

between two groups normally distributed having quantitative variables. Mann-Whitney test (U) was used for comparison between two groups not normally distributed having quantitative variables. A P value of < 0.05 was considered statistically significant.

Results

A Consolidated Standards of Reporting Trials (CONSORT) flow chart for patient enrollment, allocation, and analysis was presented in (Fig. 1). The trial involved seventy-five patients. Seven patients refused to participate, and sixty-eight patients successfully completed the trial after having provided a written informed consent. They were separated equally into two groups: (ISB) group and (STB) group. The demographic characteristics showed similarity between the groups. (Tab. 1).

There was a significant difference between the two groups regarding the occurrence of hemidiaphragmatic paralysis, which was greater in the ISB group than in the STB group (76.5% vs. 38.2%) (P value 0.001). Moreover, the degree of movement was completely affected in 44.1% of the ISB group compared to 11.8% of the STB group (P value 0.002) (Tab. 2). The procedure duration (min) was significantly higher in the STB group than in the ISB group (6.97 ± 0.67) vs. (6.48 ± 0.69), respectively (P value = 0.008). There was no significant difference between the study groups regarding block onset or motor block duration (P value > 0.05) (Tab. 3). There was no significant difference between the study groups regarding the mean blood pressure and mean heart rate (Fig. 2, 3), time to the first call of analgesia, and intraoperative fentanyl consumption (P value > 0.05) (Tab. 3). No significant complications were observed. Two patients in the ISB group developed hand grip weakness which resolved completely 12 hours after the block.

Discussion

Our investigation revealed that the administration of local anesthetics to the superior trunk selectively results in a reduced incidence of diaphragmatic paralysis when compared with conventional interscalene blocks. However, both blocks provide equivalent analgesic efficacy without obvious side effects.

The traditional interscalene approach of brachial plexus block represents a good choice for postoperative pain control in shoulder arthroscopy. However, its association with a high incidence of diaphragmatic paralysis makes it of limited value for patients with pre-existing respiratory disease [6].

The known mechanism of phrenic nerve palsy after ISB is due to direct local anesthetic spread. However, there are other theories explaining the incidence of phrenic nerve palsy as nerve compression by local anesthetic volume, paracervical hematoma, local ischemic changes, and/or direct nerve injury [7–10].

Great efforts have been made to decrease the incidence of HDP, such as low-volume ISBs, but the occurrence of hemidiaphragmatic involvement is still high, ranging from 34% to 62.5% [11]. Therefore, phrenic-sparing techniques should be available to provide adequate analgesia and reduce the incidence of hemidiaphragmatic paralysis [12].

Burkett-St. Laurent et al. (2014) introduced selective STB as an alternative to ISB in shoulder surgery. They targeted the superior trunk

inferolaterally. Injection was administered more distally after the union of the C6 and C5 nerve roots and before the suprascapular nerve branches off. Therefore, avoiding phrenic nerve block which consequently reduces the risk of respiratory depression, particularly in patients with underlying respiratory diseases, can improve the safety profile of these patients [4, 13].

In this trial, we found that STB was associated with a lower incidence of HDP than interscalene nerve block. This can be explained by the occurrence of diaphragmatic paralysis which is indirectly proportional to the distance from the nerve roots. Additionally, the analgesic efficacy of both blocks was comparable as evidenced by the intraoperative analgesic consumption and the first analgesia call. However, the duration of the STB was slightly longer but statistically comparable to that of the interscalene block, and there was no difference between the two blocks regarding the duration of the motor block or the onset of the sensory block. Patients in both blocks were hemodynamically stable, and no other complications were detected in either group.

Kim et al. carried out their trial with 126 patients, and compared STB with ISB as a sole anesthetic agent with sedo-analgesia. They used 15 ml of 0.5% bupivacaine. The superior trunk group exhibited a significantly lower incidence of HDP than did the interscalene group (4.8% vs. 71.4) as evidenced by a non-inferior worst pain score during the recovery period. This finding is consistent with our own findings [11].

In our study, the incidence of HDP in the STB and ISB groups was 38.2% and 76.5%, respectively. There was a greater incidence of HDP in the STB group than in the STB group in the Kim trial (38.2% vs. 4.8%). This can be explained by the use of different block techniques. In this study, we deposited local anesthetics immediately after the C5 and C6 roots united together. However, Kim and his colleagues performed the block more distally in the supraclavicular fossa.

In agreement with our results, Kang et al. reported similar findings. The incidence of HDP in the STB and ISB groups was 76.3% and 97.5%, respectively, with similar pain scores and analgesic requirements in both groups. The same block technique was used in our study [14].

We noticed that the STB was associated with less diaphragmatic movement involvement. This is because the distance between the C5 and the phrenic nerve root is 1.8 to 2.0 mm in adults at the cricoid cartilage level, and it increases by 3 mm for each distance of 1 cm [4, 15].

This decreases the incidence of local anesthetic spread to the phrenic nerve with superior trunk block [6].

The incidence of hemidiaphragmatic paresis is reduced when the volume of local anesthetics is reduced. However, a low volume may be associated with a high incidence of block failure and poor perioperative analgesic quality among less experienced anesthetists. Therefore, we used 15 ml of 0.25% bupivacaine for both blocks, which is in accordance with the reported practices of other centers [16–19].

The duration of the STB was longer than that of the ISB in our trial. However, the STB is clearly visible and easily defined because it is surround-