Diagnosis of monoclonal gammopathy of renal significance

Sofia O Correia, Sofia Santos, La Salete Martins, Josefina Santos

Nephrology and Kidney Transplantation Department, Centro Hospitalar do Porto, Hospital de Santo António.

ABSTRACT

Monoclonal gammopathies are a heterogeneous group of disorders characterized by clonal proliferation of immunoglobulin produced by B-lymphocytes or plasma cell clone.

The term monoclonal gammopathy of renal significance (MGRS) was introduced to distinguish monoclonal gammopathies that result in the development of kidney disease from those that are benign.

Screening for monoclonal immunoglobulin and an appropriate hematologic workup are fundamental and sometimes a difficult challenge, with therapeutic and prognostic implications. Kidney biopsy is essential to determine the exact nature of the lesion and to evaluate the severity of renal disease.

In this review we discuss the clinical and pathologic features of MGRS, highlighting the most diagnostic difficulties and current therapeutic options.

Keywords: Monoclonal gammopathy of renal significance, M protein, renal pathology, treatment.

INTRODUCTION

Monoclonal gammopathies are a heterogeneous group of disorders characterized by clonal proliferation of immunoglobulin produced by B-lymphocytes or plasma cell clone. The spectrum includes the benign condition known as monoclonal gammopathy of undetermined significance (MGUS), low grade lymphoplasmacytic lymphoma with Waldenstrom’s macroglobulinemia (WM), chronic lymphocytic leukemia (CLL), B-cell lymphoma and multiple myeloma (MM).

MGUS is defined as a plasma cell proliferative disorder with the presence of serum M-protein <3g/dL or <10% bone marrow clonal plasma cells and it is not associated with end organ damage\(^1\). The term monoclonal gammopathy of renal significance (MGRS) was introduced to distinguish monoclonal gammopathies that result in the development of kidney disease from those that are benign\(^2\). MGRS do not meet criteria for MM, WM, CLL or malignant lymphoma but can be associated with high morbidity due to renal lesions induced by a monoclonal immunoglobulin (MIg)\(^2\).

An incidentally identification of monoclonal gammopathy should be followed by renal evaluation. On the other hand, unexplained proteinuria or renal dysfunction should involve monoclonal protein screening.

The importance of differentiating the term MGRS from other monoclonal gammopathies lies in the fact that diagnostic and therapeutic procedures aimed at controlling monoclonal protein synthesis and secretion can be indicated. Because treatment is not recommended for MGUS, appropriate therapy is commonly withheld but, in MGRS clone-directed therapy is required for disease control and has impact on the outcome.
In this review we discuss the clinical and pathologic features of MGRS, highlighting the most diagnostic difficulties and current therapeutic options.

HEMATOLOGIC EVALUATION

The M protein may consist of a heavy (commonly G, less commonly M, and rarely A, E or D chain) and light chain (either Kappa(κ) or lambda(λ)), light chain only, or less commonly, heavy chain only. The presence of a clonal IgM suggests a B cell or mixed B and plasma cell clone.

M-protein can be traced in the serum and/or urine in almost all patients, but diagnostic approach in MGRS should be sensitive enough to detect “small” plasma cell and B cell clones.

A complete screening with urine electrophoresis, immunofixation studies and free light-chain assays (FLC) is obligatory even if serum protein electrophoresis (SPEP) studies are negative. In some cases, the MIg levels are very small and may not be detected by EP that is why serum and urine immunofixation is recommended. FLC assay suggests clonality by comparing the concentration and ratio of kappa to lambda in the serum, for that matter, it is useful at diagnosis and as indicator of response to treatment. In case of renal impairment, low renal clearance of polyclonal FLC induces an elevation of FLC kappa (κ) and lambda (λ) levels. Considering a reference range of 0.37-3.17 has been shown to increase diagnostic accuracy.

