

REVIEW

Management of Common Endocrine Conditions Other Than Diabetes Mellitus during Ramadan Fasting

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Abstract

Patients with any endocrine condition wishing to observe the fasting during Ramadan may seek advice from their primary care or specialist physician. In healthy people, there are minimal changes in the metabolic and hormonal parameters during fasting. However, management of common endocrine conditions may need some adjustments. Aside from diabetes mellitus, endocrine and metabolic conditions commonly seen in clinical practice include hypothyroidism, hyperthyroidism, adrenal disease, pituitary diseases and obesity. Adjustments in medications are based on physiological and clinical aspects of these conditions, and on sound knowledge of the pharmacological characteristics of all prescribed medications. Thyroid hormones should be taken on an empty (or near empty) stomach and not be followed by food by 0.5-1 hour according to the patient's life style. Glucocorticoids should be taken in the same manner at either end of the fasting period, or changed to an extended release preparation taken on its own or in combination with hydrocortisone with *Iftar*. Management of hypogonadism is essentially the same both during and outside of Ramadan

in both men and women. Growth hormone may be taken in the same manner in both children and adults. Patients with diabetes insipidus should be careful with fluid balance, and take adequate doses of desmopresin in widely spaced dosing for maximum benefit. Spontaneous hypoglycemia may present for the first time during Ramadan, and suggestive symptoms should alert the physician to this diagnosis. Ramadan-type intermittent fasting provides an opportunity for weight loss but this is often lost as evening time feasting seems to offset any benefit from daytime fasting. In conclusion, common endocrine conditions are managed along the same lines of good clinical practice, sound understanding of physiology and pharmacology, coupled with modern approaches of individualized and ethnically competent care.

Key words: Ramadan Fasting, Ethnic, Thyroid, Adrenal, Pituitary, Bone health, Obesity

Introduction

Fasting during daytime is observed by millions of adult Muslims worldwide for 29-30 days every year during the

ninth lunar month, Ramadan (1). The duration of fasting depends on the season and the geographical location. Over the last three decades, there has been increased interest in the medical aspects of the Muslim's fasting during the holy month of Ramadan (2-4). In endocrine practice, interest has predictably focused on the effects of fasting on diabetes control and on the practical management diabetes during Ramadan (5-8). This issue was deemed the prime example of culturally competent care in the Arab and Muslim world (9-10). However, increasing numbers of patients started to enquire about how best to manage other endocrine conditions if they wish to observe fasting during Ramadan. Commonly involved disorders include hypothyroidism and hyperthyroidism, polycystic ovarian disease, chronic vitamin D deficiency, and hypoadrenalism. Less often, issues may arise with relevance to specific women's health. Occasionally, questions develop in relationship to even less common conditions, such as pituitary disease and other rare endocrine conditions, especially if patients are well enough to contemplate fasting. There is a paucity of literature on research data or practical guidance about how best to manage such conditions should contemplation of fasting be deemed safe enough. In this article, we offer a consideration of assessment and management of select endocrine conditions during the month of Ramadan. It can, however, be applicable to any other form of religious, ethnic, or spiritual fasting involving abstinence from food and drink, including intake of oral medications.

The clinical spectrum of endocrine disorders and their relevance to Ramadan fasting are described. Since there is a very limited body of published work on this subject, the article was based on a) review of the relevant physiological facts of the endocrine system b) understanding of pharmacology and therapeutics involved in endocrinology and c) application of common sense and extrapolation from clinical experience in different situations. The most common endocrine condition, namely diabetes mellitus, was deliberately excluded for the sake of an intentional focus on non-diabetic conditions. A large body of literature exists concerning diabetes and Ramadan, which is readily available to readers (5-8). In endocrinology, similar to diabetes management, most recommendations are expert opinion and some consensus statements, rather than true evidence-based practice (11).

