The aim of the study was to evaluate the effectiveness of intraoperative ultrasonography (IOUS) during operations of endocrine glands tumors.

Material and methods. The study was conducted in patients who underwent endocrine operation in Department of Endocrine, General and Vascular Surgery, Medical University in Łódź in 2008-2011.

Results. Patients with thyroid cancer recurrences: in study group we managed shorter lesion access time (10 ± 4.47 min vs 16.78 ± 8.9 min; p=0.04). Time of surgery was also shorter in study group (75 ± 30.17 min vs 85.71 ± 38.92 min), but it was not significant (p=0.46). The use of IOUS did not affect the hospitalization time (2.91 ± 1.64 days vs 3 ± 1.66 days; p=0.820), intraoperative blood loss (45.45 ± 105.96 ml vs 40 ± 82.89 ml; p=0.972) and the rate of intraoperative complications (1/11 – 9.09% vs 2/14 – 14.29%; p=1). Patients with primary hyperparathyroidism: the time of surgery (58± 22.74 min vs 65 ± 19.6 min; p=0.336) and the lesion access time (13.33 ± 7.94 min vs 17.25 ± 8.19 min; p=0.169) were shorter in study group. Hospitalization time was longer in study group (6.13 ± 5.3 days vs 4.45 ± 4.58 days; p=0.079). The rate of intraoperative complications was higher in study group (3/15 – 20% vs 2/20 – 10%; p=0.631). None of these results were statistically significant (p≤0.05). Patients who underwent open adrenalectomy: in study group we managed significantly shorter time of surgery (70 ± 44.35 min vs 80.12 ± 29.60 min; p=0.033) and shorter lesion access time (12 ± 8.88 min vs 17.37 ± 7.42 min; p=0.045). The use of IOUS did not affect the hospitalization time (5.6 ± 1.65 days vs 6.35 ± 2.38 days; p=0.429), intraoperative blood loss (110 ± 164.65 ml vs 172.5 ± 226.35 ml; p=0.442) and rate of intraoperative complications (0/10 vs 1/40; p=1). Patients who underwent videoscopic adrenalectomy: in study group we managed to get shorter time of surgery (89.44 ± 27.11 min vs 109.12 ± 33.88 min; p=0.034) and shorter lesion access time (28.61 ± 14.93 min vs 45.98 ± 20.44 min; p=0.002). Intraoperative blood loss was also significantly lower in study group (86.11 ± 157 ml vs 169.27 ± 201.04 ml; p=0.037). The use of IOUS did not affect the hospitalization time (4.39 ± 3.27 days vs 3.83 ± 3.67 days; p=0.227), the rate of intraoperative complications (0/18 vs. 2/41; p=1) and the conversion rate (2/20-10% vs. 5/46-10.87%; p=1).

Conclusions. 1. During adrenalectomies this technique facilitates finding the pathological lesion shortening the time of access to the tumor and procedure duration. 2. IOUS is useful for determining the tumor relationship with the surrounding anatomical structures. 3. IOUS is a useful technique in the assessment of adrenal tumor infiltration of vena cava. 4. The use of IOUS allows the surgeon to assess anatomical relationships in the real time, after incision and retraction of tissues. 5. During operations of thyroid cancer recurrences using this technique makes easier to find a lesion in the operated area and it is possible to assess risk of surgical error. 6. The use of IOUS allows to find pathological parathyroid glands inside thyroid gland. 7. IOUS is useful in the detection of thyroid pathology during parathyroidectomy.

Key words: intraoperative ultrasound, neoplastic lesions, endocrine glands

A decrease of invasiveness, an increase of radicalness of surgical procedures, a reduction of intra-operative complications with significant shortening of duration of procedures between type of post-operative complications, duration of hospitalization, time needed to find the tumour in the operative field, blood loss during operation, number of conversions in case of...
Navigation with use of intra-operative ultrasound in search for neoplastic lesions of endocrine glands came lately a priority in the modern surgery. For this reason, new techniques of low-invasive surgery are sought, surgical instruments and techniques of image diagnostics are improved.

One of these techniques is intraoperative ultrasound (IOUS). It is a method enabling imaging of anatomical structures directly near the operated organ in real time (so we can use heads of high frequency obtaining ultrasonograms of high resolution). It enables also evaluation of anatomical relations systematically, at each stage of the operation (1, 2).

