INCIDENCE OF HYPOXAEMIA IN THE RECOVERY ROOM FOLLOWING UPPER ABDOMINAL SURGERY

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ABSTRACT

Objective: To determine hypoxaemic episodes of those patients who underwent upper abdominal surgery (UAS).

Material and Methods: Hundred postoperative adult patients were observed during their stay in the recovery room. They were continuously monitored for peripheral arterial oxygen saturation (SpO_2) by pulse oxymeter (bpm-200). The alarms were preset at $SpO_2 \leq 90\%$. These patients also received supplemental O_2 therapy (40%) by fixed performance (Hudson's) mask. All these patients had $SpO_2 \geq 97\%$ before transfer to the recovery room. The number and frequency of un-noticed hypoxaemic events were noted.

Results: This study revealed that the overall incidence of hypoxaemia in these patients was 42%. On arrival in the recovery room 28% patients had $SpO_2 \leq 90\%$. About 106 hypoxaemic episodes occurred during their stay in the recovery room. 10% had up to one episode and 32% had >1 episodes 4% of the patients were discharged with $SpO_2 \leq 90\%$. Statistical analysis reveal that UAS with subjective factors such as obesity and smoking had more hypoxaemic incidences ($P<0.05$).

Conclusion: Our Study concludes that hypoxaemic events are common following upper abdominal surgery even in patients otherwise considered healthy. Hence continuous pulse oximetry should be employed routinely during recovery, as it remains undetected without its use.

Key words: Upper Abdominal Surgery, Pulse Oxymeter, Postoperative hypoxaemia, Oxygen therapy.

INTRODUCTION

Hypoxaemia refer specially to decrease levels of O2 in the arterial blood[1]. The severity of hypoxaemia can be categorized according to the following guidelines,

a. Mild hypoxaemia is defined as paO2 between 60-80 mmHg.

b. Moderate hypoxaemia is defined as paO2 between 40-60 mmHg.

c. Severe hypoxaemia is present when paO2 falls below 40mmHg.

Hypoxaemia may result from low FiO2, hypoventilation, V/Q imbalance or increase O2 consumption produced by restlessness or shivring[2]. Mild to moderate hypoxaemia (PaO2 50-60mmHG) in young healthy patients may be well tolerated initially, but with increasing duration and severity, the initial sympathetic stimulation often seen is replaced with progressive acidosis and circulatory depression[3]. If left untreated it may lead to significant cerebral impairment, cardiac arrest, and multiple organ dysfunctions and ultimately death[4,5]. The clinical sign and symptoms of hypoxia are non-specific, and may include restlessness, agitation, tachycardia confusion, and disorientation. Hypoxaemia is a common complication, well known to occur in the peri-operative period [6]. It can occur during induction, maintenance of anaesthesia, during transfer to the recovery room and post anaesthesia care unit (PACU), it can also occur in the postoperative period upto a period of one week[7]. Hypoxaemia is a major contribution factor in adverse anaesthesia outcome.

Upper abdominal surgery (UAS) is associated with significant impairment of respiratory mechanics, oxygenation, ventilation and pulmonary defense mechanism, independent of general anaesthesia[8]. Joris, Kaba and Lamy describe that the primary determinant of postoperative pulmonary dysfunction was surgical site[9]. Changes in the lungs function are typically restrictive-rapid and shallow breathing, reduced forced vital capacity (FVC) with consequent hypoxaemia. A shift from abdominal to rib cage breathing has been attributed to loss of diaphragmatic contribution to tidal volume. Since respiratory problems are common in the initial postoperative period pulse oximetry monitoring has been accepted universally as a standard of care to alert personnel in the recovery room to impending hypoxaemia. Pulse oximetry has been recommended as a mandatory monitoring device by the American Society of Anaesthesiologists[10]. Considering that the most common cause of anaesthesia related preventable deaths is hypoxia, the routine use of pulse oximetry proves to be of significant benefit. A.B.G (arterial blood gases) measurement should be performed to confirm diagnosis and guide therapy.

MATERIAL AND METHODS

This study was carried out in the Department of Anaesthesiology Khyber Teaching hospital Peshawar.

A total of 100 patients, who underwent elective upper abdominal surgery (UAS) were studied for hypoxaemic episodes during their stay in the recovery room. This non invasive observational study was performed in the immediate postoperative recovery period using continuous pulse oximetry. Institutional guidelines for anaesthetic and postanaesthetic care did not change during the study.