Risk Stratification of Endocrine Conditions during Fasting

When considering the individual patient's ability to fast, we propose that patients with endocrine conditions may be

classified into three groups. This is analogous to risk stratification proposed for diabetes (7). The ruling about feasibility whether or not to fast will be given for each category separately. The proposed three categories are presented in Table 1. Clinically, there are two guiding principles for management of various endocrine-conditions during Ramadan. Primarily, upholding the "*Safety first*" principle in the acutely ill or seriously unwell patient with uncontrolled and severe endocrine conditions where avoidance of fasting seems the most appropriate advice. In such circumstances, patients are advised to fast an equal number of days at a later stage if ever possible (9).

Secondly, for those who can safely fast, the aim would be to maintain the best possible state of either control or replacement of hyperfunctioning or hypofunctioning endocrine glands respectively (*compared with the non-fasting period*). Investigations, such as blood work and imaging studies, could be undertaken without nullifying validity of the fast.

Management of Thyroid Disease in Ramadan *Changes in Healthy People during Fasting*

Minimal changes in thyroid function tests have been documented in healthy individuals during Ramadan. However, the nature of changes was not invariably concordant. Mansi and Masalameh (12) found no significant change in blood T3 levels after Ramadan fasting in one group of young healthy students. They suggested that the fasting period was too short to be accompanied by any significant change in thyroid hormone, but they speculated that perhaps repetitiveness of this in Ramadan fasting may induce some mild decrease in T4 level. Other studies have shown that serum thyroid-stimulating hormone (TSH) level rises in men, and free thyroxine (fT4) level decreases significantly in both genders. In women, the rise in serum TSH correlates with the number of fasted days (13-14). In elite judo athletes maintaining their usual high training loads during Ramadan, the mean serum TSH and free T4 levels both increased significantly during fasting (15). In other studies, Ramadan fasting induced a decrease in T3 levels by approximately 30% (16-17). Additionally, refeeding with carbohydrate only caused an increase in serum T3 (18). Therefore, the high carbohydrate diets in Ramadan could explain the difference in results in various reports. Some clinicians observed a small but significant increase in serum T4 only in the last days of Ramadan (19), but others have shown no change in T3 and T4 levels during Ramadan fasting (13, 20), or of T4 between feeding and fasting conditions (20).

Table 1. Proposed risk stratification scheme for evaluation of endocrine and metabolic disorders and the safety and feasibility of fasting.

Category & Definition	Proposed clinical criteria	Feasibility of fasting
Category A: Patients with high risk of serious complications	Acute endocrine emergencies as recurrent spontaneous hypoglycemia, newly presenting severe thyrotoxicosis, poorly controlled Cushing's disease, Addisonian crisis, Hypothyroidism and thyrotoxic crisis, symptomatic hypocalcaemia, acute pituitary apoplexy, expanding pituitary lesions, unstable pheochromocytoma with severe or labile hypertension.	These should be advised not to fast in the context of their need to immediate treatment on inpatient or outpatient basis.
Category B: Patients with moderate risk of complications as a result of fasting,	Uncontrolled endocrine conditions whose severity need individual assessment to assess the feasibility of fasting such as patients with various degrees of thyrotoxicosis on treatment, subacute thyroiditis and patients recovering from conditions in category A.	The fasting safety need to be determined by the treating physician on individual basis.
Category C: Patients with low risk of complications as a result of fasting	Stable endocrine conditions: such as patients with osteoporosis, hirsutism, well replaced hypothyroidism, stable goiters, asymptomatic adrenal masses, hyperlipidemia, obesity. Subclinical thyroid disease.	These patients have no risk from fasting and they may benefit from adhering strictly to the fasting during the day and prudent exercise of self-control at night.
Individualization of assessment and guidance remains the golden rule in deciding which category a patient belongs.		

In summary, review of published work shows that the observed changes in thyroid function tests are minimal, values stay within the normal reference range and return to original levels after the Ramadan fasting is over. Therefore, it would be safe to conclude that investigation for suspected thyroid disease should discount any effects from the fasting period, and results may be interpreted in the usual manner.