The aim of the study was evaluation of efficacy of intraoperative ultrasound (IOUS) in a search for neoplastic lesions during endocrinological surgery. It was analyzed whether the use of ultrasound during operations of thyroid, parathyroid glands and adrenal glands due to neoplastic tumours (both benign and malignant) significantly facilitates the procedure.

MATERIAL AND METHODS

Patients operated in the Department of Endocrine, General and Vascular Surgery of the Medical University in Łódź due to tumours of adrenal glands in years 2008-2011 were studied.

The studied group were patients in whom intraoperative ultrasound was used during operations: 11 patients with nodal recurrence of thyroid cancer – group IA, 15 patients with suspicion of adenoma of parathyroid gland – group IIA, 10 patients with the tumour of the adrenal gland operated by classical method – group IIIA, 20 patients with the tumour of adrenal gland operated by a videoscopic method – group IVA.

The comparative group was selected from patients operated without the use of intraoperative ultrasound: 14 patients with nodal recurrence of thyroid cancer – group IB, 20 patients with suspicion of adenoma of parathyroid gland – group IIB, 40 patients with the tumour of the adrenal gland operated by classical method – group IIIIB, 46 patients with the tumour of the adrenal gland operated by videoscopic method – group IVB.

Patients of both groups were randomly selected.

The following parameters were evaluated: mean time of operation duration, number and videoscopic procedures, radicalness of the procedure in post-operative examination, histopathologic evaluation.

Apparatus Pro Focus 2202 by B-K Medical with intra-operative sterilizable heads was used for ultrasound navigation. For open operations, intraoperative head of 8815 type of size 65 x 23 x 20 mm was used, frequency from 5 to 10 MHz, imaging plane 41° and penetration depth up to 110 mm. For videoscopic operations, a head of 8666 type was used with mobile tip, of frequency from 5 to 10 MHz and penetration depth up to 130 mm (with frequency of 5 MHz).

All patients were operated by the same operator with use of the same surgical instruments.

RESULTS

Patients operated due to nodal recurrence of thyroid cancer (group IA vs IB – tab. 1)

In the studied group, compared to comparative group, a shorter time, in statistically significant manner, needed for finding the tumour in the operative field was obtained, by over 6 minutes on average (mean 10 ± 4.47 min vs 16.78 ± 8.9 min; p=0.04). Operation duration was also shorter by over 10 min (mean 75 ± 30.17 min vs 85.71 ± 38.92 min). However, no statistical significance was shown of the above relationship (p=0.460).

However, the use of intraoperative ultrasound navigation did not influence duration of hospitalization (mean 2.91 ± 1.64 days vs 3 ± 1.66 days; p=0.820), blood loss during operation (mean 45.45 ± 105.96 ml vs 40 ± 82.89 ml; p=0.972) and number of complications manifesting by one-sided paralysis of the vocal cord (1/11 – 9.09% vs 2/14 – 14.29%; p=1).

Presence of neoplastic lesions was confirmed in all patients by histopathologic examination.

Patients operated due to suspicion of adenoma of parathyroid gland (group IIA vs IIB – tab. 2)

Operation duration was on average by 7 minutes shorter in the studied group (mean
58 ± 22.74 min vs 65 ± 19.6 min; p=0.336). Time needed for finding the tumour in the operative field was also shorter in the studied group by almost 4 min (mean 13.33 ± 7.94 min vs 17.25 ± 8.19 min; p=0.169). However, duration of hospitalization was slightly longer in the studied group compared to comparative group (mean 6.13 ± 5.3 day vs 4.45 ± 4.58 day; p=0.079).

