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Effect of General and Spinal Anesthesia on Hepatic and Renal functions and Hemodynamic parameters of Iraqi Women Undergo Cesarean Section: Comparative Study

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Abstract:

Both general and spinal anesthesia can be use during caesarean section. Spinal anesthesia is preferred by anesthesiologists and gynecologists because of its beneficial effects for both mothers and their fetuses. They were not affecting the creatinine level but affecting only on elevation of liver enzymes. Spinal anesthesia effect on hemodynamic parameters more than general anesthesia, and it causes less operative blood loss than general anesthesia.

Key words: Caesarean section, General anesthesia, Spinal anesthesia, Creatinine, Alkaline phosphatase (ALP), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT).

تأثير التخدير العام والنصفي على وظائف الكلية و الكبد و معلمات الدورة الدموية للنساء العراقيات اللواتي يخضعن لعمليات ولادة قيصرية: دراسة مقارنة

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الخلاصة:

يمكن استخدام كل من التخدير العام والتخدير في الحبل الشوكي خلال العملية القيصرية. التخدير في الحبل الشوكي يفضل من قبل أطباء التخدير واطباء النسائية بسبب آثاره المفيدة للأمهات والاجنة. كلاهما لا يؤثر على مستوى الكرياتينين ولكنهما يسببان ارتفاع إنزيمات الكبد. التخدير في الحبل الشوكي يسبب تغيير في معلمات الدورة الدموية أكثر من التخدير العام ، و يسبب فقدان كميه أقل من الدم خلال العملية الجراحية مقارنة بالتخدير العام..

مفاتيح الكلمات : الولادة القيصرية،التخدير العام، التخدير النصفي، الكرياتنين، الكلاين فوسفتيس، اسبارتيت امايتوترانسفريس، النين امايتوترانسفريس

Introduction:

Anesthesia is loss of sensation with or without loss of consciousness [1]. The goals of anesthesia are hypnosis, analgesia and muscle relaxation. This allows patients to undergo surgery without the distress and pain.[2] There are three major types of anesthesia general, regional, and local.[3] General anesthesia represses activity of the

central nervous system and results in loss of consciousness and total absence of sensation.[4] The most common types of regional anesthesia are spinal anesthesia[2], is the injection of local anesthetic solution into the cerebrospinal fluid (CSF) located within the subarachnoid (intrathecal) space to supply analgesia in the pelvis, abdomen or lower extremities.[5] The glomerular filtration rate and renal blood flow are raised approximately 50% to 60% at the end of the first trimester of pregnancy and do not revert to pre pregnant scales until 3 months postnatal. So, the normal supreme limits in serum creatinine and blood urea nitrogen concentrations are reduced nearly 50% in pregnant women. Blood flow in the liver does not alteration significantly with gestation. A slight increase in hepatic function tests may occur in the third trimester [6].

Hepatic blood flow declines with anesthesia. Many drugs that used are metabolized, (at least in portion) via the liver. Also, the kidneys are susceptible to injury due to reduced blood flow. The normal kidneys will not hurt any clinical effects. Kidney that are functioning poorly before anesthesia and surgery may very well become worse afterwards [7]. Cesarean section is the birth of a fetus via laparotomy and then hysterotomy.[8] Both general and spinal anesthesia can be use during caesarean section.[9] Spinal anesthesia is usually preferred by gynecologists and anesthesiologists because of its useful influences for mothers and their babies during cesarean section. Nevertheless, when the spinal anesthesia is contraindicated, the general anesthesia may be use.[10,11] Regional anesthesia is employed in 95% of births, spinal anesthesia and combined epidural and spinal anesthesia being the most usually utilized regional techniques in elective caesarean section.[12] The spinal anesthesia is generally considered as more safer and practical than general anesthesia, advantages of spinal anesthesia include less newborn exposure to medications, a reduced peril of maternal pulmonary aspiration, no risk of failed endotracheal intubation that may occur in general anesthesia and mother is awake when her baby is born.[9]

General anesthesia requires the use of multiple drugs, most of these drugs influence the neonatal in two ways: via direct influence through placental drug transfer or via indirect influence resulting from maternal biochemical and physiological alterations, that appear to be more important. [13]

A Cochrane Review of 16 studies that comparing between general anesthesia and neuraxial blockade in cesarean sections found no marked variance in apgar scores of neonatal or the requirement for neonatal resuscitation, and there was no evidence to show that neuraxial anesthesia was superior to general anesthesia for neonatal and mother outcome[14].