Management of Hyperthyroidism

Diagnosis of hyperthyroidism is based on clinical signs and symptoms, and is confirmed by high serum thyroid hormone levels and suppressed serum TSH. There are three different modalities for treatment: medical, surgical and

radioiodine therapy (21), although there no specific data related to Ramadan fasting. From the initial principles, one can conclude that establishing the diagnosis follows the same guiding principles both within and outside Ramadan. Management of hyperthyroidism is essentially the same during Ramadan. One exception would be that for the severely symptomatic patient, he/she may be advised to skip fasting for a week or so until stabilized on medical treatment. Medical treatment is essentially the same, i.e. Thionamides (Carbimazole, Methimazole or Propylthiouracil) and beta-adrenergic receptor blockers. Long acting beta-blockers, such as Atenolol, may be taken once daily in doses of 50-100 mgs/day. This may be preferred dur-

ing Ramadan (22) although some physicians still prefer to use classical nonselective beta-blockers. Carbimazole and Methimazole (depending on availability and practice) have an advantage over Propylthiouracil, since the latter's half-life is shorter and must be taken every 6-8 hours (22). A full daily dose of Carbimazole or Methimazole may be taken once daily. However, there should be no difference in management of stable patients on small maintenance doses. Surgery for the thyroid will require admission and the preoperative course is based on principles used for any other acute illness. However, as for timing of the surgery itself, it is usually a planned operation and may be deferred until after Ramadan, except when surgery is essential for failure of medication, cancer, or pressure effects. In these circumstances patients may be admitted and treated during Ramadan. Radioiodine treatment may impose certain restrictions, and perhaps is best left until after Ramadan, unless urgently needed due to side effects of medications.

Hypothyroidism and Thyroid Replacement Therapy

Levothyroxine is the most widely used medication for replacement therapy (23). Most patients do not need any change in dosing once the adequate dose is established and the patient is stable (15). Thyroxine conventionally is taken in the morning on an empty stomach before breakfast as food and certain medications may interfere with its absorption (25). Absorption is reduced approximately from 80% down to 60% if taken after a meal (26), thus absorption is variable and may alter TSH levels. Theoretically, the best time is a half hour before *Suhoor*. However, patients may find it inconvenient to wake up 30 minutes before *Suhoor*, specifically to take medications, and may risk not waking up until after the start time of the fast. Perhaps the most convenient timing is before bed time (which is usually half way between *Iftar* and *Suhoor* since the patient would have minimal amounts of food in the stomach. After Ramadan, patients may return to their usual practice without the need to monitor, as the effects during Ramadan are short-lived and should have no long-lasting effects.

Miscellaneous Thyroid Disorders:

Subacute thyroiditis is mostly self-limiting, and may need to be treated with NSAIDs, with or without beta-blockers, to control thyrotoxic symptoms (27, 28). The illness is usually not severe enough to justify breaking the fast. Hemorrhage into thyroid nodules can be aspirated under ultrasound guidance if deemed necessary without affecting fasting (28, 29). However, all therapies for cancer patients should be undertaken at the "best practice recommendations" due to potential harm and associated anxiety related

to delay and/or cancellation of therapies (30).