In 11 cases (73.33%) in the studied group and in 14 cases (70%) in the comparative group, an increase of operation extention was needed due to pathologies of the thyroid. It resulted in prolongation of the operation duration both in studied group (43.75 ± 18.87 min vs 63.18 ± 22.5 min) and comparative group (50 ± 18.16 min vs 71.43 ± 16.92 min.). The time needed for finding the tumour in operative field was prolonged in

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group IA</th>
<th>Group IB</th>
<th>Comparison of groups</th>
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</table>
| 1. duration of operation               | mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.460)
| (min)                                  | 75 ± 30.17, median              | 85.71 ± 38.92, median           |
|                                        | 60                              | 87.5                           |
| 2. time of lesion development          | mean ± standard deviation       | mean ± standard deviation       | statistically significant difference in time of lesion development (p=0.04)
| (min)                                  | 10 ± 4.47, median               | 16.78 ± 8.9, median             |
|                                        | 10                              | 15                             |
| 3. duration of hospitalization         | mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.820)
| (days)                                 | 2.91 ± 1.64, median             | 3 ± 1.66, median                |
|                                        | 3                               | 3                              |
| 4. loss of blood during operations     | mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.972)
| (ml)                                   | 45.45 ± 105.96, median          | 40 ± 82.89, median              |
|                                        | 0                               | 0                              |
| 5. number of postoperative complications| 1/11- 9.09%                    | 2/14- 14.29%                   | no statistically significant difference between groups (p=1)

1 U Manna – Withney’s test, 2 t-Student test for unrelated samples, 3 Accurate Fischer’s test

### Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group IIA</th>
<th>Group IIB</th>
<th>Comparison of groups</th>
</tr>
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</table>
| 1. operation duration (min):           | mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.336)
| – total                                | deviation                       | deviation                       | significant difference                       |
| – in group of patients undergoing only operation of parathyroid glands | 58 ± 22.74, median              | 65 ± 19.6, median               | significant difference                       |
| – in group of patients undergoing additionally operation of thyroid gland | 55                              | 62.5                           |                                             |
| 2. Time of development of lesion (min):| mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.169)
| – total                                | deviation                       | deviation                       |                                             |
| – in group of patients undergoing only operation of parathyroid glands | 13.33 ± 7.94, median            | 17.25 ± 8.19, median            |                                             |
| – in group of patients undergoing additionally operation of thyroid gland | 10 ± 7.07, median               | 17.5 ± 9.35, median             |                                             |
| 3. Mean time of hospitalization (days):| mean ± standard deviation       | mean ± standard deviation       | no statistically significant difference between groups (p=0.079)
| – total                                | deviation                       | deviation                       |                                             |
| – in group of patients undergoing only operation of parathyroid glands | 6.13 ± 5.3, median              | 4.45 ± 4.58, median             |                                             |
| – in group of patients undergoing additionally operation of thyroid gland | 4.25 ± 2.06, median             | 2.67 ± 0.82, median             |                                             |
| 4. Number of postoperative complications| 3/15- 20%                      | 2/20- 10%                       | no statistically significant difference between groups (p=0.631)

1 U Manna – Withney’s test, 2 t-Student test for unrelated samples, 3 Accurate Fischer’s test
Navigation with use of intra-operative ultrasound in search for neoplastic lesions of endocrine glands

The number of postoperative complications was slightly higher in the studied group (3/15 – 20% vs 2/20 – 10%; p=0.631). These were 2 cases of one-sided paralysis of the vocal cord and 1 case of phonation disturbances in the studied group and 2 cases of one-sided paralysis of vocal cord in the comparative group.

Statistically significant differences were found in none of the above mentioned parameters (p ≤ 0.05).

Intraoperative blood loss was practically insignificant. In one case, it was 100 ml in the studied group and in one case it was 200 ml in the comparative group. In the remaining cases, using of the aspirator in both groups was not necessary or there was uncountable trace of blood in the aspirator.

Patients operated by classical method due to tumour of the adrenal gland (group IIIA vs IIIB – tab. 3)

In patients undergoing classical adrenalectomy, a shorter time (in statistically significant manner) by over 10 min was obtained (70 ± 44.35 min vs 80.12 ± 29.60 min; p=0.033) and over 5 min shorter time was needed for finding a tumour in the operative field (12 ± 8.88 min vs 17.37 ± 7.42 min; p=0.045).

However, no statistically significant difference was shown in the remaining evaluated parameters: duration of hospitalization (5.6 ± 1.65 days vs 6.35 ± 2.38 days; p=0.429); blood loss during hospitalization (110 ± 164.65 ml vs 172.5 ± 226.35 ml; p=0.442); number of complications (0/10 vs 1/40; p=1) – 1 case of suppurative of post-operative wound in the comparative group.