The aim of this study was designed to compare the effects of spinal and general anesthesia on hepatic and renal functions and hemodynamic parameters in the pregnant women undergoing elective cesarean section.

Materials and Methods

This clinical study was carried out on (48) pregnant women undergone cesarean section with age range (17 – 44 years) in Al-Alwaiya maternity teaching hospital during the period of study from August 2016 to November 2016 under supervision of specialist gynecologist and anesthesiologist doctors. Patients classified into two groups according to the type of anesthesia given to the patient:

•Group A: patients undergo a caesarean section under general anesthesia include (24 patients) with a range of age (17-44 years).

•Group B: patients undergo a caesarean section under spinal anesthesia include (24 patients) with a range of age (21-37 years).

Alkaline phosphatase (ALP), Creatinine, Aspartate Aminotransferase (AST),

Alanine Aminotransferase (ALT), Blood pressure, heart rate and complete blood picture were determined through this study at zero time (before anesthesia) and 24hrs postoperatively.

The diagnostic kits utilized in this study are Alkaline phosphatase (ALP) kit, Creatinine kit manufacturing by Roche/ Germany and Aspartate Aminotransferase (AST) kit, Alanine Aminotransferase (ALT) kit manufacturing by Randox/ United Kingdom. The instruments used in this study are Centrifuge manufacturing by Kokusan/ Japan, Spectrophotometer manufacturing by Cecil/ France, Reflotron manufacturing by Roch/ Germany, Blood hematology analyzer device manufacturing by Emerald/ France and Water bath manufacturing by Memmert/ Germany.

Statistical Analysis: In this study, the acquired quantitative data was inserted as mean ± standard error of mean (S.E.M.). They significance of the differences among mean values was assessed via utilizing paired and independent student's t-test. The acquired difference was regarded to be not significant if p value > 0.05, significant if ($0.05 \geq p > 0.01$) and highly significant if $p \leq 0.01$ (Daniel and Cross, 2013).

Results

The creatinine value in both patient groups showed no significant difference after 12hr and 24hr of anesthesia, and no significance differences between patients of both groups.

For ALP, there was a significant reduction in its mean level after 24hr of anesthesia in both patient groups, and spinal anesthesia cause more reduction in ALP concentration than general anesthesia. The ALT and AST values in both anesthetic groups showed highly significant elevation in its mean level after 24hr of anesthesia, and there were no significant differences between patients of both groups for AST value, while spinal anesthesia cause more elevation in ALT concentration. The mean level of white blood cell (WBC) and platelet in both group was not significantly difference after 24hr of anesthesia, and no significance differences between patients of both groups. For hemoglobin (Hb) and packed cell volume (PCV), there was a significant reduction in its mean level after 24hr of anesthesia in both patient groups, and general anesthesia cause more reduction in their concentration than spinal anesthesia.

The value of systolic and diastolic blood pressure in both groups was significantly reduction after 24hr of anesthesia, spinal anesthesia causes more reduction in systolic blood pressure than general anesthesia. No significant differences in mean heart rate level were noticed after 24hr of anesthesia in both groups, and spinal anesthesia more reduce it is level than general anesthesia.

Table (1): Effect of anesthesia on systolic blood pressure level in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Systolic blood pressure level (mmHg)			
Groups	**Zero time (before anesthesia)**	**24hr after anesthesia**	**P value**
Group A (n=24)	116 ± 1.8^{S} *	110 ± 2.1^{S} *	P=0.03
Group B (n=24)	125.75 ± 3.97^{S} *	115.62 ± 2.07^{S} *	P=0.003
P value	P=0.01	P=0.04	----------