The study was conducted over a period of three (3) months. At the beginning of each day, a prior selection of patient, who fulfilled the inclusion criteria, was made from routine surgical lists. The recovery room staff was informed to receive such patients on a separate recovery room bed, prepared and

DEMOGRAPHIC DATA OF 100 POSTOPERATIVE PATIENTS

Demographics	Females	Males
No. of patient	78 (78%)	22 (22%)
Mean age (years)	43.92	37.72
Age Range (years)	22-70	16-68
ASA-PS I	54	12
ASA-PS II	24	10

TABLE – I

allotted for the study. Exclusion criteria include ASA III and above, emergency surgery and those patients who require postoperative mechanical ventilation.

All such patients, who underwent general anaesthesia (GA) for UAS, lasted for a minimum of 30 mts duration. Before being shifted to the recovery room, they were extubated, spontaneously breathing, having received 100% O_2 by mask and with stable vital signs. Their SpO_2 level were ≥97%. It took less than 5mts in their shifting and transport to the recovery room, during which time oxygen was not administered. The observer would already be present in the recovery room and immediate continuous pulse oximetry monitoring started upon their arrival, till their discharge. The alarms were preset at SpO_2 ≤90%. The sensor of the pulse oximeter was applied to the index finger of the hand opposite to the arterial pressure cuff. Supplemental O_2 (40%) was administered by mask. The patients SpO2' pulse rate, blood pressure were recorded. Other parameters as posture, airway patency checked and recorded. On a proforma , the patient's ASA physical status, age, weight, smoking habit, duration of surgery, type of surgery and incision sites etc. were noted.

In this study, oxyhemoglobin saturation (SpO_2) <90% was defined as mild hypoxaemia, £85% as moderate hypoxaemia, and ≤80% as severe hypoxaemia. At discharge, if SpO_2 was ≤90%, the recovery room staffs were notified and supplementary O_2 was advised in the ward.

RESULTS

A total of 100 postoperative patients who underwent elective UAS were surveyed over a 3 months period. Table 1 presents the demographic details of the study group. It included 78 females and 22 males, with more older and a higher number of ASA-PS class I patients in the female group.

During their stay in the recovery room, 42 patients showed one or more hypoxaemic episodes (SpO_2 ≤ 90%) 28 patients had hypoxaemia at the time of admission to recovery room, 14 patients developed it during their stay in the recovery room while 4 patients were discharged with SpO_2 ≤ 90% as shown in Table 2 and Fig 1.

A total number of 106 desaturation episodes occurred in these 42 hypoxaemic patients. Table 3 shows the hypoxaemic episodes at different saturation levels and depicts the gradual increase in severity of hypoxaemia. Mild hypoxaemia (SpO_2 86-90%) occurred in 28% of patients, moderate hypoxaemia (SpO_2 81-85%) in 26%, while 12% of patients were observed to have severe hypoxaemia (SpO_2 76-80%). However, extreme degree (SpO_2 ≤ 75%) of desaturation also occurred in 14 patients (Fig 2).

HYPOXAEMIA AMONG PATIENTS IN THE RECOVERY ROOM

Incidence of hypoxaemia SpO_2 ≤ 90%	No. of patients	% of patients
Overall incidence	42	42%
At admission	28	28%
During stay	14	14%
On discharge	04	04%

TABLE – 2

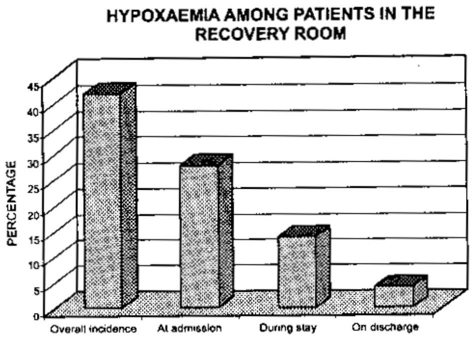

Fig. 1

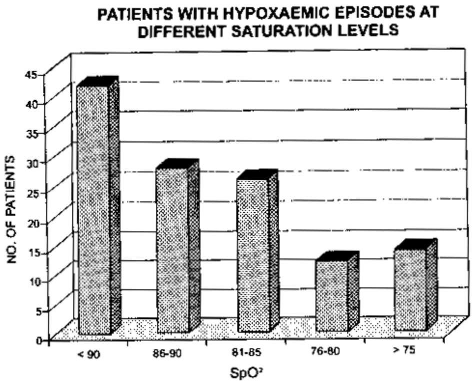

Fig. 2

The relationship between incidence of hypoxaemia and patient related factors were also noted (Table 4). These were analyzed and p value was calculated. Chi-Square (y^2) test was used for the test of significance. The number of degrees of freedom was determined. By applying statistics, it was observed that there were no significant differences for any of the patient's variables measured with the exception of obesity and smoking ($P<0.05$).