To characterize the clone, a detailed hematologic evaluation should be performed with bone marrow aspirate and biopsy with immunohistological studies. Flow cytometry can detect clonal populations below the limits of immunostaining. Computed tomography scan should be performed in patients with high suspicion for lymphoma or in those with monoclonal IgM, in order to identify pathologically involved lymph nodes for a diagnostic biopsy.

CLINICAL, PATHOLOGY AND TREATMENT CONSIDERATIONS

Diagnosis requires integration of clinical parameters, serum and urine analysis, and structural alterations identified by light microscopy, immunofluorescence (IF) and electron microscopy (EM). Anatomopathological characteristics are presented in Table 1. In difficult cases, immunoEM and mass spectrometry may be required to confirm the composition of renal deposits.

The immunoglobulin (Ig) deposits associated to MGRS can be classified into two categories: with organized and with non-organized deposits. MGRS with organized deposits includes Ig related amyloidosis, fibrillar glomerulonephritis, immunotactoid and type I cryoglobulinemic glomerulonephritis. MGRS with non-organized electro-dense granular deposits includes monoclonal immunoglobulin deposition disease, proliferative glomerulonephritis with monoclonal IgG deposits and C3 glomerulopathy with monoclonal gammopathy. MGRS also includes tubular disorders such as light chain proximal tubulopathy.

Most of these disorders are characterized by deposition and precipitation of MIg in the different components of the kidney (glomeruli, vessels, interstitium). MIg can also induce renal injury by dysregulation of the complement pathway, or by acting like autoantibodies against complement factor or phospholipase A2 receptor. Other mechanisms are still to be explained.

Treatment is required when symptoms related to the underlying proliferative process are present. No strategy is available in daily practice to inhibit MIg tissue deposition or to clear the already deposited material. A recent clinical trial with humanized monoclonal IgG1 anti-serum amyloid P component antibody safely triggered clearance of amyloid deposits from the liver and some other tissues. Cytotoxic therapy adapted to the underlying clone and renal function has been shown to improve renal outcome and patient survival. If a detectable circulating paraprotein is present, response to treatment can be monitor by paraproteins levels (EP, serum and urine immunofixation, FLC).

The agents used to treat MGRS have activity against B cell and plasma cell disorders. The therapeutic regimen chosen should be based on the International Kidney and Monoclonal Gammapathy Working Group consensus. Corticosteroids are usually part of these regimens, in monotherapy in cases of mild disease or combined in more severe disease. Bortezomib is a proteasome inhibitor. It can be given at full doses in renal insufficiency and has no renal toxicity. Prophylaxis against herpes zoster reactivation is mandatory. Cyclophosphamide and melphalan are cytotoxic agents, targeting both plasma cell and B cell. Cyclophosphamide is preferred to melphalan due to its lower toxicity.
Bendamustine, with features from alkylating agents and purine analogs, also has a predominantly nonrenal metabolism and can be given to patients with end stage renal disease (ESRD). Rituximab is a monoclonal antibody directed at CD20, and its use raises no concerns in patients with renal impairment, including ESRD.

**RENAL LESIONS ASSOCIATED WITH MGRS**

**Immunoglobulin related amyloidosis** is secondary to the deposition of immunoglobulin (Ig) produced by clonal plasma cells in tissue as amyloid.

AL amyloidosis can be diagnosed if AL deposits can be demonstrated in other tissues such as fat. Microdissection and mass spectrometry can identify the type of renal amyloidosis in more than 97% of cases and can distinguish it from non-amyloid fibrillar glomerulopathy. A detailed discussion of this pathology goes beyond the scope of this article.

**Monoclonal immunoglobulin deposition disease (MIDD)** is secondary to deposition of light-chain (κ in most cases), light and heavy chain, and heavy chain deposition disease. The deposits lack affinity for Congo red and do not have a fibrillar organization. Most often presents in the sixth decade, in the presence of renal insufficiency and proteinuria and hypertension.