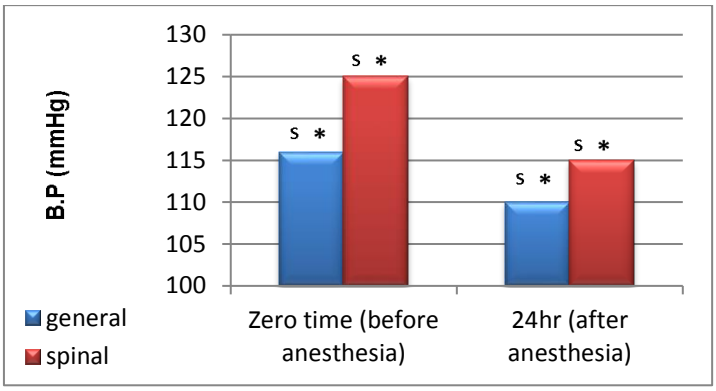

Figure (1): Effect of spinal and general anesthesia on systolic blood pressure

Table (2): Effect of anesthesia on diastolic blood pressure level in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Diastolic blood pressure level (mmHg)			
Groups	**Zero time (before anesthesia)**	**24hr after anesthesia**	**P value**
Group A (n=24)	73.75 ± 1.96 NS	71.25 ± 1.57 NS	P=0.29
Group B (n=24)	78.95 ± 2.1 NS *	74.16 ± 1.3 NS *	P=0.01
P value	P=0.06	P=0.22	----------

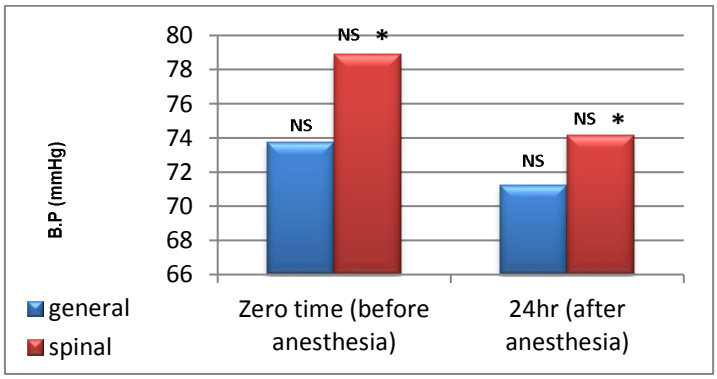

Figure (2): Effect of spinal and general anesthesia on diastolic blood pressure

Table (3): Effect of anesthesia on heart rate value in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Heart rate value (beats per minute)			
Groups	**Zero time (before anesthesia)**	**24hr after anesthesia**	**P value**
Group A (n=24)	92.62 ± 2.5 a	93.79 ± 2.4 a s	P=0.59
Group B (n=24)	89.91 ± 1.5 a	87.41 ± 1.6 a s	P=0.16
P value	P=0.36	P=0.03	----------

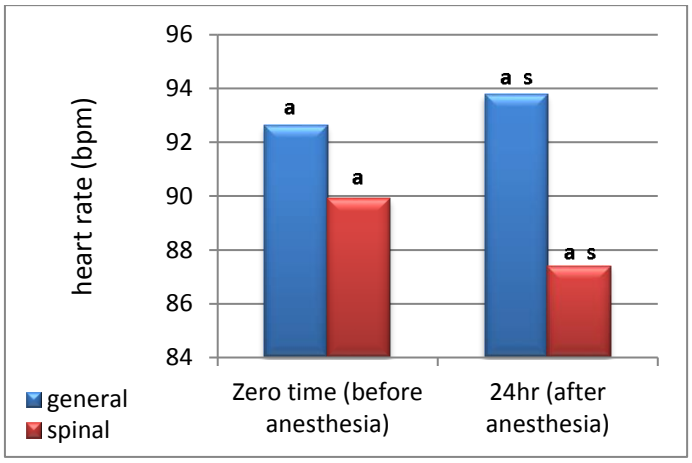

Figure (3): Effect of spinal and general anesthesia on heart rate

Table (4): Effect of anesthesia on serum creatinine in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia.