Adrenal Disease during Ramadan

Changes in Cortisol Rhythm in Ramadan

Many people alter sleeping habits and remain awake a good part of the night. Several groups have suggested that this may affect cortisol secretion rhythms. Eleven young healthy male volunteers were studied before and during Ramadan to investigate possible effects on circadian rhythms of cortisol, and its response to exogenous corticotropin (31). Before Ramadan, baseline morning cortisol levels were significantly higher than in the evening. The cortisol response to corticotropin tended to be higher in the morning than the evening (but not significantly). During Ramadan, morning cortisol levels were lower than corresponding values before Ramadan, whereas the evening cortisol levels were higher than the corresponding value before Ramadan, but remained lower than morning cortisol. However, there were no significant differences between the cortisol response to corticotropin in the evening during Ramadan when compared to responses in the morning and evening before Ramadan. Similar results were reported by others (32) who evaluated morning and midnight cortisol levels in ten healthy adults in their homes. Four of the subjects showed alterations of cortisol rhythms during the last two weeks of fasting with reversal of the morning/midnight ratio in some values. The morning cortisol returned to normal in all subjects four weeks after Ramadan. However, the midnight value was >250 nmol/l in three of the subjects. One woman additionally had her 24-h cortisol profile studied in the hospital on day 15 of Ramadan. Her acrophase and nadir showed a forward shift by about 5-6 h. This was consistent with shifts in her sleep pattern.

Maternal serum cortisol levels were significantly elevated in fasting healthy women with uncomplicated pregnancies at 20 weeks or more (33). No untoward effect of Ramadan fasting was observed on intrauterine fetal development. Similarly, fasting led to a significant increase in the corticotropin and cortisol levels in athletic students living in two different geographical localities with different altitudes (34). However, no difference was observed between the two groups suggesting that fasting induces change in an altitude-independent fashion (34).

In conclusion, the above studies suggest that changes in eating and sleeping schedules do reduce morning cortisol levels while raising evening cortisol levels without altering cortisol regulation mechanisms. Clinically, it may be suggested that single-point cortisol values may be misleading

during or shortly after Ramadan.

Adrenal Insufficiency

For a long time, endocrinologists have traditionally treated both primary and secondary forms of hypoadrenalism with combinations of glucocorticoids (hydrocortisone or cortisol, cortisone, other synthetic steroids), mineralocorticoids (fludrocortisone), and more recently androgens (dehydroepiandrosterone), depending upon the underlying etiology (35). Based on estimates of cortisol secretion rates, the usual daily hydrocortisone replacement doses vary between 10 and 30 mg in adults, and between 10 and 15 mg/m² in children. Both over-replacement and under-replacement can result in serious consequences. In particular, hypoadrenal (Addisonian) crisis, for whatever reason, is potentially fatal (35). In an attempt to mimic normal physiology, a higher dose is given upon waking and another dose is taken later in the day, but not after 1800 hours, to avoid interference in sleep patterns. Some physicians recommend giving a smaller dose around midday with some proposed improvement in wellbeing, although this was not confirmed in a recent study (36). Another option is using longer acting glucocorticoids, such as prednisolone or prednisone, in a more convenient single morning dose. No consensus exists on the role nor on the best method of biochemical monitoring of the replacement therapy. Whereas some clinicians rely solely on clinical assessment, others may adopt biochemical measurements of various levels of complexities (36). No direct comparison between these monitoring schemes has been studied. A fairly convenient method is the limited "4 point" cortisol day curve devised and used at St Mary's Hospital, London, UK documented previously (37,38).

There are no formal studies on adrenal replacement therapy during Ramadan fasting. Anecdotally, some patients report worsening of well-being and episodes of hypotension during Ramadan, particularly in the late afternoon, in those treated with short acting hydrocortisone. This was observed at times when the Ramadan period was particularly long. Therefore, although the conventional drug is hydrocortisone, its biological half-life is too short (half-life < 12 hours) to cover the long fasting hours (12-15 hours). Therefore, some have recommended longer acting glucocorticoids, such as prednisolone at *Suhoor* time and hydrocortisone in the evening, taken at *Iftar* time. The dose of prednisolone is based on the usual morning hydrocortisone dose. In primary adrenal insufficiency, the mineralocorticoid dose should be taken at *Suhoor* time. After Ramadan, patients may revert directly to their previous regimen without change. Patients should have been educated previously

regarding the acute illness rules, and should have contact details and access to return to the clinic if needed. Maintaining hydration and mineral balance and avoidance of exhausting exercise, particularly in hot weather, are obvious precautions for patients on adrenal replacement therapy.