In patients in whom navigation with use of intra-operative ultrasound was used, operations duration shortening by nearly 20 minutes was achieved (89.44 ± 27.11 min vs 109.12 ± 33.88 min; p=0.034) and time to finding the tumour in the operative field was shorter by over 15 minutes (28.61 ± 14.93 min vs 45.98 ± 20.44 min; p=0.002). Also blood loss during operations was lower in a statistically significant manner in the studied group (86.11 ± 157 ml vs 169,27 ± 201.04 ml; p=0.037).

Table 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group IIIA</th>
<th>Group IIIB</th>
<th>Comparison of groups</th>
</tr>
</thead>
</table>
| 1. Duration of operation (min)   | mean ± standard deviation| mean ± standard deviation| statistically significant difference (p=0.033)
|                                  | 70 ± 44.35 median 55     | 80.12 ± 29.60 median 75     |                                 |
| 2. Time of lesion development (min) | mean ± standard deviation| mean ± standard deviation| statistically significant difference (p=0.045)
|                                  | 12 ± 8.88 median 7.5     | 17.37 ± 7.42 median 15      |                                 |
| 3. Duration of hospitalization (days) | mean ± standard deviation| mean ± standard deviation| no statistically significant difference (p=0.429)
|                                  | 5.6 ± 1.65 median 5.5     | 6.35 ± 2.38 median 6         |                                 |
| 4. Loss of blood during operations (ml) | mean ± standard deviation| mean ± standard deviation| no statistically significant difference (p=0.442)
|                                  | 110 ± 164.65 median 25    | 172.5 ± 226.35 median 110    |                                 |
| 5. Number of postoperative complications | 0/10                      | 1/40 2.5%               | no statistically significant difference (p=1) |

1 U Mann–Whitney’s test, 2 Accurate Fischer’s test
However, the use of navigation did not influence duration of hospitalization (4.39 ± 3.27 days vs 3.83 ± 3.67 days; p=0.227), number of post-operative complications (0/18 vs 2/41; p=1) – two-time rupture of the spleen and pancreatic fistula and frequency of conversions (2/20 – 10% vs 5/46 – 10.87%; p=1).

### DISCUSSION

Ultrasound plays a special role in imaging diagnostics of the neck. It is an accurate, repeatable, safe method not burdening the patient as well as it is relatively cheap. Sensitivity in detection of pathologic lesions of the thyroid and parathyroid glands is over 90%. It is even suggested that ultrasound is a basic examination in diagnostics of metastases to cervical lymph nodes and in pathologies of the thyroid and the parathyroid glands. The other methods of imaging diagnostics (CT, NMR, PET) should only be additional examinations (3). Hence the idea of using this method in intraoperative navigation in operations due to nodal recurrence of thyroid cancer. Reoperations on the neck are a big challenge for the operator. Finding of small neoplastic lesions in cicatricial lesions is very difficult. Using IOUS may help in finding neoplastic lesions and decrease the risk of potential complications (4).

In 2001, Desai et al. reported a case of 45-year old man in whom total resection of the thyroid and excision of lymph nodes in middle neck. Multifocal papillary cancer of the thyroid with many metastases to lymph nodes. Despite that, nodal recurrence was diagnosed in the post-operative period. Due to small size of the lesion (6 mm diameter) and significant cicatrization of the tissues, visual and palpable localization of the tumour was impossible. Only using IOUS enabled resection of the lesion. The authors fund that using this technique significantly shortened operations duration and avoided injury to the retrograde laryngeal nerve (4).

In 2002, Karwowski et al. found in their study that using IOUS facilitates finding pathological lesions in recurrent thyroid cancer (5). The study included 13 patients with nodal recurrence of papillous thyroid cancer. After resection of lesions, IOUS was repeated to confirm that all lesion was removed. It was reported that IOUS was necessary in 7/13 patients.