The impact of incidence of hypoxaemia relative to the duration of surgical procedure was found to be significant ($P<0.05$), as shown in Table 5. In patients with surgical duration ≥91 min. no significant difference was obtained. This was because of the small number of patients in that group.

DISCUSSION

In the existing pool of knowledge, postoperative. Hypoxaemia is well anticipated, the risk factors discovered and oxygen therapy known to be effective in its treatment. Our study was designed to find out how common is the occurrence of postoperative hypoxaemia in our study group who are particularly prone to develop it? To what degree of severity it occurs inspite of supplemental O_2 therapy in the immediate postoperative period? Pulse oximetry shows its worth in such patients and also delineates those at risk patients from the common pool, who may need O_2 therapy

PATIENTS WITH HYPOXAEMIC EPISODES AT DIFFERENT SATURATION LEVELS

SpO_2 (%)	Degree of severity	No. of episodes	No. of patients	% of patients	Episodes per Patient	
					Mean	Range
≤ 90		106	42	42%	2.52	1-5
86-90	Mild	34	28	28%	1.21	1-2
81-85	Moderate	30	26	26%	1.15	1-2
76-80	Severe	14	12	12%	1.16	1-2
≤ 75	Extreme	14	14	14%	1.0	1-3

TABLE – 3

PATIENTS RELATED FACTORS AND INCIDENCE OF POST OPERATIVE HYPOXAEMIA IN THE RECOVERY ROOM

S. No.	Patient Factors	No. of Patients		No. of Patients with SpO_2<90%		P value	Result
		n = 100	%	n = 42	%		
1.	Hypertension	18	18%	10	24%	P>0.05	NS
2.	Diabetes	6	6%	2	4.80%	P>0.05	NS
3.	Obesity	10	10%	10	24%	P<0.05	S
4.	Smoking	4	4%	4	9.50%	P<0.05	S
5.	ASA-PS						
	Class I	64	64%	18	42.80%	P>0.05	NS
	Class II	36	36%	24	57%	P>0.05	NS
6.	Age						
	< 60 years	72	72%	28	66.70%	P>0.05	NS
	> 60 years	28	28%	14	33.30%	P>0.05	NS
7.	Gender						
	Male	22	22%	8	19%	P>0.05	NS
	Female	78	78%	34	81%	P>0.05	NS

TABLE – 4

Note:

S = Significant.

NS = Non Significant.

in the extended postoperative period. Pulse oximetry is not only the first warning sign against hypoxaemia and its severity, but also assesses the adequacy of O_2 therapy.

Mihm and Halperin[11] made comparison between pulse oximeter reading (SaO_2) and arterial blood hemoglobin O_2 saturation (PaO_2) and found excellent correlation between the two. Their study demonstrating reliability of pulse oximetery to detect clinically significant arterial desaturation.

The present study was conducted to determine the incidence of early postoperative hypoxaemia in the recovery room, in a group of patients particularly prone to develop it (i.e. following UAS) by using the reliable device of continuous pulse oximetry. The results revealed its common occurrence (42%) with varying degrees of severity ranging from mild (SpO_2 86-90% = 28%) moderate (SpO2 81-85% = 26%) to severe (SpO_2 76-80% = 12%) and extreme (SpO2 ≤75% = 14%) inspite of prophylactic oxygen therapy given. Contributing pre-operative and intraoperative risk factors were sought, a high incidence (P<0.05) was found in smokers and in obese.

On admission to the recovery room, 28% of our patients were found hypoxaemic (SaO_2 ≤ 90%) closely relating to the figure of 32% given by Moller et al[12], 35% by Tyler et al[13] and 21% by Hudes et al[14]. A much lower figure of 15% was given by Russel and Graybeal[15]. These differences could be

DURATION OF SURGERY IN COMPARISON WITH THE INCIDENCE OF HYPOXAEMIA IN THE RECOVERY ROOM

Duration of surgery (min)	No. of Patients		No. of Patients with SpO_2<90%		P value	Results
	n = 100	%	n = 42	%		
<60	74	74%	22	52%	P<0.05	S
61-90	14	14%	12	28.6%	P<0.05	S
≥90	12	12%	8	19%	P>0.05	NS

TABLE – 5

Note:

S = Significant.

NS = Non Significant.

explained on the basis of differences in patient selection and type of surgery.