Hyperadrenalism and Cushing Syndrome

Patients with hyperadrenalism, either primary or secondary, are considered high risk and must be treated seriously (39). Patients with Cushing's syndrome should refrain from fasting if they must undergo either investigative procedures or therapeutic surgical procedures as soon as that is deemed necessary. In the interim, good attention to fluid balance, glucose and blood pressure control (in those with secondary diabetes and hypertension) should be given priority over observing the fast. Opportunities for early surgery should not be missed because of social pressure (which can be very strong) to delay the surgery until after Ramadan (10).

Other Adrenal Diseases

Adrenal incidentilomas may be adequately investigated radiologically and biochemically during Ramadan without need for further delay of diagnosis (40). Management of congenital adrenal hyperplasia during Ramadan should follow the same principles as outside Ramadan (40). For adolescents, prednisolone should not be difficult to manage taken twice/daily at *Iftar* and *Suhoor*. However, those on hydrocortisone might end up with a higher serum 17-hydroxyprogesterone concentration. It may be wise to dose hydrocortisone three times within non-fasting hours but this is not thought to be ideal (41). Experience with specific temporary use of prednisolone or Dexamethasone during Ramadan is limited. We suppose auditing a group of these patients during Ramadan is a worthwhile exercise in order to build an evidence-based practice. Patients with suspected pheochromocytoma may too be readily investigated, and when confirmed stabilized on the conventional sequence of alpha blocker-beta blocker therapy with consideration toward surgery during Ramadan (43). Should there be issues with control of blood pressure during treatment, it would appear sensible to break the fast in favor of taking their medication. Again, perioperative days are covered by the "acute day" dispensation rules (1,9).

The Pituitary Gland and Ramadan Fasting

Several physiological studies were reported which will be discussed first. Clinical aspects of pituitary disease potentially relevant to fasting span pituitary tumors (functioning and non-functioning) and isolated or multiple pituitary hor-

mone deficiencies.

Neuroendocrine Changes in Ramadan:

Bogdan et al (20) showed that daytime fasting, modifications in sleep schedule, and psychological and social habits during Ramadan induce changes in the rhythmic pattern of a number of hormonal variables. Serum concentrations of melatonin, steroid hormones (cortisol, testosterone), pituitary hormones (prolactin, LH, FSH, GH, TSH) and thyroid hormones (free thyroxine and free triiodothyronine) were tested around the clock at six 4-hourly intervals before Ramadan and on the 23rd day of Ramadan. Time series studies showed statistically significant differences in some variables. Nocturnal peak of melatonin was diminished and may have been delayed; there was a shift in the onset of cortisol and testosterone secretion; the evening peak of prolactin was enhanced, but FSH and GH rhythmic patterns were affected little or not at all by Ramadan fasting. Serum TSH rhythm was blunted over the test time span.

Chennaoui (44) studied the changes in eight young adult athletes. Saliva cortisol and testosterone concentrations and plasma levels of interleukin (IL)-6, a mediator of sleepiness and energy availability, were determined before and after exercise, prior to and during Ramadan. Changes in metabolic and hormonal parameters, mood state, and nutritional and sleep profiles were evaluated too. Mean body mass and body fat remained unchanged. Maximal exercise decreased during Ramadan while testosterone/cortisol ratio values did not change significantly. Nocturnal sleep duration and energy intake decreased on day 21 compared to before Ramadan ($p < 0.05$). At the end of Ramadan, fatigue score on a questionnaire increased ($p < 0.001$). Plasma melatonin levels decreased while IL-6, adrenalin and noradrenaline all increased on day 21 of Ramadan compared to levels pre-Ramadan. As early as seven days after Ramadan, all parameters recovered to pre-Ramadan values.

