and how to deal with any complications that may be happened.

Then, we started to work on the selected cases in an ascending way, as we started to work a single day per week

until we became sure that all procedures was done perfectly and are well controlled then we began to work every other day till we complete the number of cases needed for the study.

Also the clinical pharmacist did the following:

First; training all participants how to express their sensation of unrelieved pain and how to report pain intensity they feel on the unscaled ruler of VAS.

Second; supervising the process of giving the drugs of study.

Third; collecting all data needed in the study at the right time, starting from VAS, blood glucose level, heart rate and arterial blood pressure with the help of the assistant nurse.

Forth; monitoring for any side effects that might be happened.

Statistical Analyses:

- Sample size justificationthe minimal sample size is 100 patient with type I error (Alpha) =0.05 and type II error 0.10 by power of test 90% this calculated by with Medcalc® program V3.2.

- Statistical analysis performed by using the SPSS software for Windows (Statistical Package for the Social Sciences) version 22, all continuous variables expressed as means ± standard deviation (SD).

- A P-value less than 0.05 considered significant.

3. RESULTS AND DISCUSSIONS:

The statistical analysis for demographic data shows that there is no significant difference regarding age and weight by using T-test, for gender, all participants are males.

Types of surgeries done on the participants include varicocele, appendectomy, external inguinal hernia, internal inguinal hernia and umbilical hernia.

1) Statistical analysis for VAS between Acetaminophen group and Nalbuphine group.

By using unpaired T-test to measure the difference between the both groups regarding VAS at different times (T0 before giving the drugs of study, T1 after 15 min. from giving the drugs of study, T2 after 1 hr., T3 after 2hrs., T4 after 3 hrs., T5 after 4 hrs.), it shows that;

There is no significant difference in VAS between both groups at T0, T1 and at T2. There is a significant difference in VAS between both drugs at T3, T4 and finally at T5, where Nalbuphine decrease VAS score at T3, T4 and T5 significantly more than Acetaminophen.

2) Statistical analysis for blood glucose level between Acetaminophen group and Nalbuphine group.

By using unpaired T-test to measure the difference between the both groups regarding blood glucose level at different times (T0 before giving the drugs of study, T1 after 1 hr. from giving the drugs of study, T2 after 2 hr., T3 after 3hrs., T4 after 4 hrs.), it shows that;

There is no significant difference in blood glucose level between both groups at T0, T1, T2, T3 and finally at T4.

3) Statistical analysis for heart rate between Acetaminophen group and Nalbuphine group.

By using unpaired T-test to measure the difference between the both groups regarding heart rate at different times (T0 before giving the drugs of study, T1 after 1 hr. from giving the drugs of study, T2 after 2 hr., T3 after 3hrs., T4 after 4 hrs.), it shows that;

There is no significant difference in heart rate between both groups at T0, T1, T2, T3 and finally at T4.

4) Statistical analysis for systolic blood pressure between Acetaminophen group and Nalbuphine group.

By using unpaired T-test to measure the difference between the both groups regarding systolic blood pressure at different times (T0 before giving the drugs of study, T1 after 1 hr. from giving the drugs of study, T2 after 2 hr., T3 after 3hrs., T4 after 4 hrs.), it shows that;

There is no significant difference in systolic blood pressure between both groups at T0, at T1, at T2, at T3 and finally at T4.

5) Statistical analysis for diastolic blood pressure between Acetaminophen group and Nalbuphine group.

By using unpaired T-test to measure the difference between the both groups regarding diastolic blood pressure at different times (T0 before giving the drugs of study, T1 after 1 hr. from giving the drugs of study, T2 after 2 hr., T3 after 3hrs., T4 after 4 hrs.), it shows that:

There is no significant difference in diastolic blood pressure between both groups at T0, T1, T2, T3 and finally at T4.

6) Statistical analysis regarding the need for additional analgesics.