Daley et al[16] found 41% of their patients with hypoxaemia ≤ 90% by continuous pulse oximetry occurring 28±18 mts after discontinuation of O_2 therapy, whereas in our study 42% incidence was found inspite of O_2 therapy. Desaturations in our group was primarily secondary to causes refractory to routine O_2 administration, such as development of shunts after UAS.

Russel and Graybeal gives a more specific overall incidence of 25% (range 72-91%) in 100 postop patients inspite of 40% O_2 administration by face mask, on 68 occasions. The relatively low incidence is due to their exclusion of a large number of invalid readings, as only 68 true desaturations were taken out of a total 472 detected desaturations. Some of the numbers removed (404 episodes) could have been true episodes? They correlated it positively with abdominal/thoracic surgery, longer duration of surgery and high intraoperative fluid administration.

Mckenzie[17] estimated incidence of perioperative hypoxaemia (extending upto day 6) detected by intermittent pulse oximetry in 100 patients with abdominal surgery (Upper + lower, Elective + emergency) and found 29 patients had SpO_2 ≤90% on a total of 51 occasions. This figure is relatively low compared to ours, the difference of 13% can be explained on selection of patients and intermittent recording of SpO_2. However 46 out of his 100 patients had UAS, in whom 18 patients developed hypoxaemia. This figure of 39.13% incidence closely approaches our findings of 42%.

Brown et al[18] gave an exceptional high incidence of 80% in 107 of his randomly selected surgical patients, which can be explained on extended monitoring time of 60 mts and O_2 given intermittently. But when continuous O_2 was administered to 39 of these patients, 25 patients (64%) experienced hypoxaemia as opposed to 80% for the whole study group.

Previous studies found that early post-operative hypoxaemia (SpO_2 ≤90%) occurred in 35% - 70.8% of patients undergoing elective surgery under GA, of which 12% - 34.4% experienced severe hpoxaemia (SpO_2 ≤ 85%).

The degree of severity of hypoxaemia in our study group approximates that of Moller et al[12] and Xue Fu S et al[19]. Moller et al showed an incidence of 55% for mild hypoxaemia (≤90%) 28% for moderate (≤85%) and 13% for severe hypoxaemia (≤80%). Xue Fu S et al showed incidence of hypoxaemia

(86 - 90%) and severe hypoxaemia (≤85%) after UAS to be 38% and 3% in the early postoperative period.

Sia et al[20] noted in his study group who received supplemental O_2 and SpO_2 monitoring done for 60 mts, 36% incidence for mild 13% for moderate and none for severe.

Brown et al gives a higher incidence amongst all these degrees as 80% for mild, 45% for moderate and 26% for severe hypoxaemia. O_2 administration in his study group was intermittent [18].

Recovery rate of SpO_2 was faster during the early postoperative period, hypoxaemic events becoming shorter and fewer as recovery time increased. In our study incidence dropped from 42% to 4% at discharge, as was in Brown et al study where it dropped from 64% to 18% at the end of 1 hour in the Recovery room [18]. Moller et al[12] reported 22% and Fromme et al[21] 27% during transportation from the recovery room.

Our study delineates obesity, smoking and duration of surgery as contributing risk factors predisposing the patients to postoperative hypoxaemia ($P<0.05$). The obese patient is likely to experience postoperative complications as a result of restrictive lung component associated with obesity[22]. Rose et al[23] noting adverse respiratory events in PACU in obese men with a total weight greater than 120 kg and women greater than 100 kg.

The longer the time (even as little as 60 mts) the patient is subjected to the influences of surgery and anaesthesia, the greater the chance of postoperative respiratory impairment including hypoxaemia.

CONCLUSION

Postop. monitoring is inadequate in many of our institutes, rather an institutional failure of the practice of "Standards of Monitoring". There is no protocol in most of our hospitals for postop. Monitoring. Their need still based on clinical judgement. We are still not adequately preventing its occurrence. Monitoring by eye does not recognize hypoxaemia and so we do not treat it, despite our theoretical knowledge of its common occurrence. Once oximetry is available in the recovery room, it can be used in the same way as thermometers, sphymomanometers etc to aid monitoring by the nursing staff of one of the fundamental necessities of life - adequate oxygen transport by the blood. Thus we conclude that,

* Hypoxaemia, being a potential hazard after GA despite supplemental O_2 therapy, is more severe especially after UAS (Upper Ahdminal Surgery).
* Identifying hypoxaemic events is of vital importance, as they can be corrected by suitable intervention in time, and decrease morbidity.
* Pulse oximetry aid recognition of hypoxaemia, assess adequacy of treatment and help determine the extent and duration of O_2 therapy required.

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