Serum creatinine value (mg/dl)			
Groups	**Zero time (before anesthesia)**	**24hr after anesthesia**	**P value**
Group A (n=24)	$51.11 \pm 2.4^{NS\ a}$	$50.94 \pm 2.3^{NS\ a}$	P=0.91
Group B (n=24)	$56.15 \pm 1.65^{NS\ a}$	$55.73 \pm 1.32^{NS\ a}$	P=0.85
P value	P=0.1	P=0.08	----------

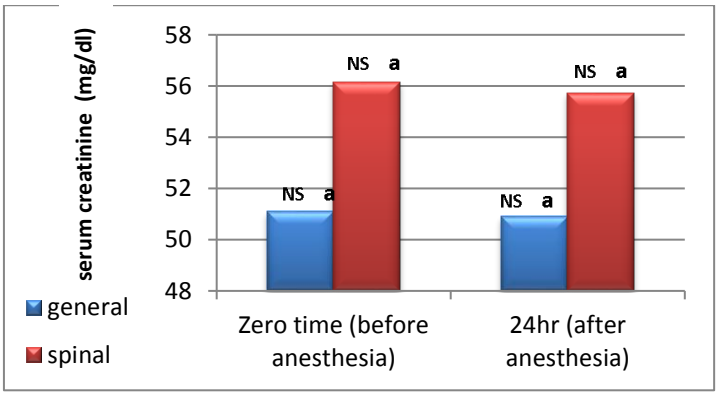

Figure (4): Effect of spinal and general anesthesia on serum creatinine

Table (5): Effect of anesthesia on serum alkaline phosphatase (ALP) value in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Serum alkaline phosphatase value (U/L)			
Groups	**Zero time (before anesthesia)**	**24hr (after anesthesia)**	**P value**
Group A (n=24)	$2.12 \times 10^2 \pm 0.16 \times 10^{2\ S}$ *	$1.82 \times 10^2 \pm 0.14 \times 10^{2\ S}$ *	P=0.0001
Group B (n=24)	$1.65 \times 10^2 \pm 0.07 \times 10^{2\ S}$ *	$1.35 \times 10^2 \pm 0.08 \times 10^{2\ S}$ *	P=0.0001
P value	P=0.01	P=0.007	----------

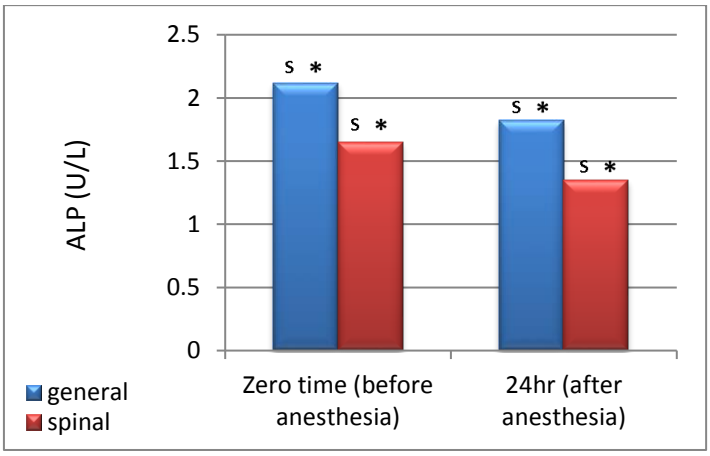

Figure (5): Effect of spinal general anesthesia on ALP

Table (6): Effect of anesthesia on serum alanine aminotransferase value (ALT) in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Serum alanine aminotransferase value (U/L)			
Groups	**Zero time (before anesthesia)**	**24hr (after anesthesia)**	**P value**
Group A (n=24)	8.4 ± 0.54 *	13.8 ± 1.26 S *	P=0.0001
Group B (n=24)	7.95 ± 0.8 *	16 ± 0.97 S *	P=0.0001
P value	P=0.64	P=0.018	----------