By using Chi-square test between Acetaminophen infusion group and Nalbuphine injection group shows insignificant difference between both groups regarding the need for additional analgesics. (Table 6)

7) Side effects assessment: there was no statistically significant difference between the two groups, as only one case had hypoglycemia throughout the study in Acetaminophen group, another two cases had complain from nausea and only one patient had vomit in Nalbuphine group and no other cases showed any signs of respiratory depression.

4. DISCUSSION

Nalbuphine is a partial kappa agonist mu antagonist opioid of the phenanthrene series which was synthesized in an attempt to produce analgesia without the undesirable side effects of a mu agonist, notably respiratory depression and drug dependence, with a lower incidence of nausea and vomiting than morphine [1]

An IV preparation of Acetaminophen was approved in 2001 for use outside the U.S., in nearly 80 countries [8] Intravenous Acetaminophen is considered as the non-opioid analgesic of choice to treat postoperative mild and moderate pain; furthermore, in the treatment of severe pain, it can reduce the need for opioid-analgesics . [9]

This study concerned in comparing the analgesic effect of intravenous Nalbuphine to intravenous Acetaminophen after lower abdominal surgery by using VAS. Also comparing the changes occurs in blood glucose level, heart rate, systolic blood pressure and diastolic blood pressure as a result of difference in perception of pain without neglecting to note any adverse events that may occur as a result of using the drugs of study. This assessment for intravenous Nalbuphine against intravenous Acetaminophen is a result of our perception in the need for a safe drug that can provide excellent analgesia with minimal side effects.

The study found that the use of I.V Acetaminophen is as effective as Nalbuphine I.V in relieving post-operative pain after lower abdominal surgeries, after 15 min. from giving both drugs and till 1 hr. as there is no significant difference between both groups after 15 min. and after 1hr. which indicates that both drugs give an approximately rapid effect after 15 min. and after 1 hr. which indicates that the analgesic effect of both drugs after 1 hr. is still statistically convergent.

However, starting from 2 hrs. after giving the drugs we noticed vanishing of the analgesic effect in Acetaminophen group, as the mean value of VAS after 2 hrs. began to increase (4.960) in a statistically significant way than the mean value of VAS in Nalbuphine group (3.878). Also after 3 and 4 hrs. there are significant differences in VAS between both groups where Nalbuphine decrease VAS score after 2, 3 and 4 hrs. significantly more than Acetaminophen.

By using paired T-test to measure difference in VAS within each group separately comparing to T0, which is the baseline. In Acetaminophen group there are significant differences in comparing VAS at T1 (after 15 minutes.), T2 (after 1 hr.) and T3 (after 2 hrs.) to the baseline T0 (before giving the drug), while it shows insignificant differences in comparing VAS at T4 (after 3 hrs.) and T5 (after 4 hrs.) to the baseline T0 and this indicates the vanishing of the analgesic effect of Acetaminophen approximately after 2 hrs.that agree with Elbohoty et al (2012) [10] who said that the analgesic effect of Acetaminophen I.V lasts at least for 2 hrs. while in Nalbuphinegroup there are significant differences in comparing VAS after 15 min (T1), 1hr (T2), 2hrs (T3), 3hrs (T4) and 4 hrs (T5) to the baseline (T0), and this indicates the continuous analgesic effect of Nalbuphine despite of passing 4 hrs, although the mean value of VAS in Nalbuphine group began to rise at T4 (4.372) and T5 (4.696) but this rising stilled insignificant.

In detecting the effect of pain on blood glucose level the study shows that there are statistically significant differences inside Nalbuphine group in comparing blood glucose level after passing 1hr, 2hrs, 3hrs and 4 hrs. to the baseline which illustrate the stress effect of pain in increasing blood glucose level (that decreases directly proportional with VAS score) which agree with the previous results of VAS. Also in Acetaminophen group there are statistically significant differences comparing blood glucose level after 1hr and 2hrs to the baseline, while it shows insignificant differences in comparing blood glucose level after 3 and 4 hrs. to the

baseline which supports the previous results of VAS that indicates the vanishing of the analgesic effect of Acetaminophen after approximately 2 hrs. Nevertheless between both groups, the study shows that the effect of pain stress on blood glucose level between both groups was not clear, as no statistically significant difference detected between both groups regarding blood glucose level at all times of the study (after 1hr, 2hrs, 3hrs and 4 hrs. from giving the drugs).