In our material, in the studied group compared to comparative group, a shorter time (by over 6 minutes, statistically significant) needed for finding the tumour in the operative field.
Navigation with use of intra-operative ultrasound in search for neoplastic lesions of endocrine glands

(p=0.04). Operation duration was also shorter by over 10 minutes – however, no statistical significance was show of the above relation (p=0.460). These small differences in time needed for finding the tumour in the operative field as well as lack of statistically significant difference in operation duration result from the fact that IOUS is only auxiliary imaging technique in this type of operations. It is thought that ultrasound examination of the neck should be a basic method of pre-operative diagnostics in cases of nodal recurrence of the thyroid cancer, especially in combination with determination of thyroglobulin concentration and thin-needle aspiration biopsy of suspected lesions. However, in many situations, despite a good preoperative localization, a change of anatomical relations after surgical cut and tissue retraction causes that neoplastic lesions are difficult to find in the operative field. Considering this, IOUS seem to be optimal method in localization of small neoplastic lesions, because it enables surgeon to evaluate anatomical relations in real time (fig. 1).

However, using of intraoperative ultrasound navigation did not influence the time of hospitalization duration, blood loss during the operation and the number of post-operative complications. The reason of this is that independently of using the intra-operative ultrasound navigation, procedures were carried out according to standards of endocrinologic surgery. The rules required operating in a dry operative field, sparing visualized parathyroid glands and visualization of the retrograde laryngeal nerve course before the resection of the lesions. Using IOUS itself does not influence the change of operation technique.

Before wide use of imaging techniques in localization of parathyroid glands, the method of choice in treatment of primary hyperparathyroidism caused by lesion in one parathyroid gland was both-sided exploration of the neck (6). Only introduction of new technologies, such as: scintigraphy with the use of 99mTc-MIBI, ultrasound of the neck or intraoperative determination of concentration of parathormone enabled less extensive and less invasive operations.

IOUS in operations of parathyroid glands was used for the first time by Siegel in 1981. He used this technique for localization of adenoma of upper right parathyroid gland (7).

However, in 1986, Norton et al. published the study concerning usefulness of IOUS in re-operations due to primary hyperparathyroidism (8). The study included 25 patients. It was fund that due to use of IOUS, more pathologic parathyroid glands were found than with the use of pre-operative ultrasound (76% vs 36%; p=0.01) and that in pre-operative ultrasound, greater number of falsepositive results than in IOUS (28% vs 4%). Moreover, due to IOUS, smaller lesions could be visualized; attention was also paid to usefulness of this technique for localization of parathyroid glands placed within the thyroid parenchyma.

In the following year, continuation of the above mentioned study was published (9). Consecutive 14 patients were examined. It was found that non-invasive methods of parathyroid localization fail in about 30%. The authors paid a special attention to the benefits of IOUS. Compared to other imaging examinations, IOUS is useful in localization of small lesions and imaging of parathyroid glands localized inside the thyroid. Moreover, not visualizing pathologic parathyroid gland within the neck should suggest the operator mediastinal localization of the lesion. IOUS also facilitates finding other pathologic parathyroid glands, if lesions are localized in several parathyroid glands.

In a group of patients operated in out clinic, operations duration was on average by 7 minutes shorter in the studied group. Time needed for finding the tumour in the operative field was shorter by almost 4 minutes in the studied group. These differences were not statistically significant (fig. 2).

It is interesting that in 11 cases (73.33%) in the studied group and in 14 cases (70%) in the comparative group, extension of operation was needed due to thyroid pathology.

Fig. 1. Metastasis of papillous cancer of thyroid to lymph node of region of the right internal cervical vein.
In the study published in 2005 (Milas et al.) 350 cases of primary hyperparathyroidism were analyzed (10). In the ultrasound examination, it was found that in 150 cases (43%) there is a concomitant thyroid disease. However, only in 21 patients (6%), thyroid was operated. These were the patients with malignant lesions or suspected of malignancy in BACC, patients with past irradiation of the head and neck and patients with a large goiter with symptoms of compression.

Intraoperative ultrasound navigation is also used during operations of adrenal glands — both open and videoscopic. This technique is useful in differentiation of solid lesions from cystic lesions, and helps to evaluate the stage and possibility of resection of malignant lesions. The use of imaging in the function of colour Doppler allows also to identify blond vessels, such as aorta, inferior caval vein or adrenal vein, allowing safe and shorter resection of the tumour (11, 12).

There are also reports describing usefulness of IOUS in differentiation of Benin and malignant lesions based on IOUS image. Moreover, this technique allows detection of metastatic lesions non-visible in pre-operative imaging diagnostics and enables precise localization of primary lesion, what is especially important in videooscopic operations in which we cannot sense of touch (13).