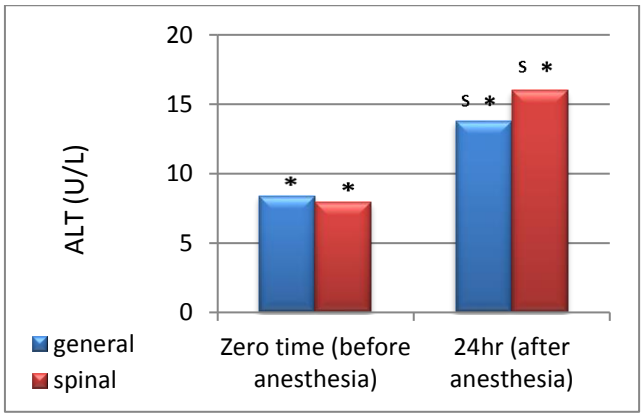

Figure (6): Effect of spinal and general anesthesia on ALT

Table (7): Effect of anesthesia on serum aspartate aminotransferase value (AST) in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Aspartate aminotransferase value (U/L)			
Groups	**Zero time (before anesthesia)**	**24hr (after anesthesia)**	**P value**
Group A (n=24)	8 ± 0.31^{NS} *	22.1 ± 2.26^{NS} *	P=0.0001
Group B (n=24)	7.95 ± 0.32^{NS} *	20.75 ± 1.75^{NS} *	P=0.0001
P value	P=0.82	P=0.64	----------

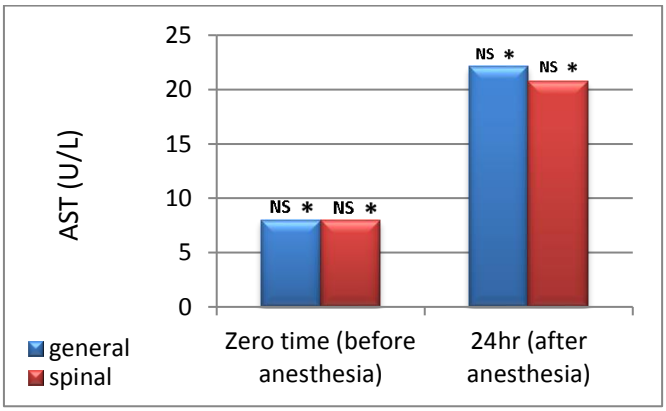

Figure (7): Effect of spinal and general anesthesia on AST

Table (8): Effect of anesthesia on hemoglobin (Hb) value in pregnant women undergo cesarean section at zero time (before anesthesia) and 24hr after anesthesia

Hemoglobin value (gm/L)			
Groups	**Zero time (before anesthesia)**	**24hr (after anesthesia)**	**P value**
Group A (n=24)	11.19 ± 0.21 *	9.65 ± 0.3^{S} *	P=0.0001
Group B (n=24)	11.25 ± 0.23 *	10.53 ± 0.32^{S} *	P=0.0001
P value	P=0.84	P=0.05	----------

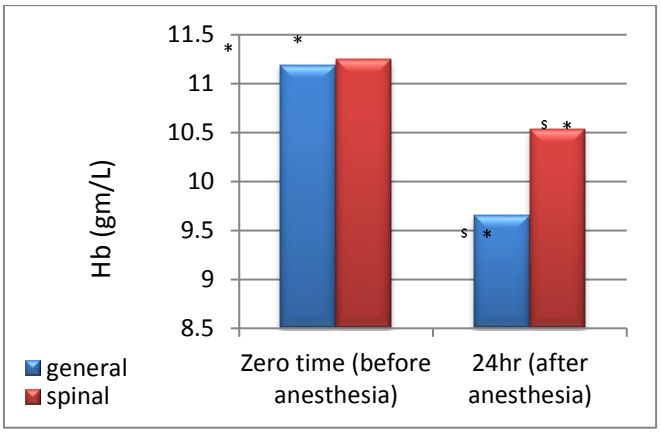

Figure (8): Effect of spinal and general anesthesia on Hb

Discussion

The creatinine value in both patient groups showed no significant difference after 12hr and 24hr of anesthesia, and no significance differences between patients of both groups. This result supported by a study on the effect of low-flow prolonged sevoflurane anesthesia effect on kidney function showed that the serum creatinine was within the normal value, and creatinine clearance was not decrease during the study period [15]. Other retrospective study on oral cancer surgery under general anesthesia that compare between sevoflurane and desflurane, both drugs did not cause clinically significant nephrotoxicity and anesthesia does not damage to the kidney[16].