Regarding heart rate, there is no significant difference between both groups at all times of study (after 1hr, 2hrs, 3hrs and 4 hrs.).

Regarding systolic blood pressure and diastolic blood pressure, there is no significant difference between both groups at all times of study (after 1hr, 2hrs, 3hrs and 4 hrs.).

Using Chi-square test to measure the difference between Acetaminophen I.V group and Nalbuphine I.V group regarding the need for any additional analgesia it shows insignificant difference between both groups. In Acetaminophen I.V group, nine patients need additional analgesics with a ratio of 18% while in Nalbuphine I.V group only five patients need additional analgesics with a ratio of 10% but this difference still statistically insignificantly.

In relation to adverse events that might happen due to drugs of study especially for respiratory depression that may appear in Nalbuphine group. And by reporting any complaints from nausea and vomiting that may appear particularly in Nalbuphine group.

As a result no case suffers from respiratory depression which was defined as; fewer than 8 breaths/min. is often considered to be a sign of respiratory depression. [11]

Regarding nausea only two patients complained from nausea and only one has vomit in Nalbuphine group which significantly indifference.

One patient had hypoglycemia in Acetaminophen group after 3 hrs. from giving the drug and it is of no origin.

Table 1: Differences in VAS betweenAcetaminophen infusion group &Nalbuphine injection group by using unpaired T-test.

VAS	Acetaminophen infusion (group I) (n=50)		Nalbuphine injection (group II) (n=50)		P-value	Sig.
	Mean	± SD	Mean	± SD		
T0	5.980	± 1.488	6.074	± 2.037	0.793	NS
T1	5.636	± 1.548	5.472	± 2.059	0.654	NS
T2	5.074	± 1.745	4.332	± 2.213	0.066	NS
T3	4.960	± 1.716	3.878	± 2.554	0.015*	S
T4	5.672	± 1.500	4.372	± 2.121	0.001*	S
T5	5.926	± 1.341	4.696	± 1.851	<0.001*	S

Where **T0**; before giving the drugs of study, **n**; number of cases, **NS**; insignificant, **S**; significant.
T1; after 15 min. from giving the drug.
T2; after 1 hr. from giving the drugs.
T3; after 2hrs.   from giving the drugs.
T4; after 3hrs.   from giving the drugs.**T5**; after 4hrs.from giving the drugs.
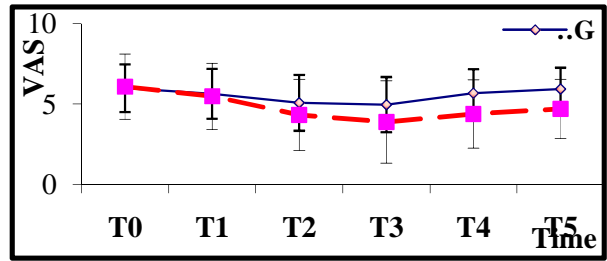(* is significant where P   0.05)

Fig 1: comparing the paired T-test of each group (**Acetaminophen** infusion group and **Nalbuphine** injection group) regarding VAS.
Group I Acetaminophen infusion and **group II**Nalbuphine injection.

Table 2: Differences in blood glucose level between Acetaminophen infusion group & Nalbuphine injection group by using unpaired T-test.