**Fibrillary glomerulonephritis (FGN)** occurs in patients with solid malignancies, autoimmune diseases, and hepatitis C. It is nearly always characterized by polyclonal IgG deposits without a detectable clonal B-cell disorder; the reason it is not considered an MGRS by some groups. Most often presents with proteinuria, 50% within nephrotic range, with or without renal insufficiency, hematuria or hypertension. Deposits are thicker than amyloid and are Congo red negative. In a case series report, M-spike was detected by SPEP/immunofixation in only 16% of 61 patients.

**Immunotactoid (microtubular) glomerulopathy (ITG)** occurs in an older population and typically presents as a nephrotic syndrome. Cryoglobulinemic GN must be ruled out, because they are difficult to differentiate histopathologically. ITG is associated with an underlying hematologic malignancy such as CLL or small lymphocytic lymphoma, but the association with MGRS is also possible. Therapeutic choice depends on the underlying disorder. In patients with gammopathy only, the role of rituximab is questionable and bortezomib-based therapy may be considered.

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**Table 1**

Pathological characteristics of MGRS. Adapted from Correia SO et al. MGRS: Diagnostic workup

<table>
<thead>
<tr>
<th>AL/AH/AHL</th>
<th>MIDD</th>
<th>FGN</th>
<th>ITG</th>
<th>PGNMI</th>
<th>Type 1 cryoglobulinemic GN</th>
<th>C3 glomerulopathy with MG</th>
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</thead>
<tbody>
<tr>
<td>LM</td>
<td>Acellular mesangial/lobular deposits; Congo red positive [or Amytracker™ 545A positive]</td>
<td>Nodular glomerulosclerosis; Thickened tubular basement membrane and vascular wall</td>
<td>Mesangial proliferation, MPGN pattern, Congo red negative</td>
<td>Mesangial GN, Membranous GP, MPGN pattern</td>
<td>MPGN pattern, Endocapillary, mesangial GN, Membranous GP</td>
<td>MPGN pattern, Endocapillary proliferative GN, Membranous GN</td>
</tr>
<tr>
<td>IF</td>
<td>Ig deposits in tubular basement membrane and vascular wall</td>
<td>IgG polyclonal</td>
<td>IgG often monotypic; C3, C4, C1q</td>
<td>Monoclonal IgG, rarely: IgM or IgA (restricted to the glomerulus)</td>
<td>Monoclonal IgG or IgM; C3, C4, C1q deposits</td>
<td>Granular C3 deposits</td>
</tr>
<tr>
<td>EM</td>
<td>Organized, random nonbranching fibrils, 8-10 nm</td>
<td>Organized, random fibrils, 12-24 nm (mostly 18-20 nm)</td>
<td>Organized, parallel, microtubular (&gt;30 nm)</td>
<td>Non organized deposits in mesangium, subendothelial and intramembranous zone</td>
<td>Organized, microtubular or vague, short fibrillary</td>
<td>DDD: intramembranous deposits; C3GN: mesangial, subendothelial and/or subepithelial deposits</td>
</tr>
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</table>

CONCLUSION

MGRS are associated with a wide range of kidney diseases resulting from the depositions of immunoglobulin or its components in the kidneys, or through the deregulation of the complement system. The likelihood of developing advanced chronic kidney disease is very high, although the mortality of patients with MGRS is lower than that of myeloma or other related gammopathies.

In MGRS, the clinical challenge begins with our ability to identify the underlying clone. So, an evaluation by a multidisciplinary team, that includes nephrologists and hematologists with expertise in this area, is highly recommended. Renal characteristics of the disease, risk of CKD progression, presence and severity of extra-renal manifestations, safety profile of antineoplastic drugs in renal impairment should be all taken into account. After the correct diagnosis and stratification of the disease, the treatment should be instituted based on the International Kidney and Monoclonal Gammopathy Working Group consensus.

Advances in the understanding of MGRS have made it possible to improve the prognosis of this disease.

Disclosure of potential conflicts of interest: None declared

References


Correspondence to:
Josefina Santos, MD
Nephrology and Transplant Department, Centro Hospitalar do Porto, 4099-001, Porto, Portugal
E-mail: josefina.sts@gmail.com