Mesbahzadeh et al (45) determined the effects of Ramadan fasting on the secretion of sex hormones in healthy young single males. Serum testosterone, luteinizing hormone (LH) and follicle-stimulating hormone (FSH) were measured before and during Ramadan. Testosterone level was lower, and FSH was higher at the end of the fasting month than before, but LH did not change significantly. In another study by Bouhleb et al. (46) Ramadan fasting induced a significant decrease in body mass and body fat, but plasma concentrations of glucose, insulin, GH, IGF-1 and IGFBP-3 did not change significantly between periods at rest or following exercise. In conclusion, the changes in Ramadan are mainly mild and temporary metabolic, hormonal, and inflamma-

tory changes, related sleep disturbances, energy deficiency, and fatigue. They may decrease physical performance with special relevance to Muslim athletes who maintain training. Reduction of workload and/or daytime napping may represent adequate strategies to counteract these effects.

Functioning Pituitary Tumors

Hyperprolactinemia (with or without prolactinoma), acromegaly, and Cushing's disease, are treated on their own merit. Hyperprolactinemia and prolactinomas are medically managed by Cabergoline in once daily or twice weekly doses (46). Acromegaly and Cushing's are primarily treated by pituitary surgery, with good perioperative care and avoidance of fasting during the acute illness (46). However, whereas acromegaly may need no medical treatment prior to surgery and can easily be observed during the fast, a patient with Cushing's may not be well enough to observe the fast (46).

Pituitary Incidentalomas and Non-secretory Tumors

These are usually quiescent and cause no acute clinical problems (47). Therefore, they cause no implications for fasting during Ramadan. The two exceptions to this rule are those excessively large or rapidly expanding tumors with space-occupying effects, and the very rare occurrence of pituitary apoplexy, which necessitates acute inpatient care for steroid coverage and monitoring of its progression with potential for surgery if necessary. Under these circumstances the rule of "acute illness" dispensation applies and patients are exempt from fasting for this period. The standard care of these situations apply and is beyond the scope of the present discussion (48).

Management of Hypopituitarism

Hypopituitary adults are replaced conventionally with hydrocortisone, thyroxine, sex hormones, and occasionally with growth hormone. Patients with central diabetes insipidus are replaced with desmopressin. The principles and practicalities of adrenal hormone and thyroid hormone replacements are the same as discussed previously. The only major difference is the loss of the contribution from measurements of ACTH and TSH to the monitoring of the adequacy of Cortisol and thyroxine replacements respectively. The other three hormones (sex hormones, growth hormone, and desmopressin) deserve some comments. In men, testosterone replacement may be given in its usual format (oral, patch, gel or intramuscular). It is important to maintain the period of injections to sustain the steady state achieved previously (49).

In women, sex hormone replacement is taken in the usual manner, mostly in combined pill format. In women on estrogen replacement therapy, they should be able to take their regular medications as usual (49).

One specific issue relates to women who do not wish to lose any Ramadan days, and these women may continue on their estrogen/progesterone replacement without having any withdrawal bleeding during Ramadan. Although the consequences of such practice are uncertain, it is perhaps more appropriate that it be discouraged, and for women to simply break the fast during menstrual period days.

Growth hormone is given by subcutaneous injections once daily. The usual dose may be injected any time of the day or night according to the patients' convenience (50). Perhaps it would be more reassuring to patients to reiterate in a sensitive and compassionate manner that both testosterone and growth hormone injections do not nullify the fast. This may be more conducive to better concordance (9,10).

Patients with central diabetes insipidus may continue on the same dose of desmopressin with adequate fluid intake (51). For those on twice daily dosing, they should take their morning dose at *Suhoor* time to maintain good hydration during the day. The second dose (if any) should be taken with *Iftar*.