For ALP, there was a significant reduction in its mean level after 24hr of anesthesia in both patient groups, and spinal anesthesia cause more reduction in ALP concentration than general anesthesia. The reason of this reduction in ALP level may be due to the demise of the placenta, which is an important source of the expression of ALP. The ALT and AST values in both anesthetic groups showed highly significant elevation in its mean level after 24hr of anesthesia, and there were no significant differences between patients of both groups for AST value, while spinal anesthesia cause more elevation in ALT concentration. The current study agreed with many studies, one study which showed that influence of anesthesia on serum AST and ALT enzymes values exhibited significant augmentation of serum efficacy of all enzymes after compared their values before and after general anesthesia [17]. There were raised liver enzymes happens with propofol anesthesia in craniotomy. Enzymes of liver were raised (peak ALT) but reverted to nearly normal values within 5 days [18]. Also, another study suggested that there were slight alterations in postoperative serum values of ALT and AST, were significant and that isoflurane and propofol anesthesia possess a similar minor influence on hepatic function during posterolateral thoracotomy [19]. In cohort research of trauma patients, it was found that some of patients with post-operative liver dysfunction likely to be due to volatile anesthetic and therefore deduced that volatile anesthetic caused liver damage in trauma adult patients may be significant [18]. Moreover, it was observed that there were moderate increases over normal values for ALT and AST after studying both spinal and general anesthesia [20]. Propofol anesthesia in children subjecting craniotomy serum AST and ALT values were elevated significantly after operation compared with baseline, with a peak level in the first day after surgery and get back to normal levels within a week [21]. Furthermore, a cohort study comparison between sevoflurane and desflurane for oral cancer surgery demonstrated that there was a 3-fold and a

2.1-fold rise in AST in the sevoflurane and desflurane groups, consecutively and there was a 3.2-fold and a 1.9-fold increase in ALT in the sevoflurane and desflurane groups, consecutively [16].

Administration of anesthesia decreases flow of blood to the liver throughout all surgical operations, anesthesia diminishes cardiac output and thus reduce portal blood flow, anesthetics alter portal venous and hepatic arterial vascular resistance. In normal hepatic function, the reduction in blood flow may cause a symptomatic rising in the results of hepatic functions biochemical tests after surgery [17]. Other influences that may cause diminished hepatic blood flow during surgery include bleeding, hypotension and vasoactive drugs [22]. Most surgical procedure, whether done under regional (epidural or spinal) or general anesthesia, are followed via minimal alterations of liver functions tests [23]. Anesthetic drugs may decrease liver blood flow via 30% to 50% after induction [17]. The liver cell is susceptible to injury due to its function of dealing with many drugs, metabolites, toxins etc. Synchronous medications, specially antibiotics, could also participate to the postoperative alterations in liver function[16].

The mean level of white blood cell (WBC) and platelet in both groups was not significantly difference after 24hr of anesthesia, and no significance differences between patients of both groups. For hemoglobin (Hb) and packed cell volume (PCV), there was a significant reduction in its mean level after 24hr of anesthesia in both patient groups, and general anesthesia cause more reduction in their concentration than spinal anesthesia. This significant difference was supported by one randomized prospective study on elective cesarean section which showed that the differences between blood values before and after surgery for each study group were statistically significant ($p<0.001$) [24]. And the significant difference between two groups was supported by many studies, one study which showed that the preoperative Hb and PCV values were similar in both groups, and significantly lesser surgical blood loss was obtained using spinal anesthesia against general anesthesia in elective CS, and the mean PCV and Hb concentrations were decreased 13.2% and 11.9%, respectively, in the GA group and 8.6% and 9.3%, consecutively, in the SA group [24]. Other study on elective cesarean section had showed that compared to Hb before surgery, values of Hb in the first day after surgery in spinal group significantly reduced compared to general group[25]. Also, the results in current study are in agreement with other studies exhibited that bleeding and reduced PCV and Hb happen significantly fewer in spinal anesthesia compared to general anesthesia[25, 26-29]. The results in current study are inconsistent with few studies, one study showed that in comparison with GA, there was significantly fewer blood lost in epidural anesthesia but not in spinal anesthesia [30]. And other a prospective trial, involving 200 women undergoing CS demonstrated that there was no significant difference in the surgical blood loss between SA and GA groups [31].