Blood glucose level	Acetaminophen infusion (group I) (n=50)		Nalbuphine injection (group II) (n=50)		P-value	Sig.
	Mean	± SD	Mean	± SD		
T0	96.680	± 16.392	95.220	± 18.127	0.674	NS
T1	94.060	± 14.782	89.900	± 14.423	0.158	NS
T2	92.300	± 14.996	88.720	± 14.559	0.229	NS
T3	93.700	± 18.442	89.360	± 14.201	0.190	NS
T4	96.200	± 19.505	88.800	± 19.251	0.059	NS

Where **T0**; before giving the drugs of study, **n**; number of cases, **NS**; insignificant, **S**; significant.
T1; after 1 hr. from giving the drugs.
T2; after 2hrs.   from giving the drugs.
T3; after 3hrs.   from giving the drugs.
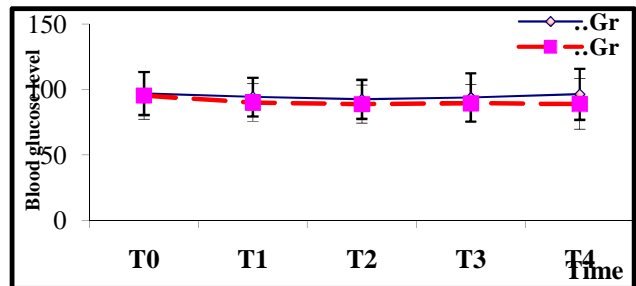**T4**; after 4hrs.   from giving the drugs.

Fig 2: Comparing the paired T-test of each group (Acetaminopheninfusion group and Nalbuphine injection group) according to blood glucose level.
Group I Acetaminophen infusion and **group II** Nalbuphine injection.

Table 3 : Differences in heart rate between Acetaminophen infusion group &Nalbuphine injection group by using unpaired T-test.

Heart rate	Acetaminophen infusion (group I) (n=50)		Nalbuphine injection (group II) (n=50)		P-value	Sig.
	Mean	± SD	Mean	± SD		
T0	76.500	± 6.861	76.840	± 6.218	0.796	NS
T1	74.120	± 6.039	74.780	± 5.545	0.571	NS
T2	71.880	± 7.190	73.740	± 6.262	0.171	NS
T3	72.320	± 6.915	74.480	± 6.497	0.111	NS
T4	72.040	± 7.578	74.740	± 7.618	0.079	NS

Where **T0**; before giving the drugs of study, **n**; number of cases, **NS**; insignificant, **S**; significant.
T1; after 1 hr. from giving the drugs.
T2; after 2hrs.   from giving the drugs.
T3; after 3hrs.   from giving the drugs.
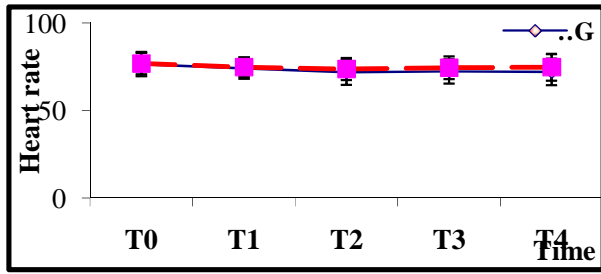**T4**; after 4hrs.   from giving the drugs.

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Fig 3: Comparing the paired T-test of each group (Acetaminophen infusion group and Nalbuphine injection group) according to heart rate.
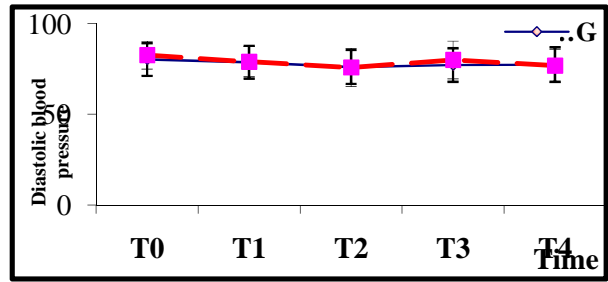**Group I** Acetaminophen infusion and **group II** Nalbuphine injection.

Table 4: Differences in systolic blood pressure between Acetaminophen infusion group & Nalbuphine injection group by using unpaired T-test.