Bone Health and Calcium Homeostasis

The bisphosphonate class of drugs is now utilized extensively in the treatment of patients with osteoporosis and Paget's disease. Gastrointestinal adverse effects, especially those associated with esophageal injury, have been of increasing concern to clinicians. Studies in humans and animals have shown that the mucosal erosion and ulceration seen with bisphosphonates is a result of direct contact with these agents. Numerous endoscopic studies in healthy volunteers and postmenopausal women have also demonstrated the potential of bisphosphonates to cause stomach and duodenal ulcers. However, serious gastrointestinal adverse events have not been noted in several large trials. Esophageal injury has for the most part been avoided by appropriate administration instructions except in certain high-risk situations (for example in the presence of existing distal esophageal disease or motility disorders) or with concurrent use of nonsteroidal anti-inflammatory drugs or anticoagulants. In general, bisphosphonates are well tolerated and not associated with serious adverse events (52). Taking these medications weekly should impose much less inconvenience. Vitamin D can be taken at any time; however calcium supplements are best taken after the main meal (53). Patients with severe hypercalcemia and uncon-

trolled hyperparathyroidism may need to take plenty of fluids (54) and may be given temporary dispensation to break the fast during the acute phases. Calcium and vitamin D analogues taken for hypoparathyroidism can be taken adequately overnight. Doses can be adjusted to achieve the desired serum calcium levels. Symptomatic hypocalcemia requires treatment by IV calcium infusion while adjusting oral medications.

Spontaneous Hypoglycemia

Diabetic hypoglycemia is the defining measure of safety in management of diabetes during Ramadan (5-9). Clinicians dealing with suspected cases of insulinoma may find it helpful to ask about any history of symptoms suggestive of spontaneous hypoglycemia during the previous Ramadan. Further investigations and management should follow standard guidelines (55). Naturally, patients with established or suspected spontaneous hypoglycemia must be advised to break the fast *immediately* should they experience any symptoms or show evidence of low blood glucose during the daytime.

Obesity and Fasting after Bariatric Surgery

The Ramadan Model of intermittent fasting is theoretically an excellent opportunity for behavioral change in obese patients. Patients are prohibited from eating during the daytime as an act of faith. Should they consolidate their efforts during the evening period, they *should* be able to lose weight. However, this is not supported by many observations in real life, or in many published studies. The reason appears to be that for many patients the evening time feasting offsets benefits of daytime fasting. Education, motivation, and support may help but has not been documented. In patients with morbid obesity and diabetes, taking medications such as glucagone like peptide 1 agonists 30-60 minutes before the *Iftar* time may reduce patients' appetite and prevent the compensatory over eating in the evening.

Bariatric surgery is increasingly being used in the management of morbid obesity. There is no clear guidance about the feasibility and safety of fasting during Ramadan for patients who have undergone any form of bariatric surgery. Anecdotally, stable patients seem to tolerate fasting well (56) although a recommendation has been made for patients to avoid fasting for a 12 month period postoperatively (57). From the first principles, it is recommended that patients take small meals of balanced content, hydrate themselves well at nighttime, and be careful during daytime to avoid dehydration and hypoglycemia. These recommendations are echoed by many experts. However, a formal discussion

among experts is still needed and should include an audit of the proportion and welfare of patients who fast after bariatric surgery. This ideally should be conducted by large academic centers with considerable experience and good documentation practices.

Final Remarks

The physiological and hormonal changes observed in healthy people during Ramadan are minimal. Values remain within reference ranges, and quickly return to baseline after fasting. Physicians must be careful in interpreting borderline results obtained during the Ramadan fasting. Physicians should identify conditions that require urgent attention (e.g. uncontrolled thyrotoxicosis, newly diagnosed pheochromocytoma, severe Cushing's disease, pituitary apoplexy, etc.) from those which are considered stable and pose no increased risk to the patient. Management of endocrine conditions is based on a sound understanding of physiology, clinical medicine, and pharmacological attributes of the patient, the condition, and the treatment. It does not deviate from the principles of good clinical practice but furthermore it fosters an individual evaluation with a culturally competent approach.

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