The spinal group had significantly lower values, which can be explicated by three causes. First, in the status of the spinal anesthesia, blood is diluted in procedure of fluid loading. Furthermore, the fluid load is commonly modified at 10 to 15 ml/Kg to avoid hypotension. This injected fluid typically extends through blood vessels pending childbearing and placental delivery, therefore the erythrocyte loss declines during the operation(154). Second, hypotension during the surgery can be a reason [32]. Finally, uterine contraction may differ in various types of anesthesia, intravenous anesthetics like ketamine, propofol and midazolam prevent uterine contraction [33]. So, the women who were given GA would have more surgical blood loss than women who were given SA because of platelet function and

adverse uterine contraction that may be associated with GA [24].

The value of systolic and diastolic blood pressure in both groups was significantly reduction after 24hr of anesthesia, spinal anesthesia causes more reduction in systolic blood pressure than general anesthesia. This significant difference was supported by many studies, in one study on curettage surgery which showed that the mean blood pressure alterations in the general and spinal groups related to the baseline value were reduced up to maximum 5.4% and 8%, respectively [34]. An another study showed that hemodynamic parameters were higher than baseline after beginning of the surgery [35]. A study on cesarean section that perform under spinal anesthesia, hypotension was found in 284 cases (56.5%) [36]. Another Prospective study on cesarean delivery under spinal anesthesia, the incidence of hypotension was 65.1% [37]. And between two groups the results were supported by many studies, one a prospective comparative study on elective cesarean delivery which showed that there were no differences between the two groups in preoperative and postoperative diastolic and systolic blood pressure. There was a statistically significant augment in terms of hypotension in spinal group compared with the general group ($p < 0.001$) [38]. At the same time another study showed that changes in the mean arterial pressure (MAP) and heart rate (HR) in the GA group were less than SA group [34]. Also there was a study demonstrated that hemodynamic variations like heart rate and blood pressure in general anesthesia group were lower than spinal anesthesia group in elective orthopedic and urology surgeries [39].

Furthermore, other study revealed that systolic and diastolic blood pressures were significantly lesser in the spinal group (systolic blood pressure: $P = 0.01$ and diastolic blood pressure: $P < 0.01$)(130). While in only one study on elective surgical patients differ with the current study had shown that the systolic and diastolic arterial pressure (AP) did not differ significantly between the groups [40].

Due to psychological stress (anxiety and fear) and physiological responses (endocrine) of surgery and anesthesia increase secretion of cross-regulating hormones (cortisol, catecholamines) and lead to augmentation of plasma proteins, potassium loss and sodium retention. Stimulation of the sympathetic nervous system, augment of catabolic hormone secretion and pituitary gland suppression occurs as a result of surgical stress, in clinical practice these events cause alterations in blood pressure, heart rate and biochemical fluctuations of adrenaline, noradrenaline, cortisol, and dopamine [41]. Spinal anesthesia produced vasodilatation and sympathetic block, and therefore the venous return reduced.

Then, as central venous pressure declined, the peripheral vascular resistance decreased, and thus the blood pressure declined [40]. No significant differences in mean heart rate level were noticed after 24hr of anesthesia in both groups, and spinal anesthesia more reduce it is level than general anesthesia. Results were supported by one study which showed that the changes in HR do not vary significantly over time for both group ($p=0.456$) [40]. In another study that inconsistent with the current study had shown that the heart rate alterations in the spinal and general groups compared to the baseline value were reduced up to maximum12.5% and 14.5%, respectively [34]. The significant difference between two groups was supported by one study which showed that the HR was significantly higher in the general anesthetic group ($p<0.01$) [40]. While in another study suggest that hemodynamic variations caused via surgical trauma were not significantly different between the groups [34].

Conclusion: -

Both general and spinal anesthesia were not affecting the creatinine level but affecting only on elevation of liver enzymes. Spinal anesthesia effect on hemodynamic parameters more than general anesthesia, and it causes less operative blood loss than general anesthesia.

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