SBP	Acetaminophen infusion (group I) (n=50)			Nalbuphine injection (group II) (n=50)			P-value	Sig.
	Mean	±	SD	Mean	±	SD		
T0	120.500	±	13.180	123.600	±	14.107	0.259	NS
T1	118.200	±	11.328	118.600	±	11.205	0.859	NS
T2	115.100	±	11.450	117.500	±	11.963	0.308	NS
T3	117.000	±	12.080	121.800	±	12.526	0.054	NS
T4	116.300	±	11.641	120.000	±	13.248	0.141	NS

Where **T0**; before giving the drugs of study, **n**; number of cases, **NS**; insignificant, **S**; significant.
T1; after 1 hr. from giving the drugs.
T2; after 2hrs.   from giving the drugs.
T3; after 3hrs.   from giving the drugs.
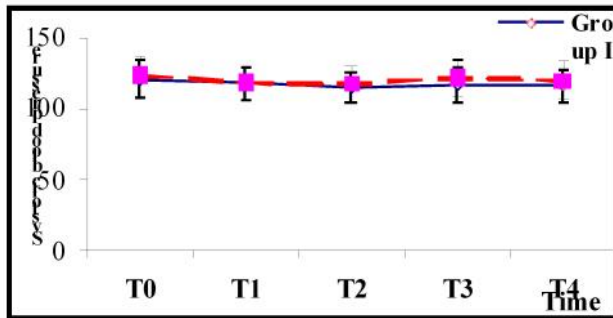**T4**; after 4hrs.   from giving the drugs.

Fig 4: comparing the paired T-test of each group (Acetaminophen infusion group and Nalbuphine injection group) according to Systolic blood pressure.
Group I Acetaminophen infusion and **group II** Nalbuphine injection.

Table 5: Differences in diastolic blood pressure between Acetaminophen infusion group & Nalbuphine injection group by using unpaired T-test.

DBP	Acetaminophen infusion (group I) (n=50)			Nalbuphine injection (group II) (n=50)			P-value	Sig.
	Mean	±	SD	Mean	±	SD		
T0	80.300	±	9.002	82.700	±	7.573	0.152	NS
T1	78.700	±	9.024	79.100	±	8.311	0.818	NS
T2	76.100	±	9.384	75.900	±	10.385	0.920	NS
T3	77.200	±	9.322	80.000	±	10.400	0.159	NS
T4	77.400	±	9.543	76.900	±	9.141	0.790	NS

Where **T0**; before giving the drugs of study, **n**; number of cases, **NS**; insignificant, **S**; significant.
T1; after 1 hr. from giving the drugs.
T2; after 2hrs.   from giving the drugs.
T3; after 3hrs.   from giving the drugs.
T4; after 4hrs.   from giving the drugs.

Fig 5: Comparing the paired T-test of each group (Acetaminophen infusion group and Nalbuphine injection group) according to diastolic blood pressure.
Group I Acetaminophen infusion and **group II** Nalbuphine injection.

Table 6: represents the need for additional analgesics by using Chi-square test between (Acetaminophen infusion) group & (Nalbuphine injection) group.

Need for additional analgesics		Groups		Total
		Acetaminophen infusion (group I) (n=50)	Nalbuphine injection (group II) (n=50)	
Negative	N	41	45	86
	%	82.00	90.00	86.00
Positive	N	9	5	14
	%	18.00	10.00	14.0
Total	N	50	50	100
	%	100.00	100.00	100.00
Chi-square	P-value	0.387		
	Sig.	NS		

n; number of cases, **NS**; insignificant

5. CONCLUSION

The study found that using of Acetaminophen iv is as effective as Nalbuphine injection in relieving post-operative pain in male patients suspected to lower abdominal surgeries after 15 min from giving both drugs and till 1 hr, but Nalbuphine has more prolonged analgesic effect than Acetaminophen iv as it's analgesic effect lasts for four hours after giving it, with a respective safety margin, after giving a dose of 10 mg Nalbuphine as an intravenous injection.

Although there were no statistically significant differences between both of them regarding the changes that happened in blood glucose level, heart rate and arterial blood pressure as a result of pain stress.

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