In the literature, there are also information concerning using IOUS during open operation of adrenal glands. In 1993 Long et al. reported usefulness of IOUS in evaluation of a degree of infiltration of the tumour on interior caval vein (5 patients with kidney cancer and 3 patients with parathyroidal cancer). IOUS was carried out in all, visualizing interior caval vein and possible neo-plastic infiltration on it. In 4 patients, resection of interior caval vein could be avoided. In conclusion, it was found that IOUS is useful tool in evaluation of infiltration on caval vein, especially when results of preoperative examinations are doubtful (14) (fig. 3).

Other use of IOUS is evaluation of possibility of tumour resection. In 2007, (Gołkowski et al.) a very rare case of operations due to oncocytoma of the adrenal cortex was reported. Due to the use of intra-operative ultrasound, non-resection tumour was fund infiltrating significantly on inferior caval vein. It was decided to carry out safe for the patient surgical biopsy of the lesion (15).

In our study, in a group of patients undergoing classical adrenalectomy, a significantly shorter time (by over 10 minutes) of operation duration in the studied group and by over 5 minutes shorter time to find the tumour in the operative field was needed. It results from the fact that the adrenal gland is a small organ hardly accessible surgically. As a rule, the surgeon must operate in tight space of limited visual access. IOUS allows to visualize the tumour fast and evaluate its relation to other anatomical structures (fig. 4).

In other evaluated parameters, no statistically significant difference was found.

There are also reports concerning use of intra-operative ultrasound during videooscopic procedures.

In the intra-operative image. The study included 8 patients with suspicion of infiltration of the tumour on interior caval vein (5 patients with kidney cancer and 3 patients with parathyroidal cancer). IOUS was carried out in all, visualizing interior caval vein and possible neo-plastic infiltration on it. In 4 patients, resection of interior caval vein could be avoided. In conclusion, it was found that IOUS is useful tool in evaluation of infiltration on caval vein, especially when results of preoperative examinations are doubtful (14) (fig. 3).

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In other evaluated parameters, no statistically significant difference was found.

There are also reports concerning use of intra-operative ultrasound during videooscopic procedures.
Navigation with use of intra-operative ultrasound in search for neoplastic lesions of endocrine glands

In 1997 (Heniford et al.), there was a report presenting the use of IOUS during laparoscopic adrenalectomy (16). IOUS was carried out in 19 out of 114 cases. In several special cases IOUS was „a key” factor for effective operation.

The interesting indication for operations of adrenal glands are both-sided chromaffinetumours, often occurring in hereditary syndromes (e.g. von Hippel-Lindau syndrome, MEN 2 – Multiple Endocrine Neoplasia). Chromaffinetumours in the course of these syndromes are very rarely malignant, therefore resection of the tumour only with sparing healthy adrenal parenchyma is allowed. As a result, substitution therapy with adrenal steroids, casting many complications, is not needed. Due to intra-operative ultrasound, the operator may determined the line of tumour resection as well as evaluate other organs placed in retroperitoneal space (17).

In the presented study in patients in whom navigation with use of ultrasound was used, a shorter operations duration, by nearly 20 minutes, was achieved sorter time needed for finding the tumour in the operative field was achieved (by over 15 minutes). Blood loss Turing operations was also lower in statically significant manner in the studied group. However, the use of navigation did not influence hospitalization duration, number of post-operative complications and frequency of conversions.

CONCLUSIONS

1. In operations of adrenal tumours, the use of IOUS facilitates finding the pathological lesion, shortens the time needed for finding the tumour in the operative field and operation duration.
2. IOUS is useful for determination of relation of the tumour to adjacent anatomical structures.
3. IOUS is useful technique in evaluation of infiltration of interior caval vein by tumour.
4. The use of IOUS enables the surgeon to evaluate anatomical relations in real time, after surgical cut and tissue retraction.
5. In operations of nodal recurrence of thyroid tumour due to the use the above mentioned technique, finding the pathologic lesion in operated region becomes easier and evaluation of procedure radicalness is possible.
6. The use of this technique allows finding changed parathyroid gland inside thyroid parenchyma.
7. IOUS is useful in finding pathologies of the thyroid during operations of the parathyroidal glands.

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